Norwegian University of Life Sciences
Faculty of Landscape and Society
Department of Urban and Regional Planning

Philosophiae Doctor (PhD)
Thesis 2018:52

# Compact city or sprawl? The role of urban form in subjective well-being

## Kompakt by eller byspredning? Bystrukturens betydning for subjektiv livskvalitet

Kostas Mouratidis

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Ås (2018)

Thesis number 2018:52
ISSN 1894-6402
ISBN 978-82-575-1523-2

*It's one of the joys, you know, in the morning to go out… Early in the morning and all the sound of the city waking up. People maybe opening the stores or... I don't know it's a special sound. Very often a special smell. I love that. And… Yeah, the wind of the trees. No, it has to be. I have to live in a nice area. The area is very, very important, absolutely. Extremely important.*

–Project participant

## Acknowledgements

First of all, I want to thank the person who initiated this fellowship, resulting in a wonderful, fulfilling journey for me, my main supervisor Petter Næss. I am deeply grateful to Petter for his continuous trust, support, encouraging words, and mentorship from the beginning to the end of this journey. His work, knowledge, and devoted and meaningful guidance have been an enormous source of inspiration for me. I also owe a sincere debt of gratitude to my co-supervisor Jin Xue for her insightful comments, empathy, encouragement, as well as for her thought-provoking questions which always motivated me to sharpen my research. I truly thank you both for being such inspiring supervisors and colleagues and hope I have been able to meet your expectations.

Particular thanks go to the members of the PhD thesis evaluation committee, Julie Lawson, Jason Cao, and Mina Di Marino. Thank you for accepting to be members of the committee, for devoting time to reading the thesis, and for providing very useful remarks and evaluation. I consider your feedback to be greatly beneficial for my future research.

At this point, I want to thank all the colleagues at the Department of Urban and Regional Planning at NMBU as well as the colleagues from the other departments of the Faculty of Landscape and Society for their academic as well as personal support. I was lucky enough to work with you and want to thank you for creating this welcoming, friendly, and stimulating working environment. Special thank you to my fellow PhD colleagues for their friendship and the extremely precious informal time we shared together. I also want to warmly thank the administrative personnel of our faculty for their vital assistance during these years.

I must stress the importance of the invaluable experience and knowledge I gained from my research visit at the Department of Human Geography and Planning at Utrecht University, in the Netherlands. I sincerely thank Dick Ettema for his invitation, guidance, and support. A very fruitful collaboration emerged during this stay.

I am grateful to the opponents in my three PhD seminars, Hege Hofstad, Marit Ekne Ruud, and Rolf Barlindhaug. Thank you for your helpful comments and advice during the various stages of the project.

Kind thanks are also dedicated to the coordinators of the PhD courses I followed during these years, Erling Berge, Tim Richardson, Petter Næss, Elin Børrud, Marius Grønning, Nikolai Olavi Czajkowski, Tilmann von Soest, Arnt Fløysand, and Tor Aase. You helped me acquire knowledge and competences that greatly contributed to successfully complete this thesis.

I am also deeply indebted to all the participants of my project for being willing to get involved in the project's survey and interviews. Without them, this thesis would not have been realized.

I want to take the opportunity to thank the wonderful friends who have been my family in Oslo throughout this period. Thank you for being such good friends and for sharing these special years together. Special thanks also to the ones who have been physically away but continuously accompanied me on this journey nevertheless. Thank you my beloved friends from Thessaloniki, from other parts of Greece, and from other parts of the world. And finally, I want to profoundly thank my beloved family, my mother Rea, my father Tasos, and my sister Elena. This thesis is dedicated to them.

## Summary

The novel contribution of this thesis is the new theoretical and empirical knowledge it generates on the relationship between urban form and subjective well-being (SWB). It specifically examines how urban form, in other words the composite of the physical characteristics and functions of cities, affects SWB, the subjectively-measured quality of life. By investigating this topic, the thesis (a) improves the state-of-the-art of scientific knowledge on quality of life in cities and (b) contributes to scientific debates on environmental versus social sustainability of cities since the urban form can influence both environmental (e.g. emissions, land consumption, pollution) and social (e.g. SWB) sustainability. Such knowledge can have a significant societal impact, providing practitioners and policymakers with input on how to enhance quality of life in present and future cities.

The thesis' empirical investigations are based in Oslo metropolitan area, which constitutes a good case for this type of research due to the high variety of urban forms present within the same geographical and cultural context. The empirical study follows a mixed-methods research approach. Data are collected through survey and interviews, both developed and conducted for the purposes of this project, and are analyzed with both quantitative and qualitative methods.

This thesis develops, applies, and assesses a new theory on urban form and SWB. According to this theory, urban form can influence certain life domains (personal relationships, leisure activities, health, and neighborhood impact on emotions and mood) which in turn influence SWB measures (life satisfaction, hedonic well-being, and eudaimonia). The thesis also develops, applies, and assesses a new theory on urban form and personal relationships, which is a major life domain of SWB previously understudied for its relation to urban form.

The empirical results of this thesis suggest that neighborhood satisfaction, social well-being and personal relationships satisfaction, and perceived physical health are all facilitated by compact urban forms compared with low-density sprawled ones. On the other hand, emotional response to place is less positive for compact urban forms. Leisure activities satisfaction is similar across different types of urban form. SWB measures – life satisfaction, happiness, and eudaimonia – are also found to be similar across different types of urban form, while anxiety is found to be higher for compact urban forms. Independently of the type of urban form, the empirical findings suggest that some attributes are important for most residents: easy access to facilities and services, public transport, open public spaces, green areas, safety, quietness, cleanliness, and aesthetic quality.

The thesis' findings indicate positive signs for urban sustainability. High-density development does not necessarily exert a negative influence on SWB, as often claimed. Important synergies between environmental and social sustainability are identified. It is of particular significance that environmentally friendly urban forms (compact) can be beneficial for personal relationships and physical health. These are not only among the most crucial domains for quality of life at a certain point in time, but are very important for human flourishing across the lifespan. On the other hand, special attention should be paid to fear of crime and noise, which appear to be concerns even in relatively peaceful and quiet compact cities and may lead to unpleasant emotions and increased anxiety. Researchers, practitioners, and policymakers should carefully look into ways to counter these implications in order to mitigate conflicts between environmental and social sustainability.

# Sammendrag

Denne avhandlingen har frambrakt ny og original teoretisk og empirisk kunnskap om forholdet mellom bystruktur og subjektiv livskvalitet (SLK). Avhandlingen undersøker spesifikt hvordan bystrukturen, dvs. byens fysiske elementer og funksjoner, påvirker SLK, den subjektivt målte livskvaliteten. Ved å undersøke dette emnet bidrar avhandlingen (a) med ny vitenskapelig kunnskap om livskvalitet i byer, og (b) med innspill til den vitenskapelige debatten om miljømessig versus sosial bærekraft i byer, siden bystrukturen kan påvirke både miljø (f.eks. utslipp, arealforbruk, forurensning) og sosial (f.eks. SLK) bærekraft. Slik kunnskap kan få stor samfunnsmessig betydning, bl.a. ved å gi praktikere og beslutningstakere innspill om hvordan man kan forbedre livskvaliteten i dagens og framtidens byer.

Avhandlingens empiriske undersøkelser er utført i Oslos storbyområde. Dette byområdet egner seg godt for denne typen forskning på grunn av den store variasjonen av bystrukturelle nabolagsegenskaper innenfor samme geografiske og kulturelle kontekst. Den empiriske studien følger en forskningstilnærming basert på metodekombinasjon. Dataene er samlet gjennom en spørreskjemaundersøkelse og kvalitative intervju utformet og utført for dette prosjektets formål, og analyseres med både kvantitative og kvalitative metoder.

Avhandlingen utvikler, anvender og vurderer en ny teori om bystruktur og SLK. Ifølge denne teorien kan bystrukturen påvirke visse livsdomener (personlige relasjoner, fritidsaktiviteter, helse og nabolagets innvirkning på følelser og stemninger), som igjen påvirker aspekter ved SLK (livtilfredshet, hedonisk velvære og eudaimonia). Avhandlingen utvikler, anvender og vurderer også en ny teori om bystruktur og personlige relasjoner, som er et viktig livsdomene i SLK og som henger sammen med bystrukturen på måter som tidligere ikke har blitt tilstrekkelig undersøkt.

De empiriske resultatene fra denne avhandlingen antyder at kompakte bystrukturer fremmer nabolagstilfredshet, sosial livskvalitet og tilfredshet med personlige relasjoner, så vel som opplevd fysisk helse, sammenlignet med bystrukturer med lav tetthet. På den annen side er folks følelsesmessige respons på nabolaget mindre positiv i kompakte bystrukturer. Tilfredsheten med utøvelse av fritidsaktiviteter er på samme nivå, uavhengig av bystrukturen der man bor. SLK-aspektene – livtilfredshet, lykke og eudaimonia – er også på samme nivå uavhengig av bystrukturelle nabolagsegenskaper, mens angst er mer utbredt i kompakte nabolag. Uavhengig av typen bystruktur antyder de empiriske funnene at noen egenskaper er viktige for de fleste innbyggere: enkel tilgang til fasiliteter og tjenester, offentlig transport, åpne offentlige rom, grønne områder, sikkerhet, stillhet, renslighet og estetisk kvalitet.

Avhandlingens funn er positive med tanke på bærekraftig byutvikling. Høy tetthet påvirker ikke nødvendigvis SLK negativt, slik det ofte blir hevdet. Avhandlingen viser at det finnes viktige synergier mellom miljømessig og sosial bærekraft. Det er spesielt viktig at miljøvennlige (kompakte) bystrukturer kan være gunstig for personlige relasjoner og fysisk helse. Disse domenene er ikke bare blant de mest avgjørende for opplevd livskvalitet på et bestemt tidspunkt, men er svært viktige for menneskelig utfoldelse over hele levetiden. På den annen side bør spesiell oppmerksomhet rettes mot kriminalitet og støy, som synes å gi opphav til bekymring selv i relativt fredelige og stille, kompakte byer og kan føre til følelse av ubehag og angst. Forskere, praktikere og beslutningstakere bør nøye undersøke måter å motvirke disse implikasjonene på for å redusere konflikter mellom miljømessig og sosial bærekraft.

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Paper 2

Mouratidis, K. (2017). Is compact city livable? The impact of compact versus sprawled neighborhoods on neighborhood satisfaction. *Urban Studies, 55*(11), 2408-2430.

Paper 3

Mouratidis, K. (2018). Built environment and social well-being: How does urban form affect social life and personal relationships? *Cities, 74*, 7-20.

Paper 4

Mouratidis, K. (2018). Compact city and subjective well-being: The role of urban form in life satisfaction, hedonic well-being, and eudaimonia. *Paper under review*.

**Appendices**

Appendix A: Survey questionnaire

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# 1. Introduction

## 1.1. Importance of the topic

This project investigates the relationship between urban form and subjective well-being (SWB), attempting to address the overall research question "*how does urban form influence SWB?*" This field of study is pertinent to a wide range of academic debates on if and how the material world shapes the social world and more specifically, if and how a city and its attributes shape residents' current and future lives. This relationship is of interest to several fields such as urban planning, architecture, geography, engineering, psychology, philosophy, public health science, and sociology. The importance of investigating this relationship is twofold.

First, this topic improves our knowledge on quality of life in cities. Achieving high levels of SWB, a personal evaluation of one's quality of life, is one of the most important life goals and thus has emerged as an important political goal (Stiglitz et al., 2009; Veenhoven, 2012). To develop cities that promote SWB has subsequently emerged as a major goal of urban planning (Thin, 2012). Investigations of how the physical characteristics and the functions of cities, in other words the urban form, influence subjective measures of well-being, SWB, can provide necessary knowledge towards these goals. What makes urban quality of life even more critical is that it concerns more and more people due to the rapid urbanization and global population growth. More than half of the global population nowadays lives in cities and this percentage is constantly increasing. In parallel, the global population is also increasing. These phenomena are expected to add 2.5 billion residents to the global urban population by 2050 (United Nations, 2015). In addition to being relevant to more and more people, urban quality of life is affected by changes in the physical attributes of cities. As cities are expanding and/or densifying, urban form changes can affect residents' life in several ways, such as by increasing travel times and reducing accessibility or by increasing noise levels and overcrowding, with subsequent possible impacts on SWB. Considering all these aspects, it seems that a deeper knowledge on the relationship between the city and human well-being can play a catalytic role in future urban development.

Second, this topic improves our knowledge on the synergies and conflicts between environmental and social sustainability of cities. This is an issue of high scientific as well as practical and political importance. The way cities are structured and the way they are functioning can influence both human well-being (e.g. Sirgy, 2012), which is an important component of social sustainability (e.g. Kyttä et al., 2016; Moser, 2009), and environmental

sustainability (e.g. Meyer, 2013). Urban form and relevant policies can affect transport-generated emissions, greenfield development, lifestyles and consumption of natural resources, and building energy consumption. All these have various implications for environmental issues such as climate change, environmental degradation, biodiversity loss, pollution, and depletion of natural resources. As cities are growing to accommodate increasing populations, the impact of their structure and functions on these environmental issues is becoming continuously more significant. But how can the environmental impact of cities be minimized while at the same time the needs of a high human well-being are fulfilled under this global population explosion? This is a very difficult task. It has various political, economic, and even philosophical dimensions. As far as planning-related research is concerned, it is necessary to systematically investigate the relationship between cities and human well-being. This can help us deeply understand this relationship. Then we can identify potential synergies and conflicts between environmental and social sustainability, and subsequently find ways to support synergies and mitigate conflicts. By examining the relationship between urban form and SWB, this project aims to contribute to this effort.

### 1.2. Urban form and its relation to environmental and social sustainability

Urban form can influence *environmental sustainability* in several ways. First, the morphological density of cities has an impact on the use of space. Densely built cities can accommodate more residents in a given area, thus consuming less available land. Thereby, compact development can help preserve forests and farmlands (MacDonald & Rudel, 2005) and protect natural resources and biodiversity (Beatley, 2000). Second, density, accessibility to public transport, and land use mix all have an impact on travel behavior and transport-generated emissions. High densities, high accessibility to public transport, and mixed land uses – all of which are components of the compact city (Jenks et al., 2003; Lee et al., 2015; Neuman, 2005) – can decrease travel distances, increase walking, biking and public transport usage, while decreasing car usage (Banister, 2008; Dieleman & Wegener, 2004; Næss, 2012; Næss et al., 2017). All these result in lower energy demands for transport purposes, lower transport-generated emissions, and lower overall pollution (Bechle et al., 2011; Ewing & Hamidi, 2015; Newman & Kenworthy, 1999). It has to be noted though, that pollution could be higher locally in main transport axes of dense cities (Troy, 1996). Third, higher urban form density is less demanding in natural resources needed for construction, operation, and maintenance of

buildings (Ewing & Rong, 2008) as high-density apartment blocks are less laborious and less costly to build, operate, and maintain, and are more energy-efficient than low-density structures such as single-family homes (Schläpfer et al., 2015). Fourth, higher urban form density is less demanding in natural resources needed for construction, operation, and maintenance of city infrastructure. For example, fewer roads, pavements, pipelines, cables, and signposts are needed in denser cities and fewer resources for the operation and maintenance of such infrastructure are required (Brueckner, 2000). To sum up, it seems evident that compact urban forms are in general friendlier to the natural environment, while the more dispersed, low-density urban forms are more land-consuming, resource intense, and polluting.

Urban form can also influence *social sustainability*. There exists no agreed-upon definition of social sustainability and there are several views on its components (Dempsey et al., 2011; Eizenberg & Jabareen, 2017; Hemani et al., 2017; Kyttä et al., 2016; Opp, 2017). According to Dempsey et al. (2011), urban social sustainability revolves around equitable access (access to facilities, services, green spaces, public spaces) and sustainability of community (social interaction, social participation, community stability, pride and sense of place, and safety and security). This view is similar to the one by Hemani et al. (2017). Other scholars (e.g. Kyttä et al., 2016; Moser, 2009), on the other hand, examine social sustainability by focusing on well-being outcomes (health, happiness, and life satisfaction). Based on a relevant review, Susan Opp identifies four dimensions of social sustainability: equal access and opportunity, environmental justice, community and the value of place, and basic human needs (Opp, 2017). Independently of the distinctions made by different scholars, all the components of social sustainability revolve around two grand themes: human well-being and social justice. The discourse on urban form and human well-being is about preventing potential negative effects of the built environment on human well-being and enabling a healthy, happy, and satisfying life as well as human flourishing. The discourse on urban form and social justice is about avoiding social and spatial exclusion and securing living conditions of a high standard for all at multiple spatial scales. Naturally, the two discourses are highly interrelated. Limiting exclusion and improving living conditions for all can increase overall human well-being.

*Social justice* has been linked to the city since ancient times through works such as Plato's "Republic" and Aristotle's "Politics". In modern times, thinkers such as Henri Lefebvre and David Harvey have deeply focused on how social justice is related to urban space. In his work "The right to the city", Lefebvre discusses the demand for "a transformed and renewed access to urban life" (Lefebvre, 1996, p. 158), which as Harvey explains is not restricted to

accessing urban resources but "it is a right to change ourselves by changing the city" (Harvey, 2008, p. 272). These notions refer to both how urban planning decisions are made as well to the outcomes of these decisions. Regarding the outcomes of urban planning decisions, which is the aspect that this thesis focuses on, socio-spatial justice is usually operationalized with the relevant concept of social equity which can be described as the "fairness in the apportionment of resources" (Burton, 2000, p. 1970). Urban planning outcomes pertaining to social equity and justice in urban space are examined with access to space, transport, facilities and services, social segregation, safety, inequality of housing standards, differences in environmental quality, water quality, air quality, and noise, and fairness in the distribution of health and well-being (e.g. Burton, 2000; Dempsey et al., 2012; Hofstad & Bergsli, 2017; Opp, 2017).

The other theme of social sustainability is *human well-being*. SWB is one of the most prevalent ways to measure human well-being. Research shows that it is influenced by life domains such as social relationships, health, income, and employment (Blanchflower & Oswald, 2011; Diener, 2009; Dolan et al., 2008; Sirgy, 2012), and is strongly moderated by personality traits (Diener, 2009; Diener & Lucas, 1999). Urban form can also influence SWB (Dolan et al., 2008; Morrison, 2007; Sirgy, 2012) by affecting access to people, workplaces, healthcare, facilities, nature, and green spaces and by playing a role in safety, noise, pollution, social relationships, health, leisure, and emotional reactions. From a philosophical point of view, the structure and functions of a city can affect both basic human needs as well as Aristotelian views on human flourishing (eudaimonia). Relevant notions of human flourishing brought by modern thinkers are personal growth, positive relations with others, and self-fulfillment (Maslow, 1943; Ryff, 1989). These elements could be influenced by the physical attributes of the built environment, for example through accessibility to people and institutions.

### 1.3. A need for systematic research

It is time for systematic scientific research on how cities influence SWB. Urban theories and models of the past and present such as the Garden City, the Radiant City, the Broadacre City, the ideas of Jane Jacobs, the Compact City, New Urbanism, and Smart Growth have affected how cities have been planned and developed, and subsequently have affected people's lives in them. However, theories have not been adequately followed or supported by empirical research (Bettencourt & West, 2010; Marshall, 2012). There is not enough scientific evidence on the relationship between cities and SWB. This lack of scientific evidence is paradoxical since

achieving high levels of human well-being is one of the primary, if not the primary goal of urban planning. Livable cities are a very popular topic among urban scholars, planners, thinkers, and journalists, but there is still insufficient scientific knowledge on the link between cities and people's lives in them.

Land use, urban design, architecture, transport, and infrastructure play an important role in human life locally, in human life in other parts of the planet, and in nature both locally as well as globally. Therefore, scientific input combined with public discussion and participation is needed so that decisions are not solely driven by the market, political ambitions, or personal preferences and tastes of a few individuals. Scientific input is needed at all scales of planning. For instance, at a small scale, the architectural design of a building can influence a city's residents as well as the natural environment, and therefore should not be seen as a means to fulfill the personal ambitions of the architect or the developer but as a means to serve the greater good, based on informed decisions towards established values (see e.g. Andersen & Røe, 2017). Similarly, at a larger scale, the overall physical form of cities can influence humans, other species, and nature, and thus a holistic understanding of how the city functions should be considered.

### 1.4. Literature review and research gaps

#### *Urban form and life domains relevant to SWB*

Existing knowledge on how urban form influences SWB is limited, but there are empirical studies that focus on urban form and life domains that contribute to SWB. Most previous research is relevant to three main life domains: neighborhood satisfaction, health, and social relationships. Other life domains less explored for their relation to urban form are leisure activities and neighborhood impact on emotions and mood.

*Neighborhood satisfaction* is a life domain relevant to SWB (Campbell et al., 1976; Marans & Rodgers, 1975), which is directly linked to the urban form. Neighborhood satisfaction refers to the degree to which a neighborhood covers the perceived needs of its residents (Campbell et al., 1976; Francescato et al., 1987). Some empirical studies suggest that high density is associated with lower neighborhood satisfaction (Bramley et al., 2009; Cook, 1988; Rodgers, 1981). Others suggest that density per se does not influence neighborhood satisfaction (Adams, 1992; Arundel & Ronald, 2017). A study which examines compact and

sprawled areas of Portland finds a small positive association between density and neighborhood satisfaction (Yang, 2008). Apart from density, attributes relevant to urban form that play a role in neighborhood satisfaction are perceived safety, quietness, neighbor ties, public spaces and green spaces, aesthetic quality, and neighborhood attachment (Buys & Miller, 2012; Cook, 1988; Davis & Fine-Davis, 1991; Grogan-Kaylor et al., 2006; Gruber & Shelton, 1987; Howley et al., 2009; Hur & Morrow-Jones, 2008; Hur et al., 2010; Lovejoy et al., 2010; Low & Altman, 1992; Lu, 1999; Parkes et al., 2002).

*Health* is probably the most widely studied life domain for its relation to urban form. The World Health Organization (WHO) has defined health as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity" (WHO, 2006). This definition has been criticized as difficult to operationalize while it is also argued that health is perhaps too vague to define (Callahan, 1973; Jadad & O'Grady, 2008). Policymakers have been trying to establish health as one of the most important goals of planning at a national, regional, and municipal level (Barton et al., 2003; Hofstad, 2011, 2016). However, at times is has been challenging to achieve effective levels of communication between planning professionals and public health experts (Frank & Engelke, 2001; Hofstad, 2011). Health is naturally highly related to SWB and relevant measures are significantly correlated. Healthy people tend to have higher levels of SWB and happier people tend to be healthier (Blanchflower & Oswald, 2011; Diener, 2009; Okun et al., 1984). Certain measures such as anxiety levels are used to assess both mental health and the emotional well-being component of SWB. Several theories and subsequent studies on the built environment and well-being place measures of both health and SWB as the final outcomes (e.g. Kyttä et al., 2016; Northridge et al., 2003) while others consider health as a predictor of SWB (e.g. Feng et al., 2017). The final outcome depends on the main focus of the theory or empirical study. Most empirical research studies on built environment and health examine health with physical and mental health outcomes (see e.g. Diez Roux & Mair, 2010; Northridge et al., 2003; Yen et al., 2009). Researchers agree that the urban form can play an important role in increasing moderate types of physical activity such as walking and cycling, which can be beneficial for public health (Diez Roux & Mair, 2010; Frank & Engelke, 2001). Compact urban forms of higher densities and mixed land uses promote walking and cycling (Ewing, Schmid, et al., 2003; Hong & Chen, 2014; Stevenson et al., 2016) and are associated with lower obesity (Ewing & Hamidi, 2015; Sturm & Cohen, 2004). This may result in better physical health (Stevenson et al., 2016; Sturm & Cohen, 2004) in compact areas. On the other hand, higher density is associated with higher

noise levels (WHO, 2011) and lower perceived safety from crime (Hong & Chen, 2014), which in turn are associated with possible negative health outcomes (WHO, 2011; Won et al., 2016). Another important attribute of the urban form that may affect health is access to green spaces and nature (White et al., 2013). Access to green space tends to decrease as density increases (Bramley et al., 2009; Burton, 2000; Tappert et al., 2017). Higher density is also associated with higher stress levels (Lederbogen et al., 2011), higher prevalence of mood and anxiety disorders (Peen et al., 2010), and higher occurrence of mental health issues (Gifford, 2007; Gruebner et al., 2017). However, correlation does not imply causation. It is not clear yet whether the associations between density and mental health issues are due to the urban form itself (e.g. due to noise, fear of crime, overcrowding, lack of green space) or due to differences in personality, human values, social isolation, and poverty across different residential locations (Gruebner et al., 2017; Jokela et al., 2015; Morrison & Weckroth, 2017). What makes the relationship between urban form and mental health even less clear is that studies report contrasting results. For instance, it has been argued that higher urban density and public transport accessibility may contribute to reduced risk of depression, especially for women and older adults, by increasing mobility and leading to more active social life (Melis et al., 2015; Miles et al., 2012).

*Social relationships* constitute another life domain relevant to SWB (Sirgy, 2012) that has been studied for its association with urban form. One way to assess the impact of the physical built environment on social relationships is by focusing on concepts such as social cohesion and social capital (Forrest & Kearns, 2001; Putnam, 2001). Social cohesion is the "extent of connectedness and solidarity among groups in society" (Kawachi & Berkman, 2000, p. 175) and social capital refers to "features of social organization, such as trust, norms, and networks, that can improve the efficacy of society by facilitating coordinated actions" (Putnam et al., 1993, p. 167). Another relevant concept is social well-being: an evaluation of an individual's "positive social functioning" (Keyes, 2007). To operationalize these concepts in empirical research related to the built environment, researchers have been examining neighborhood community involvement (e.g. Cabrera & Najarian, 2013; Leyden, 2003), neighborhood sense of community (e.g. Kim & Kaplan, 2004; Nasar, 2003), and neighborhood social ties (e.g. Hipp & Perrin, 2009; Lund, 2003). Social relationships between neighbors at a local neighborhood level have been found to be stronger in low-density areas (Bramley et al., 2009; Churchman, 1999; Fischer, 1982; Milgram, 1970). High-rise buildings are also associated with impersonal relationships between neighbors (Gifford, 2007). On the other

hand, urban theorists have pointed out that higher concentrations of people and mixed land uses are necessary to increase social interaction (Alexander, 1965; Duany et al., 2010; Gehl, 2013; Glass, 1949; Jacobs, 1961). Access to so-called "third places" (e.g. community centers, cafés, restaurants, parks, and malls), which is higher in compact areas (Burton, 2000; Jenks et al., 2003), could facilitate socializing (Balducci & Checchi, 2009; Leyden, 2003; Oldenburg, 1999) and therefore promote SWB (Jeffres et al., 2009; Leyden et al., 2011). Similarly, mixed land uses and walkability have been found to promote local neighbor ties according to a relevant literature review (Talen & Koschinsky, 2014). In general, most relevant studies examine social relationships only between local residents at a neighborhood level. However, in modern times of high education, specialization, and mobility, such local social ties are of decreasing significance (Pløger, 1997; Popenoe, 2005) and people are enabled to have multiple relationships all over the city region. Very limited research exists on how urban form shapes an individual's overall relationships with friends, family, and partners, in other words "personal relationships" (Allan, 2001; Furman & Buhrmester, 1992; Livesay & Duck, 2009), which is surprising considering how important personal relationships are for SWB (Diener & Seligman, 2002; Hintikka et al., 2000; Lucas & Dyrenforth, 2006; Vaillant, 2002). The evaluation of the influence of the built environment on satisfaction with these relationships can constitute a useful indicator of how the built environment affects an individual's social well-being.

*Leisure activities* are the non-compulsory activities: the activities performed during time away from work, education, housekeeping, and sleeping. Although there are empirical studies on urban form and certain types of leisure activities such as physical exercise, there is generally limited knowledge on how urban form can shape access to different types of leisure activities, for example socializing activities, cultural activities, hobbies, sports, and nature visits. Another aspect that has not been adequately investigated is how time available for leisure activities can be affected by the urban form and how this can in turn influence SWB. Longer leisure time may have a significant positive impact on SWB (Hershfield et al., 2016; Mogilner, 2010). This available free time could be moderated by accessibility to workplaces and non-recreational facilities (Næss et al., 2018). The less accessible these places are, the more time residents spend on traveling and the less time remains for leisure activities (Hägerstrand, 1970).

*Neighborhood impact on emotions and mood* is another domain that can play a role in SWB. It may affect both health and SWB. It can be categorized into "emotional response to place" which refers to the affective reaction to a place or area or in other words, the experience of emotions and feelings induced by a place or area, and into "feelings while traveling" which

refer to the affective reaction to traveling for everyday purposes. Emotional response to place can be influenced by perceived safety, noise, liveliness, aesthetics, openness, greenery, water, and place attachment (e.g. Ettema & Smajic, 2015; Fried, 1982; Hanyu, 2000; Hur et al., 2010; Zhang & Lin, 2011). Different types of urban atmosphere (see Stefansdottir, 2017) might also induce certain emotional responses. More research is needed to understand the extent of the impact of emotional response to place on SWB. Feelings while traveling depend on trip duration and transport mode; shorter trips and active travel generally induce more positive feelings but this also depends on the combination of trip duration and transport mode (Lancée et al., 2017; Morris & Guerra, 2015; Smith, 2017). Perceptions towards traveling can also be measured with travel satisfaction. Feelings while traveling and travel satisfaction may influence measures of SWB (De Vos et al., 2013; Ettema et al., 2011; Friman et al., 2017; Olsson et al., 2013).

***Urban form and overall SWB***

Urban researchers have only recently started to systematically investigate the relationship between urban form and SWB. At a larger geographical scale, comparing different regions within countries, it has been suggested that SWB is higher in villages or small towns than in big metropolitan areas (Ballas & Tranmer, 2012; Berry & Okulicz-Kozaryn, 2011; Morrison, 2011; Okulicz-Kozaryn, 2015, 2017; Okulicz-Kozaryn & Mazelis, 2018; Sørensen, 2014). However, there is little evidence on whether this association represents a causal relationship between the settlement size and SWB or whether it is due to personality traits and human values that may differ across geographical locations (Ballas & Tranmer, 2012; Jokela et al., 2015; Morrison & Weckroth, 2017).

Fewer studies have explored the relationship between urban form and SWB within city regions. An analysis based in Oslo finds a negative association between population density and SWB (Cramer et al., 2004). However, serious methodological issues characterize this study since its researchers use physical health as a control variable in their regression models. As explained above, health has been found to be influenced by urban form, and therefore it should not be used as a control variable in studies of this type. One study compares high-rise urban neighborhoods with a low-density suburban neighborhood in Chicago and finds that life satisfaction is higher in the high-rise neighborhoods (Du et al., 2017). Nevertheless, the areas and the sample examined in that study are very limited. Another study in Nanjing, China

focuses on elderly populations and includes neighborhoods of diverse urban form (Feng et al., 2017). The outcomes suggest that density has nonsignificant effects on satisfaction with health, residence, transport, and social interaction and eventually nonsignificant effects on SWB among elderly populations (Feng et al., 2017).

Other attributes related to the urban form have been found to be associated with overall SWB besides morphological and population density. Perceived safety, green spaces, and neighborhood quality are associated with higher SWB (Carrus et al., 2015; Dong & Qin, 2017; Ettema & Schekkerman, 2016; Kyttä et al., 2016; Pfeiffer & Cloutier, 2016; White et al., 2013). Some studies also find that shorter distances to city center are positively associated with SWB (Arifwidodo & Perera, 2011; MacKerron & Mourato, 2009; Wang & Wang, 2016). However, the cases used in these three studies do not include low-density areas, and therefore we cannot evaluate potential benefits of living in such places and draw comparisons with compact areas.

The relationship between urban form and SWB is moderated by social inequality and poverty. Social inequality, poverty, as well as social and spatial justice are important predictors of SWB in cities (Ballas, 2013; Blanchflower & Oswald, 2011; Ludwig et al., 2012). Social inequality and poverty can moderate the relationship between urban form and SWB by restricting access to material resources, limiting access to facilities, to housing, to green spaces, and possibly to healthcare, education, and work, and also by lowering self-esteem and reducing the power one has on life decisions (e.g. Gordon-Larsen et al., 2006; Mitchell & Popham, 2008; Nordahl, 2014; Wolch et al., 2014). In addition to its direct impact on the individual, inequality can affect SWB through its impact on neighborhood quality. Inequality between neighborhoods can affect neighborhood quality, with poorer neighborhoods usually being perceived as lower-quality compared with more affluent neighborhoods (Fried, 1982; Hipp, 2009). Lower neighborhood quality can negatively affect residents' everyday life, health, and SWB (Ludwig et al., 2012). It is evident then that when studying the influence of the physical characteristics of the city on SWB, social characteristics such as social inequality and poverty should be taken into consideration.

***Research gaps***

The relationship between urban form and SWB is very complex. It has to be investigated from various angles and within several different disciplines. Researchers have recently started to be more actively involved in relevant research. Nevertheless, there is still a long way to deeply

understand the relationship between urban form and SWB. This project naturally cannot cover all the gaps in knowledge but attempts to cover some important ones. The identified research gaps as well as the conceptual and methodological deficiencies that this project aims to address are thoroughly presented in the individual papers of this thesis. These gaps and deficiencies revolve around three main themes: (a) *lack of conceptual frameworks*, (b) *lack of empirical evidence*, and (c) *methodological issues*.

(a) There is a general lack of adequate *conceptual frameworks* on the relationship between urban form and SWB and also on the relationships between urban form and important life domains, such as personal relationships. Such conceptual frameworks can synthesize existing knowledge from different disciplines and serve as a platform for future interdisciplinary empirical research. The lack of adequate conceptual frameworks leads to problems in the conceptual approach that is often followed in existing empirical research. These problems lie in the omission of life domains or SWB determinants when examining the role of urban form in SWB. The relationship between urban form and SWB is very complex so simply identifying associations between the two does not help understand causal pathways. Due to the lack of adequate conceptual frameworks, most empirical studies do not examine life domains and SWB determinants as mediators when investigating how urban form can influence SWB. Some studies use neighborhood satisfaction for this purpose, but, although a useful overall indicator of neighborhood environmental quality, neighborhood satisfaction is not sufficient as a sole mediator between urban form and SWB.

(b) There is a lack of *empirical evidence* on several aspects of the topic of this thesis. Empirical studies on the relationship between diverse and distinct urban forms, such as typical compact and typical sprawled forms, and overall SWB within city regions are still lacking. Besides a lack of studies focusing on the direct impact of the urban form on SWB, there is also limited empirical evidence on the impact of the urban form on relevant life domains or determinants that can in turn influence SWB, such as personal relationships, leisure activities, and emotional response to place.

(c) The *methods* used for data analysis in relevant studies are mainly descriptive statistics and cross-sectional correlation or regression analyses. Although these methods provide important insights, there is lack of additional methods that can help reveal causal pathways and support causal relationships. Mixed-methods studies, which can provide deeper explanations of causal pathways, are almost non-existent in this type of research. Qualitative

studies, which can explain causal pathways and additionally shed light on the context of physical form and social aspects of case areas, are scarce. Structural equation modeling, which can help develop and test theoretical models and explain causal pathways, has only recently started being used more systematically. Longitudinal studies, which can help support causality, are almost non-existent.

### 1.5. Aim, objectives, and research questions

The main elements of the thesis are presented in Table 1. The *main aim* of the thesis is to provide new knowledge on the relationship between urban form and SWB. Thereby, the thesis provides knowledge on urban quality of life and also reveals synergies and conflicts between environmental and social sustainability of cities. This thesis attempts to contribute to addressing the aforementioned gaps and deficiencies.

Based on the identified research gaps, the overarching *objectives* are: (a) to develop a new conceptual framework on how urban form influences SWB (using life domains as mediators) and a new conceptual model on how urban form influences personal relationships (which is a major life domain of SWB that has been previously understudied for its relation to urban form), (b) to provide empirical evidence on the relationship between urban form and SWB and between urban form and relevant life domains, (c) to explain causal pathways by using suitable conceptual and methodological approaches.

In line with its main aim and overarching objectives, this thesis attempts to answer the aforementioned *overall research question* "how does urban form influence SWB?" and the following *sub-questions*:

1. How can the influence of urban form on SWB be conceptualized?

2. How does urban form influence relevant life domains that contribute to SWB?

3. How does urban form influence the different components of SWB?

The research strategy of this thesis is presented in detail in Chapter 4. The case for the empirical investigations of this research is the metropolitan area of Oslo, which constitutes a good case for this type of research due to the high variety of urban forms present in different neighborhoods within the same geographical and cultural context. Data were collected through survey and interviews, both developed and conducted for the purposes of this project. Data

were analyzed with both quantitative and qualitative methods. The thesis is based on four papers that aim to address the aforementioned overall research questions (Table 2). The papers are presented in detail in the following chapters.

This thesis examines urban form at a city-region scale. It is not within the scope of this thesis to conduct comparisons between different regions, countries, or cultures. Its scope is to examine diverse urban forms within the city region, in order to focus on the urban form and control geographical and cultural differences to the extent possible. In that scale of investigation, the project focuses mostly on land use, transport, as well as urban design at a neighborhood, city, and city-regional scale. Detailed urban design, such as thorough investigation of building and street morphology or public space design, is not covered by this thesis.

**Table 1.** The main elements of the thesis.

| Main topic | The relationship between urban form and subjective well-being (SWB) |
|---|---|
| Societal problem | • One of the primary goals of urban planning is to enable high SWB but there is still insufficient knowledge on how to achieve this goal.<br>• Global urban population is increasing, thus the influence of urban form on SWB concerns more and more people.<br>• As cities are expanding and/or densifying, urban form changes with subsequent impacts on residents' life and potentially SWB. |
| Scientific problem | • The relationship between urban form and SWB is not fully understood as the social impacts of urban development are often overlooked.<br>• There is not enough knowledge on whether and to what extent environmentally sustainable urban forms can coincide with social sustainability. |
| Research needs | • Need to understand how urban form influences SWB to improve urban quality of life<br>• Need to evaluate synergies and conflicts between environmental and social sustainability of cities |
| Research gaps and problems | (a) Lack of conceptual frameworks<br>(b) Lack of empirical evidence<br>(c) Methodological issues |
| Main aim | New knowledge on the relationship between urban form and SWB |
| Objectives | (a) Develop a new conceptual framework on how urban form influences SWB and a new conceptual model on how urban form influences personal relationships<br>(b) Provide empirical evidence on the relationship between urban form and SWB and between urban form and relevant life domains<br>(c) Explain causal pathways by using suitable conceptual and methodological approaches |
| Overall research question | How does urban form influence SWB? |

| | |
|---|---|
| Sub-questions | 1. How can the influence of urban form on SWB be conceptualized?<br>2. How does urban form influence relevant life domains that contribute to SWB?<br>3. How does urban form influence the different components of SWB? |
| Scientific contribution of thesis | • Better understanding of the relationship between urban form and SWB<br>• Better understanding of the relationship between urban form and relevant life domains<br>• Contribution to debates on compact city, sprawl, and human well-being and therefore to debates on environmental and social sustainability of urban development |
| Societal contribution of thesis | • Insights for planners, designers, and policymakers into how to promote SWB in cities<br>• Contribution to the goal of enhancing quality of life in compact cities |

**Table 2.** Overview of research papers of the thesis.

| Paper | Theme | Title | Journal | Status |
|---|---|---|---|---|
| Paper 1 | Urban form and SWB (theory) | Rethinking how built environments influence subjective well-being: A new conceptual framework | Journal of Urbanism | Published |
| Paper 2 | Urban form and neighborhood satisfaction (empirical) | Is compact city livable? The impact of compact versus sprawled neighborhoods on neighborhood satisfaction | Urban Studies | Published |
| Paper 3 | Urban form and personal relationships (theory and empirical) | Built environment and social well-being: How does urban form affect social life and personal relationships? | Cities | Published |
| Paper 4 | Urban form and SWB (empirical) | Compact city and subjective well-being: The role of urban form in life satisfaction, hedonic well-being, and eudaimonia | Paper under review in international peer-reviewed journal | Under review |

## 1.6. Structure of the thesis

This first chapter (Introduction) has provided an overview of the main elements of the thesis. The second chapter (Philosophy of science) presents its ontological, epistemological, and methodological considerations. The third chapter (Theoretical background) presents basic concepts, theory on typical urban forms, and theoretical approaches to the study of urban form and SWB. The fourth chapter (Research strategy) presents the research design, case area, data collection, data analysis, and research papers' scope and methods. The fifth chapter (Paper

summaries) presents short summaries of the four papers of this thesis. The sixth chapter (Results and discussion) presents the synthesis of the results, identified synergies and conflicts between environmental and social sustainability, policy implications, contribution to knowledge as well as limitations and future research recommendations. The seventh chapter (Conclusions) provides an overall summary of the findings and contributions of the thesis. These chapters are followed by references, the full papers of the thesis, and appendices with the survey questionnaire and the interview guide.

# 2. Philosophy of science

## 2.1. Ontological and epistemological considerations

This thesis is based on a realist ontology. In other words, it is based on an understanding of the world that is close to philosophical *realism*. Realism considers the existence of a single reality and the world as independent of our knowledge of it. The reality exists independently of the mind: individual perceptions, language, views, and beliefs. Phenomena related to the mind, emotions, and behavior of one of the worlds' species, humans, can be difficult and complex to understand but they are part of the single reality as are phenomena related to other species or objects. This contrasts with anthropocentric considerations of philosophical *idealism* or some postmodern philosophies that view reality as ideas in a human's mind and therefore consider the existence of multiple realities. Contrary to such views though, after a human or other living form ceases to exist, the world continues to exist. The reality is still there. In line with the realist philosophical viewpoint, it is acknowledged in this thesis that our current knowledge is only an approximation of reality, but also that this knowledge can always be improved and expanded.

Views on how to obtain new knowledge, the philosophical branch of epistemology, differ. This thesis is in disagreement – but not complete disagreement – with three main epistemological views. (1) It is in disagreement with the views of *naïve realism* supporting that the senses can provide direct knowledge of the world. Similarly, the thesis is in disagreement with *empiricism* and *positivism*, especially when dealing with phenomena relevant to human perception and behavior. These complex phenomena cannot be explained and understood sufficiently solely by the senses or by empirical results. (2) On the other hand, *rationalist* views that regard reason as the main source of obtaining and assessing knowledge are also not completely in line with the views of this thesis. (3) *Relativist*, *post-structuralist*, and *interpretivist* views consider everything relative and open to different interpretations. Although these views can be a source of inspiration for critical thinking, they can also be chaotic and fruitless when seen as the only way of obtaining knowledge. For instance, despite differences between individuals, cultures, and geographical contexts, the study of human well-being has been able to identify similarities in human needs even globally across different cultures.

The *epistemological views* of this thesis consider both empirical data and reasoning as necessary for improving and expanding knowledge, especially in the social sciences. Simply observing empirical data may lead to false conclusions, whereas simply using reason to

understand the world can be limited as well as flawed. In that regard and in agreement with Immanuel Kant, both an *a priori* approach (reason, rational judgement, theory) and an *a posteriori* approach (empirical data, experience, senses) are necessary (Kant, 1934). As Kant explained, reason is essential for processing empirical data into coherent thought and therefore for expanding knowledge. This thesis, despite being in disagreement with each of one individually, considers elements from all empiricism, rationalism, and relativism important for obtaining knowledge. Empirical data are needed to identify or uncover relationships within phenomena, reason is needed to obtain and process empirical data, and relativist approaches can provide a critical assessment of both empirical data and reason.

One philosophical approach that can fruitfully complement these views in social science research is *critical realism*, conceptualized by Roy Bhaskar (2013, 2014). The social sciences investigate relationships among the social world or relationships between the natural and the social worlds. These relationships are often complex since the human mind, human behavior, and human societies are diverse and complex. To identify causal relationships in the social sciences, critical realism focuses on the generative (causal) mechanism between cause and effect, instead of primarily focusing on constant correlations between events, as suggested by more positivist views. In other words, critical realist views suggest that we need to seek explanations of why A causes B in order to provide credible evidence that there exists a causal relationship between the two. As the human world is complex, these generative mechanisms (causal pathways) might also be complex. In addition, as critical realism recognizes, causal relationships or the generative mechanisms can change due to the Heraclitean notion of constant change: nature, society, and individuals changing constantly.

The critical realist idea of focusing on *generative mechanisms* is particularly pertinent to and useful for the purposes of this study. The relationship between the built environment and human well-being, which constitutes the general theme in this thesis, is very complex. It starts with the physical built environment, followed by its perception by residents, by their experience and behavior in the environment, and then by a subsequent impact on several aspects of their life (life domains), which in turn influence what we can call overall human well-being. Of course, both this sequence and the concepts described are all social constructs – as explained by constructivist epistemology – that could be described and defined differently. The long and complex sequence and the potential inaccuracy of social constructs are what make the investigation of generative mechanisms essential in this type of study. The identification of generative mechanisms can reveal the steps in the sequence, provide explanations of possible

causal links, reduce the likelihood of misinterpreting identified correlations, and thereby provide increased evidence for causality. An additional synergy of the critical realist philosophy and the present thesis lies in the fact that critical realism supports that a correlation is not sufficient but also sometimes not necessary to establish a causal relationship. In other words, although there might be no significant correlation between two events, this does not necessarily mean that there are no causal pathways between the events. There might be mechanisms that counteract each other and thus produce an insignificant correlation between the events of interest. In the context of this study for example, there might be a positive impact of the urban form on some life domains and a negative impact of similar size on other life domains, resulting in an insignificant correlation between urban form and overall subjective well-being (SWB). Nevertheless, this does not mean that the urban form cannot influence SWB. Investigations of causal pathways can help reveal such misleading correlations.

The critical realist philosophy of science can be well-suited to studies related to *urban planning*, such as this one, as explained by Næss (2015, 2016). Næss argues that critical realism can be very relevant for urban planning studies for several reasons: (a) it enables critical investigation of generative mechanisms between relationships, (b) it acknowledges a priori thinking, (c) it considers both structure and agency, (d) it allows interdisciplinary integration common to the urban planning field, and (e) allows cautious generalization and prediction that are fundamental for urban planning. The importance of investigating generative mechanisms and the importance of a priori thinking have already been highlighted in relation to this thesis. Critical realism also considers both structure and agency, in other words both social forces and individual choice, as having their own properties and causal powers. For this thesis and for urban planning research in general, such consideration is useful as it acknowledges that the context (social and physical attributes of the built environment) can exert influence on the individual's perceptions and behavior, while at the same time the individual can exert influence on the context. Critical realist thinking also supports the interdisciplinary character of the theme of this thesis. Although the starting points (the built environment and the policies that shape it) and the endpoints (the future policy implications) of this thesis directly refer to urban planning, the relationships that it examines have a strong interdisciplinary character pertinent to urban planning, architecture, human geography, environmental psychology, public health science, sociology, and philosophy. Investigating causal pathways, as supported by critical realism, with an interdisciplinary perspective is particularly important in order to enlighten all the different aspects of the relationship between urban form and SWB. Furthermore, in contrast with other

critiques of positivism such as relativism and post-structuralism, critical realism accepts the possibility of some sort of generalization and prediction. Its difference to positivism lies both in the critical way of investigation and also in the critical and cautious way of interpreting empirical results. In that sense, critical realism supports what can be called cautious generalizations and predictions.

The notion of *cautious generalization* is very relevant to this study. On the one hand, this study is not descriptive; on the contrary, it aims to identify causal relationships and to provide *generalizations* that expand scientific knowledge about how the material world shapes the human world and that inform practitioners and policymakers on how to enhance urban quality of life. On the other hand, since the nature of this topic is very complex, the causal relationships identified should be critically and carefully examined and any potential generalizations should be made with *caution*, acknowledging that findings cannot be perfectly representative of reality as well as that different contexts might produce different findings. These two arguments contrast with both relativist and naïve empiricist views respectively. Although each individual may function and react differently and everything is open to interpretation, as relativists support, scientists and thinkers have been able to identify some common patterns and similarities. It does not mean that they have identified identical ways of thinking, feeling or behaving, but some approximations of reality only pertaining to some groups of individuals. These approximations are not a completely representative picture of reality, as a naïve empiricist view might imply, but an effort to come closer to reality. Whereas these approximations are not the perfectly accurate portrayal of reality, some of them are closer to reality than others. Reality is perhaps impossible to conceive. And the human world is one of its most challenging elements.

Even when a portrayal of reality is quite accurate, this does not mean that it can necessarily be generalized in the form of accurate figures and projected to other contexts. The exact strength of a correlation coefficient in a certain context cannot be generalized to another one. What can be generalized are the causal mechanisms behind the relationships, independently of whether such mechanisms are active or not in a particular context. For example, the exact statistical effect of an urban form attribute on a SWB measure is impossible to be generalized to other contexts. But the identified tendency of the urban form attribute to influence a SWB measure in certain ways under certain conditions can be used to provide cautious generalizations.

## 2.2. Methodological considerations

Since this thesis mainly focuses on causal relationships, its empirical investigation aims to identify and explain causes and effects by examining possible patterns and associations while at the same time revealing causal pathways. To achieve these goals, a mixed-methods strategy comprising both quantitative and qualitative research methods is employed. Quantitative research based on a questionnaire survey and qualitative research based on in-depth interviews are combined.

The *quantitative* part contributes to the thesis' goals through the identification of associations between events and through the development and assessment of conceptual models that can reveal causal pathways. Although an association between two events, in other words a correlation between two variables, is neither sufficient nor necessary to establish a causal relationship, when theoretically sound it can still provide an indication that there exists a causal relationship. The identification of a theoretically sound association is followed by an investigation of generative mechanisms. The investigation of generative mechanisms is conducted empirically whenever possible, and when it is not possible, it is conducted theoretically using abductive reasoning and a critical examination of previous relevant empirical findings. The empirical investigation of generative mechanisms is conducted both quantitatively through developing and assessing conceptual models with path analysis and qualitatively through the analysis of qualitative interviews with residents. When possible, measurement triangulation is also conducted when examining a relationship between two events: the identified associations are assessed with multiple quantitative methods (e.g. cross-sectional and longitudinal) and/or with robustness checks (e.g. using different models to examine the same relationship). This provides results that are more robust and increases the validity of the study.

The *qualitative* part contributes to the thesis' goals by providing the necessary context of built environments and residents' lives in them as well as by shedding light into causal pathways. It is very difficult to represent and explain the whole picture of complex phenomena such as the one examined in this thesis solely by numerical models. The qualitative in-depth interviews with residents can provide a rich verbal understanding of the context of investigation and of residents' perceptions, and ultimately possible explanations of causal relationships. More specifically for this thesis, the analysis of interviews provides insights into residents' perceptions of physical and social attributes related to the urban form and insights into how

their lives and overall well-being might be shaped by these attributes. Such insights help us discern whether a causal relationship between some urban form attribute and some aspect of SWB may exist, what is the potential direction of causality, and what are the mechanisms that shape this causal relationship. These insights in turn complement quantitative results in two ways, both before and after quantitative analysis has been performed. First, they provide input on the development of quantitative models. For example, they provide input on options for possible causal models or more specifically on which variables to choose as dependent, independent, and control variables. Second, after quantitative results have been generated, qualitative material can offer important input on the interpretation of generative mechanisms and on discussions on causality.

To reach more valid and accurate outcomes, to the extent possible, urban planning studies such as this one should acknowledge and counter relevant *limitations and biases*. The challenge is to counter limitations and biases and strive for objectivity in order to comprehend and present reality more accurately. First, such studies, and this study also, analyze a set of observations in order to reach a conclusion. To arrive at informed generalization, the representativeness of the set of observations, in other words the sample, has to be carefully examined in relation to the phenomenon and the population the generalization is pertinent to. Second, personal biases should be limited. Personal biases such as confirmation bias, a possible inclination of the researcher to seek answers that confirm established hypotheses, can produce findings that present a seriously distorted portrayal of reality. Knowledge produced is an effort to understand a part of reality, but can be naturally influenced by personal interpretations of social phenomena. The researcher's goal in this case should be to try to keep personal interpretations as unbiased as possible in order to come closer to reality. The data collected should be critically filtered and analyzed to produce knowledge and reach outcomes that are as well-founded as possible.

# 3. Theoretical background

The purpose of this chapter is to complement the literature review in Chapter 1 and the theoretical background on urban form and subjective well-being (SWB) presented in the conceptual framework in Paper 1. The chapter presents the main concepts around urban form and SWB and provides clarifications on how they are used in this thesis (Section 3.1), since perceptions on these concepts may vary. Subsequently, the chapter gives a historical presentation of how different urban forms emerged and changed the character of cities (Section 3.2). It presents the main arguments behind the debates on different types of urban development, with a special focus on compact city and urban sprawl, which are probably the two most distinct paradigms, and explains the importance of covering the gaps in knowledge on urban form and quality of life. Following the explanation of the need for relevant research, the chapter concludes by presenting the different theoretical (conceptual) approaches to the study of urban form and SWB (Section 3.3). It thereby additionally explains how problems in commonly used theoretical approaches have driven the formulation of this thesis' research questions and the development of an alternative conceptual framework.

## 3.1. Basic concepts

*Urban form*:

Urban form is also referred to as city form, settlement form, urban structure, or built environment. The clarification of the concept of urban form has been a matter of debate by scholars in urban studies and there are differing views on what attributes it encompasses. There are narrow as well as wide views on urban form. A relatively narrow definition of urban form is given by Kevin Lynch, who defines it as ''the spatial pattern of the large, inert, permanent physical objects in a city'' (Lynch, 1984, p. 47). This definition is mainly pertinent to design and does not incorporate more dynamic patterns such as those related to mobility and land use (Tonkiss, 2013). A wider definition of urban form has been advocated by other scholars who argue that urban form, in addition to physical elements, also encompasses non-physical elements such as perceptions and activities (Dempsey et al., 2010). In the present thesis, such elements are considered separately from the concept of urban form, but in strong relation to it. In this thesis, urban form is viewed as a composite of the physical characteristics and the functions of human settlements. More specifically, the term urban form is used to describe a composite of characteristics related to land-use patterns, transport systems, and design

elements, as also conceptualized by Handy (1996). Types of typical urban forms examined in the thesis are compact city and urban sprawl (Ewing & Hamidi, 2015; Jenks et al., 2003).

*Density*:

Density in urban research commonly refers to the population density of an area, i.e. the concentration of inhabitants in a given area. Population density is naturally associated with morphological density (Churchman, 1999), in other words how densely built an area is. Morphological density refers to the distance between buildings as well as their height.

*Compact city*:

The characteristic that is most commonly associated with the compact city is high density, followed by mixed land uses and public transport (Neuman, 2005). The compact city concept is also used to describe the opposite of urban sprawl (Jenks et al., 2003; Neuman, 2005). Although the term compact city has been used for several decades (Dantzig & Saaty, 1973) and the ideas that it encompasses were expressed even earlier (Jacobs, 1961), scholars have quite recently started to provide more concrete and inclusive definitions (Lee et al., 2015; Song & Knaap, 2004). Ewing uses urban sprawl to define compact development as anything that is not characterized by dispersed housing, low densities, and single land uses (Ewing, 1997; Ewing & Hamidi, 2015). In Europe, however, the term compact is typically used to refer to higher densities than those in Ewing's definition. It refers to densely built urban forms usually found in historical centers of European cities. In this thesis, compact is defined as a composite of high densities, continuous urban fabric, mixed land uses, high accessibility, and public transport provisions. Therefore, compact city, compact area, compact neighborhood, and compact development refer to cities, areas, neighborhoods, and developments that have these characteristics.

*Urban sprawl*:

Urban sprawl is also known as suburban sprawl, leapfrog or scattered or dispersed development, or simply sprawl. In this thesis, urban sprawl refers to low densities, dispersed housing, single land uses, low public transport accessibility, and high car reliance. Sprawled neighborhoods are also referred to as "low-density suburban" in the thesis.

*Subjective well-being*:

Subjective well-being (SWB) is a subjective measurement of quality of life, defined as a cognitive and affective personal evaluation of one's life (Diener, 2000). Quality of life, well-being, and happiness are concepts that are being used interchangeably (Veenhoven, 2012), despite having slightly different connotations, and can be assessed using objective or subjective indicators (Okulicz-Kozaryn, 2013; Sirgy, 2012). SWB is the most commonly used subjective measurement. A more detailed presentation of SWB is given in Paper 1. There are three main components of SWB. According to OECD (2013, p. 10) guidelines on measuring SWB, these three components are defined as:

• Hedonic well-being / emotional well-being / affect: "a person's feelings or emotional states, typically measured with reference to a particular point in time"

• Life satisfaction / life evaluation: "a reflective assessment on a person's life or some specific aspect of it"

• Eudaimonia: "a sense of meaning and purpose in life, or good psychological functioning"

### 3.2. Urban theory: compact city versus urban sprawl

The compact city is not something novel. Human settlements have always been mostly compact (before the 20$^{th}$ century). The agricultural revolution in 10,000 B.C. caused the transition of many human cultures from a nomadic lifestyle of hunting and gathering to one of agriculture and therefore, the first fixed human settlements emerged. People chose to build their houses close to one another in order to exchange products easily, provide help to each other, and protect settlements and crops from possible enemies. Archaeological excavations of ancient settlements reveal that those settlements were indeed very close to what compact-city or new urbanist scholars advocate nowadays. For example, excavations of Akrotiri, a Minoan Bronze Age settlement, reveal vicinity of houses, two- or possibly even three-story buildings, mix of residences and shops, and narrow streets. All these resulted in high densities (considering the technology of that age) and high accessibility. An element that subsequently emerged in ancient cities was the permanent, open public space, such as the agora in ancient Greece and the forum in ancient Rome. Settlements remained compact and started to grow both in size and in density. The typical medieval city is a fortified densely built settlement with narrow streets. The agora and the forum are now replaced by the main market square.

With the industrial revolution, cities started to grow also vertically with higher buildings and consequently became denser and more crowded. In addition to that, the industrial revolution brought factories which had to be placed in the city so that workers could access them easily. Factories naturally increased air pollution.

As a result of the overcrowding, pollution, and loss of easy access to nature (due to the increase of city size) associated with the industrial city (the Victorian city), several thinkers started to write critiques about large and dense industrial metropolises. Early urban sociologists expressed their fears over urbanization which can induce alienation, unhealthy lifestyles, and impersonal relationships. Simmel (1903) observed that cities generate impersonal social interactions since residents strive to adapt to the intense rhythms of urban life. He argued that big-city residents encounter numerous people in their every-day lives compared with residents of small towns or rural areas, and since they cannot engage with everyone, they eventually become emotionally detached. Similarly, Wirth (1938), in the classic "Urbanism as a way of life", noted that urbanism generates impersonal and superficial relationships between residents, and that the size, density, and heterogeneity of big cities may negatively affect behavior and mental health.

At the same time, thinkers also suggested alternatives to the dense, large, and polluted industrial city. Ebenezer Howard conceived the highly influential Garden City in 1898 (Howard, 2010). Howard was critical of the industrial city (Fishman, 1982). He proposed the development of garden cities which are small communities of maximum 32,000 inhabitants surrounded by green-belts (Howard, 2010). These cities are characterized by non-continuously built residences. Each residence is surrounded by ample green space. With the garden city, he therefore tried to combine the city and the country (Breheny, 1996). Howard proposed a polycentric model for regional development. He envisaged garden cities to be satellites of the main city where the industries are located. He suggested that garden cities are linked to the main city through roads and railways. In Howard's Garden City, we can discern the first signs of urban sprawl: lower densities, larger private or semi-private green spaces, and separation of land uses. The rise of the automobile in the first half of the 20$^{th}$ century quickly put these ideas into practice.

An even more radical alternative to the industrial city was the Broadacre City, conceived by Frank Lloyd Wright in 1930s (Wright, 1932). The Broadacre City is a more extreme version of Howard's Garden City and could be viewed as the exact opposite of the

compact city. The rise of the automobile and the beginning of suburbanization inspired Wright to suggest that homes should be even more dispersed. He suggested that each single-family house is built on a one-acre plot and that transportation within the Broadacre City is done mainly by car. The result resembles more an agriculturalist landscape (Breheny, 1996) than that of a village, town or city. In contrast with Howard's ideal of the small community, Wright shifts focus on individuality through an individually owned piece of land in which one can live a chosen lifestyle (Fishman, 1982). All these characteristics make the Broadacre City an archetype of urban sprawl.

Another alternative to the industrial city was suggested by Le Corbusier with his Radiant City (Ville Radieuse) in the 1930s. The Radiant City consists of high-rise apartment blocks, surrounded by large green spaces, ample parking space, and wide streets that allow the free flow of cars and public transport. This plan is also referred to as "towers in a park". The main idea is to use high-rise buildings in order to free up space for green areas. His modernist ideas about planning have been and still are influential to the development of new cities such as Brasilia and the development of new neighborhoods worldwide. The traditional pedestrian-oriented neighborhood of continuous housing and small shops is replaced by scattered high-rise housing in vast green plots. Although denser than both the Garden City and the Broadacre City and generating different landscapes than typical urban sprawl, the Radiant city shares several similarities with urban sprawl: car reliance, separation of land uses, and lower walkability as a result.

By the 1950s, urban sprawl had already expanded rapidly in several cities of developed economies. Similar to the concerns about the industrial city, concerns about urban sprawl also started to appear. The term "urban sprawl" was first used in an article in "The Times" in 1955 as a critique of London's growing suburbs. Ian Nairn, an architectural journalist, expressed his polemic against the rise of suburbia and warned that if this type of development continued at the same rate, "then by the end of the century Great Britain will consist of isolated oases of preserved monuments in a desert of wire, concrete roads, cozy plots and bungalows. There will be no distinction between town and country…" (Nairn, 1955, p. 365).

Jane Jacobs also attacked the "rationalist" ideas of urban planning of that period which were mostly based on modernist planning and urban sprawl. She argued that planners of that period actually rejected the main idea of the "city". She contested the utopian ideas of both the Garden City as well as the Radiant City and criticized this type of "orthodox urbanism" for its

authoritarianism, for violent separation of land uses, and for loss of public realm, vitality, and diversity (Jacobs, 1961). What she suggested can be interpreted as a return to the traditional way of building cities, the compact city (although this term was not used by then). She suggested undisrupted urban fabric, mix of shops and residences, preservation of historic buildings, and relatively high densities; with all these resulting in high walkability and increased safety through "eyes on the street".

About a decade later, Dantzig and Saaty proposed their visions for future urban development in what they first described as the "Compact City" (Dantzig & Saaty, 1973). Their proposal is also a response to utopian and modernist planning and to urban sprawl. Their core ideas that revolve around high-density and mixed land uses are again not something novel; they are in line with the main principles of city building since ancient times, adjusted to the demands and technology of their times.

Besides the critiques against urban sprawl for its aesthetics, induced lifestyle, and possible impacts on quality of life, concerns had started to emerge about its environmental impact. The global environmental problems and the discussions on a "sustainable development" that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 43) brought a lot of attention to the environmental impact of cities. Urban form would be considered crucial for the promotion of sustainable development and a dilemma between urban compaction and urban sprawl arose (Breheny, 1996). This led to classic debates between scholars who highlighted the negative environmental effects of urban sprawl (Ewing, 1997; Ewing & Cervero, 2010; Ewing & Hamidi, 2015; Ewing, Pendall, et al., 2003; Ewing & Rong, 2008; Næss, 2003, 2012; Næss et al., 1996; Newman & Kenworthy, 1989a, 1989b, 1999) and scholars who contested the environmental benefits as well as the desirability of compact forms (Gordon & Richardson, 1989, 1997, 2000; Gordon et al., 1991). Gordon and Richardson argued against possible environmental gains of compact development and strongly supported urban sprawl. They criticized interventionist planning and suggested that urban form should be developed according to the free market.

Since the general consensus was, however, that urban sprawl has negative environmental effects, the compact city became the principle for sustainable urban form (Jabareen, 2006) and was supported by several leading organizations worldwide (American Planning Association, 1999; European Commission, 2007; United Nations, 2012). Several

cities or countries based their urban development on compact-city principles (e.g. Dieleman et al., 1999; Næss et al., 2011). In parallel, after further critiques of the lifestyle associated with urban sprawl in USA (Duany et al., 2001; Kunstler, 1994), other planning paradigms relevant to the compact city started to emerge: New Urbanism and Smart Growth (Duany et al., 2010). These paradigms were developed as antidotes to American sprawl, advocating concepts such as traditional neighborhood design and transit-oriented development. Their main characteristics are neighborhood centers, continuous urban fabric, mixed land uses, mixed-income housing, and medium densities.

Although the compact city is now usually acknowledged as the urban form that is the least harmful to the natural environment, unanswered questions remain on the debate on compact city versus urban sprawl, high density versus low density, urban versus suburban, centralization versus decentralization, urban densification (or consolidation, intensification, compaction) versus urban expansion. These unanswered questions are critical for future urban development and revolve around two themes: environmental sustainability (environmental impact) and social sustainability (quality of life).

Existing knowledge on the impact of urban form on quality of life is limited. Scientific research has not followed the wide range of theories and critiques on urban form typologies. For example, there is a perception that compactness is detrimental to quality of life (e.g. Breheny, 1996; Churchman, 1999; Neuman, 2005; Simmel, 1903; Wirth, 1938) but this has not been adequately supported by empirical evidence. Similarly, the criticisms on urban sprawl or modernist planning (e.g. Jacobs, 1961; Kunstler, 1994) have not been followed by adequate empirical research. One explanation for the limited research efforts to date could be related to the complexity and interdisciplinarity of the topic. Nevertheless, systematic knowledge is needed on how the elements of urban form and the size of human settlements may influence quality of life. This thesis focuses on elements of urban form, while the size of human settlements is also important. There has been some research on this in recent years suggesting that larger cities may negatively affect quality of life (e.g. Berry & Okulicz-Kozaryn, 2011), but causal mechanisms to explain and support this claim are still not adequately examined. Knowledge on the role of urban form and city size in quality of life can be crucial for future urban development both in conjunction with knowledge on environmental sustainability as well as independently. If seen in conjunction with environmental sustainability, this knowledge will provide insights into ways to combine both environmental and social sustainability to the extent possible or into ways to improve quality of life in environmentally friendly urban forms. If seen

independently, in cases where environmental sustainability is not considered in decision-making, this knowledge will provide input on how to use urban form to cover human needs. More specifically, it will provide input on human needs in relation to the discussions on centralization versus decentralization and on whether and to what extent we should: build cities in the traditional compact way, merge the city with the countryside (urban sprawl), and use hybrid models such as garden cities and modernist paradigms.

### 3.3. Theoretical approaches to the study of urban form and SWB

There are three main approaches that can be used to study the impact of urban form on subjectively measured quality of life, SWB. These are briefly presented here and explained in more detail in Paper 1. Studies on this topic usually investigate urban form at a neighborhood scale and use objective and/or perceived measurements of urban form attributes.

The first approach (Figure 1) is based on the model by Campbell et al. (1976) which suggests that objective and perceived attributes of a certain domain influence satisfaction with the domain and in turn life satisfaction. The domain most commonly used when this model is applied to the built environment is the neighborhood and therefore neighborhood satisfaction is used as a mediator between the built environment and life satisfaction. Neighborhood satisfaction (Francescato, 2002; Francescato et al., 1987) is probably the most commonly used way of studying neighborhood environmental quality. Most studies examine the impact of urban form attributes solely on neighborhood satisfaction (Arundel & Ronald, 2017; Buys & Miller, 2012; Cook, 1988; Davis & Fine-Davis, 1991; De Vos et al., 2016; Howley et al., 2009; Hur & Morrow-Jones, 2008; Hur et al., 2010; Lovejoy et al., 2010; Lu, 1999; Parkes et al., 2002; Yang, 2008), while a few others investigate the subsequent impact on life satisfaction as well (Adams, 1992; Cao, 2016; Sirgy & Cornwell, 2002). Paper 2 of the thesis is based on the neighborhood satisfaction approach. Neighborhood satisfaction is a good overall indicator of the quality of urban form, but it may not cover the full range of the impact of urban form on life satisfaction and it does not help reveal causal pathways between urban form and life satisfaction.

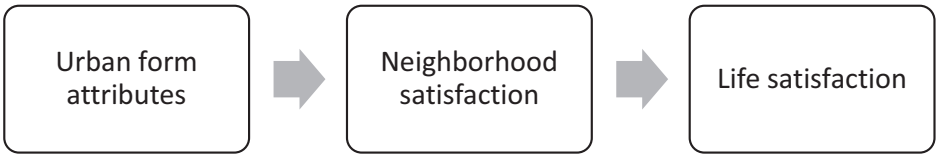


**Figure 1.** Neighborhood satisfaction approach.

The second approach (Figure 2) is to examine the direct impact of objective and/or perceived urban form attributes on measures of SWB, such as life satisfaction or positive/negative affect, without using life domains as mediators. Several studies follow this approach (e.g. Arifwidodo & Perera, 2011; Berry & Okulicz-Kozaryn, 2011; Cramer et al., 2004; Du et al., 2017; Ettema & Schekkerman, 2016; Kyttä et al., 2016; MacKerron & Mourato, 2009; White et al., 2013). The absence of mediators between urban form and SWB makes it difficult to support and explain causal relationships.

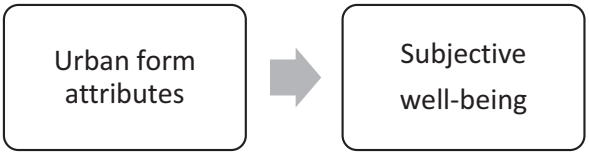


**Figure 2.** No mediator approach.

The third approach (Figure 3) is based on multiple life domains that act as mediators between urban form attributes and SWB. A version of this approach is developed, explained, and presented in Paper 1. Relevant life domains suggested as mediators in Paper 1 are personal relationships, health, leisure activities, and neighborhood impact on emotions and mood. Empirical investigations in Paper 3 and Paper 4 follow this approach. Another version of this approach is used by an empirical study by Feng et al. (2017) who use satisfaction with residence, health, transport, and social interaction as mediators between urban form attributes and SWB. The life domains approach helps explain causal pathways and more strongly support causality.

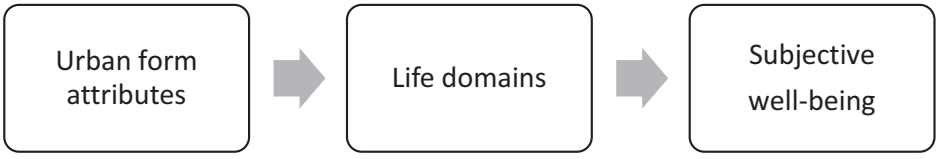


**Figure 3.** Life domains approach.

Most studies relevant to urban form and SWB are based on the first and second approaches presented here. This leads to a lack of knowledge on causal pathways between urban form and SWB. This lack of knowledge on causal pathways contributes to an inadequate understanding of the relationship between urban form and SWB and demonstrates the need for different theoretical approaches. This thesis employs both the neighborhood satisfaction approach (Paper 2) and the life domains approach (Paper 1, 3, and 4) in order to examine the phenomenon from various angles, make comparisons of findings from the two approaches, and eventually provide more nuanced knowledge.

# 4. Research strategy

## 4.1. Research design

The research design of this thesis is characterized by interdisciplinarity, an iterative research process, and a mix of research methods. Due to the interdisciplinary character of the topic, this thesis examines and synthesizes theories and empirical studies from a variety of fields such as urban planning, human geography, psychology, public health science, and philosophy. The thesis follows an iterative approach, meaning that its different methodological elements inform each other in various stages of the research process. A mixed-methods (quantitative and qualitative) strategy is employed in order to both identify trends that may indicate causal relationships and provide input on causal mechanisms. The case area for the empirical research of this thesis is the metropolitan area of Oslo, and is presented in detail in Section 4.2. Empirical data are obtained from survey and interviews conducted for the purposes of this project. The survey and interviews are presented in detail in Section 4.3. Data analysis methods are presented in Section 4.4. The scope and methods of each paper are presented in Section 4.5.

The methodological process of the thesis, in other words the sequence of its methodological elements, is presented in Figure 4. The research starts with a wide literature review on aspects relevant to its main topic. It examines theories and empirical studies on urban form and its characteristics, on distinct urban forms such as the compact city and urban sprawl, and on subjective well-being (SWB) and relevant life domains. It also examines theories and empirical studies on how urban form can influence SWB and relevant life domains: neighborhood satisfaction, personal relationships, health, leisure activities, and emotional response to place. The development of new theory as well as the selection of existing theory is based on this literature review. These theories additionally stimulate further relevant literature review. Data collection is based on the selected theories, and the survey and interview are designed accordingly. After collecting the data, quantitative and qualitative analyses are performed based on selected theory. At the same time, results from data analysis are used to evaluate or redevelop theory. Further literature review is conducted when necessary to contextualize the empirical results. The empirical results are then juxtaposed with the literature review in order to evaluate key findings, draw comparisons with previous research, and discuss limitations and implications for future research.

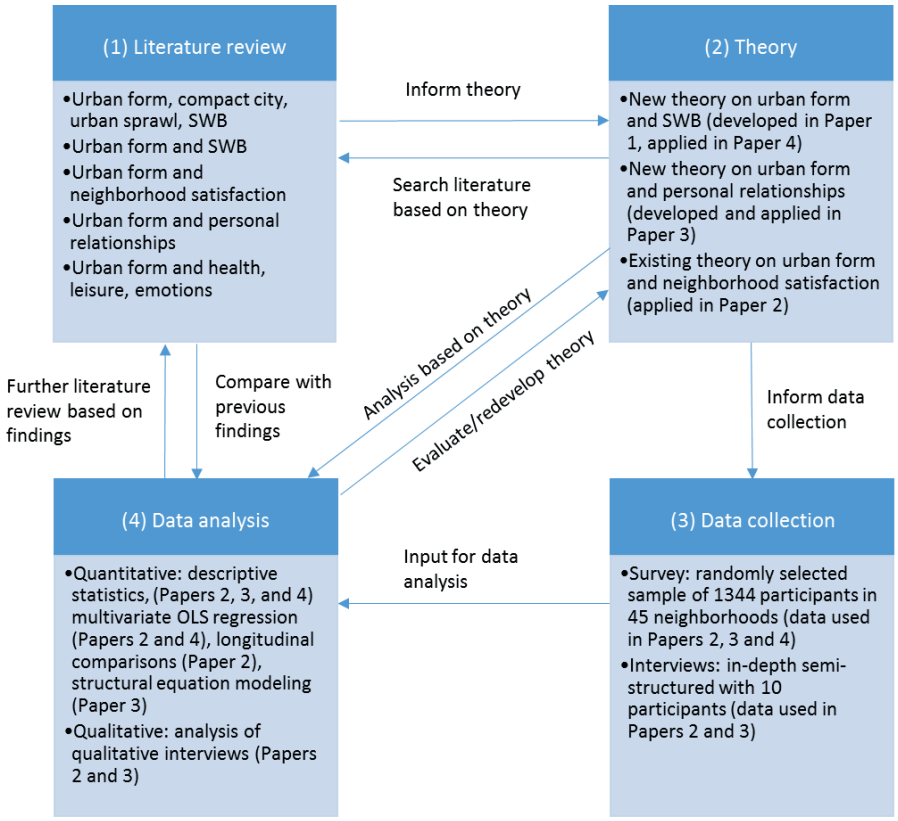


**Figure 4.** Methodological process of the thesis.

### 4.2. Oslo as case area

The case for the empirical investigations of this research is the metropolitan area of Oslo. Since the early 2000s, Oslo has been one of the fastest growing major cities in Europe. To cover its growing housing needs, the metropolitan area of Oslo has focused mostly on urban densification policies, instead of urban expansion, in order to protect surrounding forests and farmlands and promote environmentally friendly mobility by means of walkability, cycling, and public transport. Oslo has an extensive multi-modal public transport system that covers the counties of Oslo and Akershus. There are three main reasons that make the metropolitan area of Oslo a suitable and interesting case for the purposes of this research.

First, the diversity of urban forms found within the metropolitan area of Oslo provides a platform for meaningful comparisons within the same geographical and cultural context.

Several, if not most of the previous relevant research studies examine cases of either only low-density suburban forms, or only compact forms, or urban forms that are neither typical compact nor low-density suburban. Studies that examine neighborhoods of diverse and distinct urban form types are scarce. A high variation in physical attributes, such as the one found in Oslo, ensures that a wider range of built environment factors are considered and leads to less biased estimates in quantitative analysis. This enables deep investigations of the impact of compact-city, sprawled, or medium-density forms and their characteristics on SWB and expands the relevance of the findings to other geographical contexts. Oslo includes compact urban forms (Figure 5) that are characterized by high density, continuous urban fabric, high public transport accessibility, and mixed land uses. It has to be noted that, in this thesis, compactness and high density refer to medium-rise development typically found in the historical centers of European cities. Oslo does not contain, apart from very few exceptions, extremely high-density forms with high-rise blocks. Oslo also includes typical sprawled forms (Figure 6) characterized by low density, disrupted urban fabric, lower public transport accessibility, higher car reliance, and mostly separate land uses. It includes modernist, medium-density urban forms (Figure 7) that are characterized by medium density, disrupted urban fabric, relatively high public transport accessibility, and mostly separate land uses. It includes continuous medium-density housing (Figure 8) characterized by medium density, continuous urban fabric, relatively high public transport accessibility, and mostly separate land uses. It also includes low-density forms within the inner city (Figure 9) characterized by low density, disrupted urban fabric, relatively high public transport accessibility due to the adjacent compact areas, and separate land uses. Sample from all these types of urban forms is collected in the survey conducted for this research project.

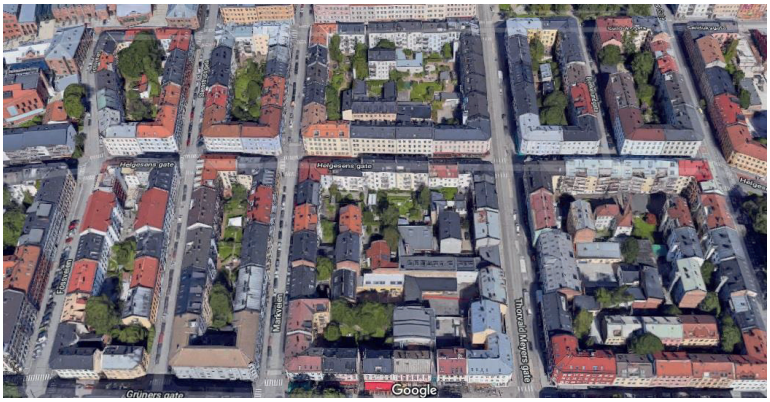


**Figure 5.** Example of a compact urban form in Oslo (Grünerløkka).


**Figure 6.** Example of a sprawled urban form in Oslo (Holmenkollen).

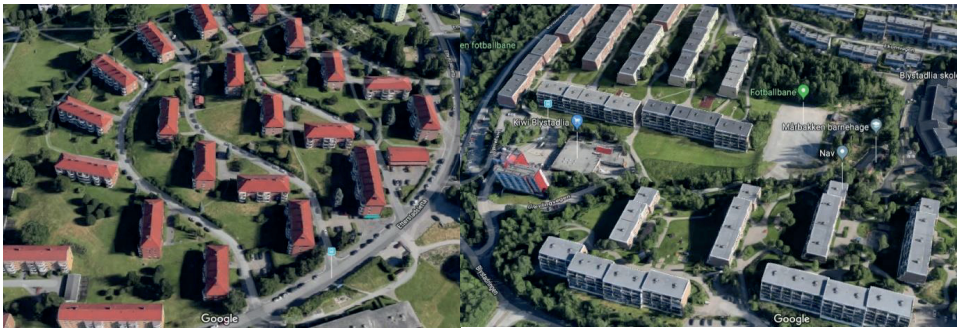


**Figure 7.** Examples of modernist medium-density urban forms in Oslo (Etterstad and Blystadlia).


**Figure 8.** Example of continuous medium-density housing in Oslo (Vålerenga).

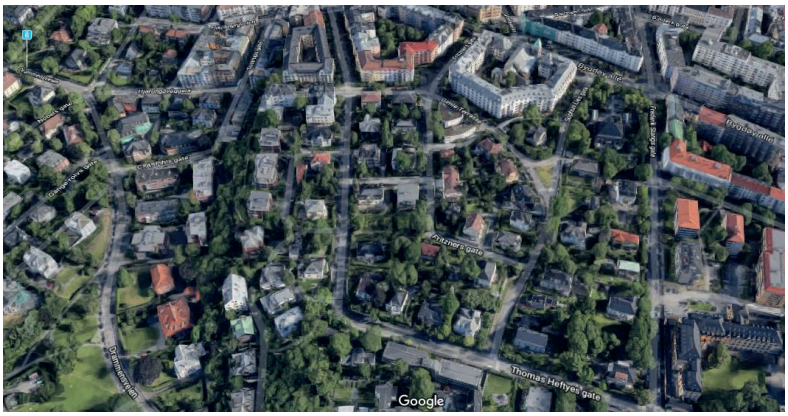


**Figure 9.** Example of low-density inner-city housing in Oslo (Frogner).

Second, the relatively high overall social equity and the spatially distributed social differences across urban form types of Oslo help counter possible sample selection biases. Oslo is a city characterized by high social equity compared to world but also European standards. Among all countries, Norway has the highest score in the inequality-adjusted human development index (IHDI) as measured in 2015 and one of the lowest levels of inequality according to Gini coefficient. Income inequalities are relatively small, unemployment rates are low, healthcare access is high, security is high, and education is free and accessible. There are no extreme differences in income, unemployment rate, security, access to healthcare, and access to education across different neighborhoods. However, some social inequalities do exist in Oslo (Wessel, 2010). Certain neighborhoods are relatively more prosperous than others, certain neighborhoods are relatively ghettoized, and there are differences in life expectancy between neighborhoods. What is very important for this research though is that these differences exist for both high- and low-density urban forms. There are poorer and richer neighborhoods in both compact and suburban areas. Similarly, there are neighborhoods with a high immigrant concentration in both compact and suburban areas. This contrasts with many US cases for example, where the whole inner city could be degraded and impoverished, while suburbs are more prosperous. Making comparisons of urban quality of life in such cases could lead to biased findings as social equity plays a key role in quality of life.

Third, Oslo's urban densification policies, the adoption of compact-city principles, and the efforts to limit urban sprawl (see Hanssen et al., 2015; Næss et al., 2011) make this project meaningful not only for its contribution to theoretical knowledge or general policymaking but also for its practical implications at a local level. Examining the role of urban form and

subsequent lifestyles in the well-being of Oslo's residents can provide useful insights for policies on its urban development. This could contribute to bridging the gap between urban planning policies and the well-being related goals of public health policy in Norway (Hofstad, 2011, 2016). In specific, identifying synergies and conflicts between compactness and SWB can offer input for policymakers on how to strengthen the advantages of the compact city and how to mitigate its weaknesses, therefore offering input on how to design and plan livable compact areas. The same can be done for other types of urban form. In that regard, Oslo can be considered as a "dynamic laboratory" for urban quality of life research.

### 4.3. Data collection methods

#### *Survey*

A questionnaire survey was conducted in May-June 2016 in the metropolitan area of Oslo. Survey participants were residents of 45 neighborhoods within central and suburban locations (Figure 10). Participants were invited to participate in an online questionnaire via letter. The questionnaire was available in both Norwegian and English. The choice of neighborhoods as well as the number of letters sent to each neighborhood aimed at generating a socioeconomically representative sample that includes residents from a diverse range of urban forms (see Appendices in papers for details). The number of valid responses was 1344. Sample was collected from compact neighborhoods (N=535), sprawled neighborhoods (N=504), and other types such as medium-density neighborhoods and low-density inner-city neighborhoods (N=305). The questions of the survey were addressed at the individual level and only one person per household received a letter. Participants were 18 years or older, but apart from this they were randomly selected within each case neighborhood. The survey did not include any incentives or reminder letter. The questionnaire was first pilot-tested and then revised accordingly.

To obtain a list of addresses for the selected 45 neighborhoods, which correspond to specific postal zones, an application was submitted to the Norwegian Tax Administration for disclosure of registry information. Following the approval of this application, the data service provision for the list of addresses was outsourced to EVRY AS. This company provided a full list of addresses for each of the 45 postal zones. After excluding residents below 18 years old, an algorithm was created that randomly selected 10000 addresses and simultaneously made sure that only one person per household was selected. After randomly selecting the addresses,

AiT Bjerch AS was employed to print the 10000 invitation letters, prepare envelops, packaging, and stamping, and finally deliver the letters to each address. Out of the 10000 letters, 9730 were sent to valid addresses, while the rest were returned.

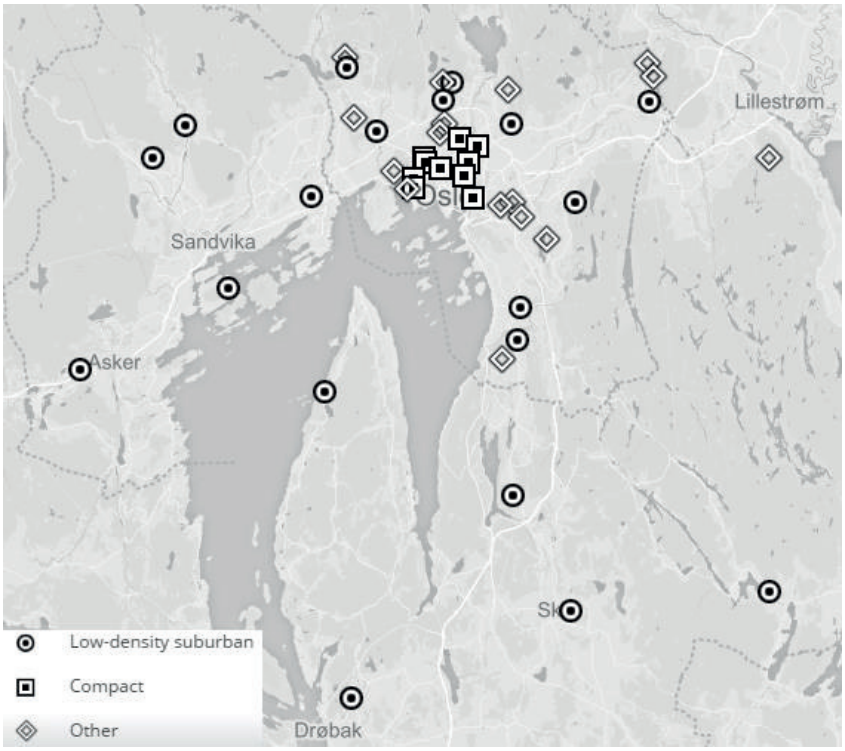


**Figure 10.** Selected neighborhoods within the metropolitan area of Oslo.

The sample's sociodemographic characteristics do not deviate much from the population, but there are some differences (Table 3). Survey participants are on average slightly older and more highly educated than the population. Immigrant populations are underrepresented in the survey, as their response rate is lower. Incomes are higher among the respondents than among the population. Couples are overrepresented in the study. In addition, as the response rate in the survey is 13.8%, non-response bias might be relevant. However, because relevant variables are controlled for in multivariate regression analysis, these biases are not expected to significantly affect results in the present study. Since the main purpose of the study is not to describe the univariate distribution of SWB or relevant life domains but to explore their conditional relationship with urban form characteristics using multivariate

analysis, any geographical over- or underrepresentation of certain groups of people in the sample would not be expected to materially affect the results (Crano et al., 2015).

**Table 3.** Comparison of sociodemographic characteristics.

| Sociodemographic variables | Survey respondents (N=1344) | Population |
|---|---|---|
| | Mean | Mean |
| Age (for aged 18 or older)[1] | 50.16 | 46.30 |
| Unemployed[2] | 2.50% | 3.50% |
| Living with partner/spouse[1] | 61% | 48% |
| Non-Norwegian[1] | 9% | 21% |
| Adjusted household income (1000s NOK)[1] | 642.20 | 582.98 |
| Household size (persons)[1] | 2.22 | 1.94 |
| Number of children in household[1] | 0.54 | 0.46 |
| Household with children[1] | 32% | 26% |
| Respondent is female[1] | 53.4% | 50.3% |
| Respondent has college degree or higher[2] | 79% | 47% |

*Notes*:

[1]Population mean refers to the counties of Oslo and Akershus.

[2]Population mean refers to Oslo municipality.

*Sources*: Statistics Norway (2017) and European Commission (2016).

The survey collected data on several themes. These are sociodemographic characteristics, neighborhood perceptions, life domains, and SWB. SWB was measured following the state of the art guidelines of OECD (2013) and the European Social Survey (2012). The complete questionnaire of the survey can be found in Appendix A. The data items used in the thesis are presented in Table 4. Certain items were collected but not used for the purposes of this thesis for various reasons. Some were not relevant to the scope of the four research papers and some did not have a significant contribution to the analysis. All these items might be useful for future research.

The survey followed a sequence of questions aiming to limit biased responses to the extent possible (see Appendix A for questionnaire). As recommended by guidelines on measuring SWB (OECD, 2013), the SWB items were placed at the very beginning of the survey, just after some brief "warm-up" questions on housing type and duration living in the dwelling. This is done to avoid preceding relevant questions that might influence the evaluation of overall SWB, since asking questions on life domains before SWB has been found to lead to biased SWB measurements (Kahneman et al., 2006). Similarly, items on predictors of life domains satisfaction were placed after the life domains satisfaction question. For example,

questions on the number of close relationships and frequency of socializing were placed after the question on personal relationships satisfaction. The sociodemographic questions were placed in the end of the questionnaire since placing them earlier could increase the possibility that the respondent gets disinterested and ceases participation.

Physical urban form attributes for each of the 45 neighborhoods of the survey have also been measured "objectively" using GIS data. Neighborhood population density is measured by dividing the population of each postal zone by the area coverage in hectares. Distances to Oslo city center and to the Marka forest (Oslo's forested zone and major outdoor recreation area) are measured from the centroid of each neighborhood. Public transport is calculated as the aggregate number of departures per hour in the peak period from all public transit stops within a radius of 500 m from the centroid of each neighborhood. Land use mix is measured by means of grocery stores as well as cafés, restaurants, bars, and community centers. The number of grocery stores is also calculated within a 500 m buffer. The number of cafés, restaurants, bars, and community centers is similarly measured but within a 1000 m buffer as people are willing to travel longer distances to visit such places (Næss et al., 2017).

**Table 4.** Survey data used in the thesis.

| Sociodemographics | Neighborhood perceptions | Life domains / SWB determinants | SWB |
|---|---|---|---|
| Age | Open public spaces | Neighborhood satisfaction | Life satisfaction |
| Gender | Aesthetic quality | Satisfaction with previous neighborhood | Meaningful life (eudaimonia) |
| Citizenship | Cleanliness | Satisfaction with personal relationships | Happy (hedonic) |
| Education level | Safety | How often meet friends/relatives | Anxious (hedonic) |
| Household size | Noise | How many people feel close to | |
| Living with partner/spouse | Traffic | How much support you receive | |
| Children in household | Neighborhood attachment | Opportunities to meet new people | |
| Household income | Feel close to neighbors | Perceived overall health | |
| Employment status | Neighborhood influence on social life | Satisfaction with leisure activities | |
| Type of residence | | Feelings when walking in neighborhood | |
| Time living in residence | | | |
| Address | | | |
| Postal code | | | |
| City | | | |
| Address of previous residence | | | |
| Postal code of previous residence | | | |
| City of previous residence | | | |
| Email | | | |

***Interviews***

In-depth semi-structured interviews were conducted with 10 residents of the metropolitan area of Oslo (Table 5). Among the interviews that were conducted, 5 were in compact neighborhoods (within the Grünerløkka district) and 5 in inner and outer suburbs (Bærums Verk, Hellerud, Nordstrand, and Ski). The interviewees were selected using the results of the survey. The duration of the interviews varied from approximately one hour to one and a half hour. The interviews were conducted in English. They were recorded using a specialized audio recorder. Whenever possible, there was a second person, a colleague, facilitating the interview process. In total, 4 out of 10 interviews were conducted with the help of a second interviewer (Petter Næss, Jin Xue, and Anja Standal). Maps of the municipality of Oslo and of the counties of Oslo and Akershus were used as visual methods to facilitate the interview process (Crang, 2010). The recorded interviews were then fully transcribed by a Master's student of the department (Jeppe Wethal). The transcriptions were subsequently corrected by the author for minor errors.

To achieve the goal of uncovering as many basic causal mechanisms as possible, the concept of representativeness in interviewee selection is relevant. Despite unlimited possibilities in interviewee selection, there was an effort to select an interview sample, to the extent possible, from various urban neighborhood types, i.e. compact, inner suburbs, and outer suburbs, with differing sociodemographic characteristics, with differing perceptions of urban form attributes, and with differing evaluations of life domains and SWB. Selecting such an interview sample was facilitated by using the results of the survey. Naturally, the final sample of the interviews is not representative of the phenomenon, but it was selected to achieve at least a certain degree of "representativeness".

Neighborhoods of Grünerløkka district were selected as compact-city cases because they are seen as representative of compactness for Oslo's standards. They are characterized by relatively high densities, continuous urban fabric, high access to frequent public transport, mixed land uses, and high concentration of "third places". Based on the collected survey data, it was also possible to recruit interviewees from a wide range of age groups, varying from people in their 30s, 50s, and 70s, and a relative diversity in income levels, varying from low-medium to medium-high incomes. Recruiting residents of suburbs was more challenging since the survey covered numerous suburbs (because there are significantly more suburban neighborhoods in Oslo than compact ones) but with lower sample sizes. Suburban residents,

especially those with small children, were more reluctant to participate in a personal interview. There was an effort to recruit interviewees from both inner and outer suburban neighborhoods. Hellerud and Nordstrand are inner suburbs while Bærums Verk and Ski are outer suburbs. Again, a similar variation in demographic and socioeconomic profiles, as in compact-city interviewees, was intended. In general, for both compact and suburban cases, it was difficult to recruit immigrant interviewees, as their survey response rate was relatively low as was their willingness to participate in the interview. Therefore, there were no interviewees with an immigrant background. It was also noted that females were more willing to participate in the interview than men, despite their survey response rates being somewhat similar. This resulted in recruiting seven females and three males (Table 5).

**Table 5.** Interview participants.

| Interviewee | Age | Gender | Living with partner | Children in household | Neighborhood | Neighborhood type |
|---|---|---|---|---|---|---|
| 1 | 32 | Female | Yes | Yes | Grünerløkka A | Compact |
| 2 | 33 | Female | No | No | Grünerløkka A | Compact |
| 3 | 52 | Female | No | Yes | Grünerløkka B | Compact |
| 4 | 76 | Male | Yes | No | Grünerløkka B | Compact |
| 5 | 39 | Female | Yes | Yes | Grünerløkka B | Compact |
| 6 | 74 | Female | Yes | No | Nordstrand | Inner suburb |
| 7 | 46 | Male | Yes | Yes | Hellerud | Inner suburb |
| 8 | 36 | Male | No | No | Bærums Verk | Outer suburb |
| 9 | 62 | Female | No | No | Ski | Outer suburb |
| 10 | 30 | Female | Yes | No | Ski | Outer suburb |

An important challenge during the interview process has been how to obtain qualitative data from the interviewee that are as close to reality as possible (Aase & Fossåskaret, 2014). To address this challenge, there was an effort to limit biases relevant to both the way of asking questions but also to the content of the questions themselves. Although a priori thinking is unavoidable and also necessary (Kant, 1934) in a study such as this one, the idea of starting the interviews in as open-ended and objective ways as possible (Glaser & Strauss, 1967) has been useful to limit such biases. This helped keep personal participation to minimum. As the interview continued, there was a need to cover previously undiscussed themes of interest or illuminate aspects of the phenomenon that the interviewee might not have the time or background to think of and elaborate on. For these reasons, semi-structured interview was selected for being the most useful approach for the investigation of such a complex topic. To counter biases relevant to the content of the questions, the interview process in this project

aimed to cover a wide range of themes so that diverse generative mechanisms are exposed. In parallel, it was intended to additionally strive for objectivity by just examining possibilities of associations between objects of interest in a neutral way and not unconsciously put words into the participant's mouth.

The interviewees were initially asked a general open-ended question in order to cover as many aspects of the main research question as possible. They were asked about their general thoughts on the influence that their neighborhood – defined as the local area approximately 15 min walking distance from their home to ensure consistency – has on their life. Subsequently, depending on the range of topics and the depth already covered by each interviewee, they were asked about several topics. These topics include perceptions of the local area, things they like and dislike about it, favorite places in the area, comparisons with other areas, open public spaces and streets, facilities and services, transport and travel, and potential impacts of the local area on social life, leisure activities, walking, biking, health, emotions, life satisfaction, happiness, and eudaimonia. The complete interview guide can be found in Appendix B.

***Ethical considerations***

Both survey and interview have been registered with the Data Protection Official for Research, Norwegian Social Science Data Services. All main ethical issues have been taken into consideration. All personal data have been treated confidentially. Participants' answers have been anonymized. The submitted questionnaires have been stored and treated confidentially. Access to the data has been given only to the research team (author and supervisors).

## 4.4. Data analysis methods

***Quantitative analysis***

Quantitative analysis in this thesis is conducted using measurements of physical attributes of the urban form along with results of the survey. Survey results were first screened for misspelled addresses, postal codes or survey identification numbers, duplicate responses, and careless responses. Quantitative data are analyzed with descriptive and inferential statistics (see Papers 2, 3, and 4). Descriptive statistics such as mean, median, min and max, and standard deviation are used to present the sample's main characteristics. The main methods of inferential

statistics employed are bivariate correlations, t-tests, multivariate OLS regression, longitudinal comparisons, and structural equation modeling. These statistical methods are used to identify associations between variables, draw comparisons, indicate trends and patterns, and empirically assess theoretical models. Moreover, when available data allow, multiple methods of quantitative analysis are employed to examine the same research question, thus offering measurement triangulation (see Papers 2 and 3). The primary statistical methods in Paper 2 are multivariate OLS regression and longitudinal comparisons. In Paper 3, the primary statistical method is structural equation modeling, and in Paper 4, it is again multivariate OLS regression.

The analysis and the reporting of the quantitative results aimed at eliminating researcher's *biases* such as confirmation bias and reporting bias. To achieve that, the thesis as well as the research papers that it is based on have an exploratory character instead of intending to confirm or reject pre-established hypotheses. In other words, the empirical work in this thesis attempts to answer "what", "how", and "why" questions, and do so without aiming to confirm preconceptions of what the answers to these questions would be. This can be seen in the quantitative results of the papers of this thesis, which in some cases appear to be paradoxical or conflicting at first glance (see Section 6.1). Moreover, to tackle such biases, quantitative results are presented in the empirical papers independently of their level of statistical significance. In cases of explanatory variables that are not included in the analysis due to being nonsignificant, this is explicitly stated in the papers.

Quantitative datasets, naturally, have *limitations*. They cannot grasp all the details of the phenomenon under study, but aim to depict its basic elements. Data collected by the questionnaires are mostly numerical. When reflecting on the numbers that express participants' perceptions of social constructs, attention is paid not to concentrate on the exact numerical values rather than on general tendencies. An effort is made to critically develop and then critically interpret statistical models. Input from a priori thinking (literature review, theory, critical thinking) as well as from qualitative material is taken into consideration when deciding on model types and selection of variables. The same is done during the interpretation of the results. It should be noted that quantitative models could never completely portray the whole picture of reality because variables and relationships between them can be indefinite. However, the inclusion of the most relevant variables for each model and the well-founded interpretation of results are crucial for meaningful generalizations and predictions in this thesis.

***Qualitative analysis***

Qualitative analysis is presented in Paper 2 and Paper 3. The qualitative analysis has been conducted in parallel with the quantitative analysis. The qualitative analysis provided input for the selection of variables in quantitative models, while at the same time quantitative results provided indications on which possible causal relationships and respective mechanisms to investigate in the qualitative analysis. In certain cases, the explanatory variables used in quantitative models and the verbal qualitative explanations represent the same causal mechanism (see Paper 3). Qualitative interview data have been analyzed without using any formal qualitative analysis process. Separate qualitative analyses have been conducted for Papers 2 and 3. In Paper 2, the main factors that contribute to neighborhood satisfaction and urban quality of life have been explored. Differences in neighborhood perception and satisfaction between two distinct types of urban form in Oslo, the compact city and urban sprawl, as well as their advantages and disadvantages have also been identified. Insights from residents who have lived in both neighborhood types have been particularly useful in that regard. In Paper 3, qualitative analysis focuses on providing explanations on how urban form affects social life and if and how this influence differs between compact and sprawled urban forms. Indications on three main causal mechanisms emerged based on common patterns in the interviewee responses and on theoretical considerations. These qualitative explanations coincide with the most significant explanatory variables in quantitative models. Qualitative analysis in Paper 2 and Paper 3 provides the most relevant and meaningful context as well as insights into causal mechanisms on the subject of urban form and urban quality of life that can be extracted from the obtained qualitative material. The qualitative material does not provide new relevant and significant knowledge for Paper 4, and thus Paper 4 is based solely on quantitative data.

Analyzing and interpreting qualitative interviews is a challenging task that could be characterized by *misconceptions* and *biases*. Interview analysis and interpretation rely on the researcher's perception of the interviewees' perceptions of reality. Therefore, approaching reality with a high level of accuracy can be difficult. Qualitative analysis in this thesis employed certain techniques to achieve high accuracy. Each interview was firstly analyzed individually and then it was juxtaposed with the other interviews in order to identify common recurring themes. The interview was not only analyzed by using the transcription but also by using the audio recording. Specific attention was paid to critically interpret words, concepts and their meaning for each individual. The audio recording also contributed to this as it helps towards a

more nuanced understanding of the interviewee's expressions and language usage. To better understand the interviewee's perceptions and explanations, the interview was also compared with the individual's responses to the relevant survey items.

Some *limitations* of the qualitative interviews that should be acknowledged are that although they provide indications on causal mechanisms, in a complex subject such as this they cannot always reveal all causal mechanisms in place and they cannot always highlight the most dominant causal mechanism or mechanisms. For example, residents might not be able to consciously realize and verbally express all the different ways in which their neighborhood affects their happiness, and even if they did, it would be very difficult to evaluate the most important causal pathways. This is reasonable since the pathways between the built environment and happiness are both complex and numerous; the built environment may affect perceptions and behaviors, these in turn may affect several life domains, and all these may result in a certain impact on total happiness. For these reasons, interviews should not be seen as a tool that is sufficient on its own for explaining causal mechanisms in such topics. The more holistic, iterative process employed in this thesis and described above is necessary; qualitative interview analysis should be combined with quantitative models that investigate causal pathways and with theoretical considerations based on observation, previous research, and critical thinking.

### 4.5. Research papers: scope and methods

This thesis is based on four research papers that are developed in response to the literature review, research gaps, overarching research questions and objectives, philosophy of science, and theoretical background, presented in the previous chapters. Table 6 provides an overview of the theme and research approach of each paper. Table 7 presents the research questions of each paper. Paper 1 is a theoretical and methodological paper, Paper 2 and Paper 4 are mostly empirical, and Paper 3 combines the development of new theory with empirical investigation.

*Paper 1* covers the lack of systematic theory and sufficient conceptual framework on the influence of urban form on SWB. It develops a new theory, by means of a new conceptual framework, that aims to explain how the built environment, including urban form as well as perceived neighborhood attributes, may influence SWB. This theory argues for and is based on a life domains approach (see Section 3.3) that addresses the omission of possible causal mechanisms between urban form and SWB in previous relevant theories and empirical studies.

The paper contributes to research question (1) of this thesis "How can the influence of urban form on SWB be conceptualized?"

*Paper 2* examines the impact of the urban form on neighborhood satisfaction. It employs the neighborhood satisfaction approach (see Section 3.3) to examine the role of different urban forms and their characteristics in needs satisfaction. Including a paper that follows the neighborhood satisfaction approach in the thesis can offer comparisons with similar studies in different contexts and also comparisons with results from papers following the life domains approach (Paper 3 and Paper 4). The paper contributes to knowledge by evaluating differences between typical compact and typical sprawled urban forms and their characteristics. Such comparisons are scarce in existing literature. It also examines urban form characteristics within a wider range of urban forms (e.g. compact, sprawled, medium-density, inner-city low-density). The paper also contributes to knowledge by employing a mixed-methods approach which comprises not only the commonly used quantitative cross-sectional analysis but also quantitative longitudinal analysis as well as qualitative analysis. It therefore offers explanations of causal mechanisms (by using qualitative data) and additional support for causality (by using longitudinal quantitative data). By examining neighborhood satisfaction, which is a life domain that can influence SWB, the paper contributes to research question (2) of this thesis "How does urban form influence relevant life domains that contribute to SWB?"

*Paper 3* develops and empirically assesses a new theory on how urban form affects personal relationships. This paper is in line with the life domains approach since personal relationships are one of the intermediate life domains identified in Paper 1 (see Section 3.3). The focus on urban form and personal relationships in this paper has been based on the fact that personal relationships are one of, if not the single most important life domain of SWB, while at the same time relevant theories and empirical studies are insufficient and mostly focus on local neighbor ties. Thereby, this paper aims to cover a significant gap in knowledge. The paper synthesizes theoretical knowledge from urban studies and psychology, and accordingly develops a theoretical model that explains how urban form may affect personal relationships satisfaction. This model is then empirically assessed using structural equation modeling. Intermediate variables in quantitative analysis combined with qualitative analysis help investigate and explain causal mechanisms between urban form and personal relationships satisfaction. The paper compares distinct urban forms – compact versus low-density (sprawled) – and also evaluates detailed urban form characteristics within a wider range of urban forms. By developing a theory on urban form and personal relationships, which is a life domain that

can influence SWB, the paper contributes to research question (1) of this thesis "How can the influence of urban form on SWB be conceptualized?" By applying and empirically assessing this theory, the paper also contributes to research question (2) of this thesis "How does urban form influence relevant life domains that contribute to SWB?"

*Paper 4* empirically investigates how urban form may affect life domains as well as overall SWB by applying the conceptual model developed in Paper 1. This paper is in line with the life domains approach (see Section 3.3). The contribution of the paper is threefold. First, it provides new insights into whether compact or low-density forms influence SWB more positively. Second, it examines the ways in which urban form may shape SWB by investigating the indirect statistical effects of urban form on SWB through relevant life domains, and thus attempts to unveil causal mechanisms and offer a new paradigm for further relevant research. Third, it additionally examines the role of common urban problems in SWB, thus offering input for policymakers on how to enhance quality of life in compact cities. The paper is based solely on quantitative data, since most of the qualitative data that offer meaningful relevant input have been already presented in Paper 2 and Paper 3. This paper explores causal mechanisms by means of life domains used as mediators and by using abductive reasoning based on theory and on input on causal mechanisms from Papers 2 and 3 and other relevant studies. By examining life domains as well as overall SWB, the paper contributes to two research questions of the thesis: (2) "How does urban form influence relevant life domains that contribute to SWB?" and (3) "How does urban form influence the different components of SWB?"

**Table 6.** Research approach of each paper.

| Paper | Theme | Title | Research approach | Data sources | Data analysis |
|---|---|---|---|---|---|
| Paper 1 | Urban form and SWB (theory) | Rethinking how built environments influence subjective well-being: A new conceptual framework | Develop new theory on urban form and SWB | Existing literature | Theoretical reasoning |
| Paper 2 | Urban form and neighborhood satisfaction (empirical) | Is compact city livable? The impact of compact versus sprawled neighborhoods on neighborhood satisfaction | Apply neighborhood satisfaction approach to examine different urban forms and their characteristics | Survey and interviews | Quantitative and qualitative |
| Paper 3 | Urban form and personal relationships (theory and empirical) | Built environment and social well-being: How does urban form affect social life and personal relationships? | Develop, apply, and empirically assess new theoretical model on urban form and personal relationships | Survey and interviews | Quantitative and qualitative |
| Paper 4 | Urban form and SWB (empirical) | Compact city and subjective well-being: The role of urban form in life satisfaction, hedonic well-being, and eudaimonia | Empirically investigate urban form and SWB applying theory developed in Paper 1 | Survey | Quantitative |

**Table 7.** Research questions of each paper and contribution to overall research questions.

| Paper | Theme | Paper research questions | Thesis research questions addressed |
|---|---|---|---|
| Paper 1 | Urban form and SWB (theory) | (1) In what ways can urban form influence SWB?<br>(2) How can the influence of urban form on SWB be conceptualized? | 1. How can the influence of urban form on SWB be conceptualized? |
| Paper 2 | Urban form and neighborhood satisfaction (empirical) | (1) Which residents have higher levels of neighborhood satisfaction, other things being equal: those living in compact areas or those living in sprawled ones?<br>(2) What is the impact of compactness (density, public transport, accessibility, and mixed land uses) on neighborhood satisfaction among residents of various types of areas?<br>(3) How does neighborhood satisfaction change for residents who have moved from sprawled areas to compact ones compared to the ones who have moved from compact areas to sprawled ones? | 2. How does urban form influence relevant life domains that contribute to SWB? |
| Paper 3 | Urban form and personal relationships (theory and empirical) | (1) How does the compact city affect personal relationships?<br>(2) How do urban form characteristics affect personal relationships? | 1. How can the influence of urban form on SWB be conceptualized?<br>2. How does urban form influence relevant life domains that contribute to SWB? |
| Paper 4 | Urban form and SWB (empirical) | (1) How does compactness affect relevant SWB determinants (personal relationships, leisure activities, health, emotional response to place) and eventually SWB itself (life satisfaction, eudaimonia, hedonic well-being)?<br>(2) How does this effect change when we additionally control for common urban problems: fear of crime, litter, noise? | 2. How does urban form influence relevant life domains that contribute to SWB?<br>3. How does urban form influence the different components of SWB? |

# 5. Paper summaries

## 5.1. Paper 1: Rethinking how built environments influence subjective well-being: A new conceptual framework

This paper aims to contribute to understanding the role of the built environment in subjective well-being (SWB). A comprehensive theory on how the built environment can influence SWB is missing. The paper presents a new conceptual framework that integrates and links together (Figure 11): (a) different sets of objective and perceived neighborhood characteristics, (b) different perspectives on SWB, and (c) mediating factors that explain how neighborhood characteristics influence SWB. Neighborhood characteristics include urban from (e.g. density, land uses, transport, urban design), perceptions and experiences (e.g. place attachment, perceived safety, aesthetics, neighborliness, liveliness), and sociodemographics (e.g. age, education, household size, income). SWB perspectives are hedonic, life satisfaction, and eudaimonic. The life domains that act as mediating factors between the built environment and SWB are personal relationships, leisure activities, health, and neighborhood impact on emotions and mood. The paper suggests that a "good", "livable", or "high quality" built environment is one that promotes human well-being. A line of thought focused on SWB can offer an interdisciplinary platform for theory building and empirical research involving scholars and practitioners from various fields. The proposed conceptual framework on built environment and SWB can be a new powerful tool for planning and designing livable built environments and for evaluating the social sustainability of planning policies.

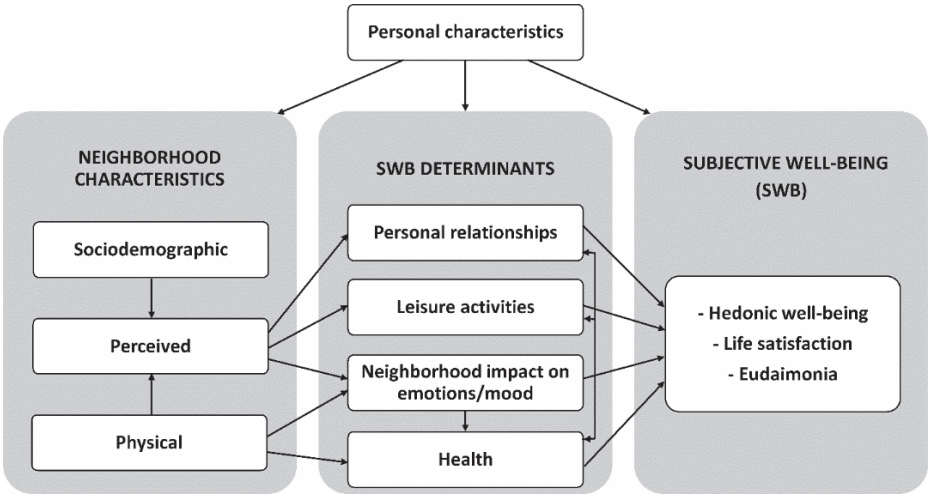


**Figure 11.** New conceptual model developed in Paper 1.

### 5.2. Paper 2: Is compact city livable? The impact of compact versus sprawled neighborhoods on neighborhood satisfaction

Low-density urban forms are often considered more livable than compact ones. Yet, studies investigating the relationship between compact cities and livability often do not take into consideration the importance of public transport, accessibility, and mix of land uses along with high densities. Moreover, direct comparisons of livability between the compact city and its alternative, urban sprawl are scarce, and even more so in a European context. Investigating the metropolitan area of Oslo, which encompasses both compact and sprawled areas, this study examines the impact of the compact city on livability by employing neighborhood satisfaction as a livability measure (Figure 12). Three different methods are used: cross-sectional regression analysis, longitudinal comparisons, and qualitative analysis. Cross-sectional results indicate that compact-city residents are significantly more satisfied with their neighborhood than those who live in sprawled neighborhoods, even after controlling for sociodemographic and other variables. Longitudinal analysis based on residents who have lived in both neighborhood types confirms this finding. Moving from a sprawled neighborhood to a compact one significantly increases neighborhood satisfaction, while moving in the opposite direction does not cause significant changes. This study also examines the impact of compactness within a wider range of urban form typologies and finds that the higher the density, the higher the neighborhood satisfaction. Important components of the compact city – public transport, accessibility to city center, and land use mix – demonstrate a positive association with neighborhood satisfaction. Findings from this study suggest that, when common urban problems are addressed and when planned to integrate all its essential characteristics, the compact city has a positive influence on livability.

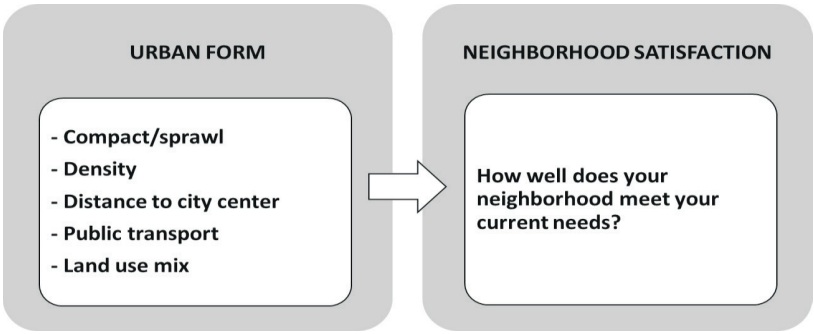


**Figure 12.** Conceptual model for empirical investigations in Paper 2.

### 5.3. Paper 3: Built environment and social well-being: How does urban form affect social life and personal relationships?

Personal relationships are among the most influential factors for achieving a happy life. Yet, there is insufficient empirical evidence on the role of the built environment in social life and personal relationships. This paper investigates how the urban form affects social life and personal relationships by applying structural equation models to survey data collected in Oslo metropolitan area. The paper develops and empirically examines a new theoretical model on urban form and personal relationships satisfaction (Figure 13). Results indicate that residents of compact neighborhoods are significantly more satisfied with their personal relationships compared with residents of low-density suburban neighborhoods. Shorter distances to the city center, higher densities, and mixed land uses are found to positively contribute to overall social well-being. Path analysis as well as qualitative analysis suggest that compact urban forms enable residents to maintain larger networks of close relationships, socialize more frequently with friends and family, receive stronger social support, and enjoy increased opportunities to make new acquaintances. Based on SEM results and qualitative analysis, the fact that social life and personal relationships are facilitated by compactness can be attributed to three factors relevant to its structural characteristics: (1) more people within close proximity due to high density and centrality, (2) higher access to "third places" (community centers, cafés, restaurants etc.), and (3) higher access to and from other areas due to centrality and public transport.

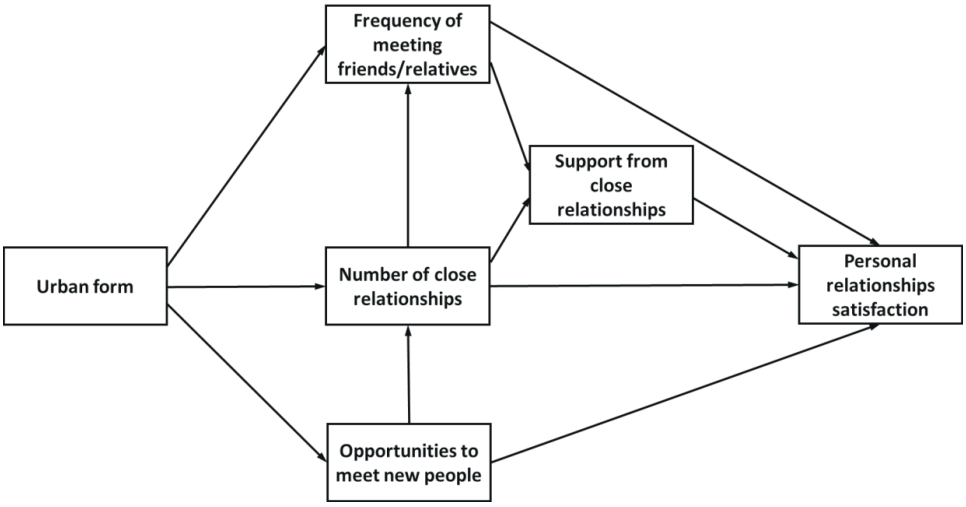


**Figure 13.** New conceptual model developed, applied, and empirically assessed in Paper 3.

### 5.4. Paper 4: Compact city and subjective well-being: The role of urban form in life satisfaction, hedonic well-being, and eudaimonia

Understanding the role of urban form in subjective well-being (SWB) can provide important input to urban planning debates on synergies and conflicts between environmental and social sustainability of cities. Hitherto, there is little empirical evidence on how SWB is shaped by compact or lower-density development. This paper investigates this topic using survey data collected in Oslo metropolitan area. In addition to SWB measures, the paper examines determinants of SWB as intermediate variables between urban form and SWB (Figure 14). Findings suggest that, compared with residents of lower-density neighborhoods, compact-city residents have higher levels of personal relationships satisfaction and perceived physical health, similar levels of leisure activities satisfaction, but also lower emotional response to place and higher levels of anxiety. Potential benefits of the compact city on personal relationships and physical health seem to be at least partially canceled out by lower emotional response to place and increased anxiety. As a result, compactness has nonsignificant associations with life satisfaction, eudaimonia, and happiness. However, when additionally controlling for variables relevant to urban problems – perceived safety, cleanliness, and noise – emotional response becomes more positive and the impact of anxiety diminishes, resulting in a significant positive association of compactness with life satisfaction. This paper's outcomes are encouraging for urban sustainability as they indicate that high-density development does not negatively influence SWB, as often claimed, and that by addressing problems such as fear of crime, litter and noise, it has the potential to promote SWB.

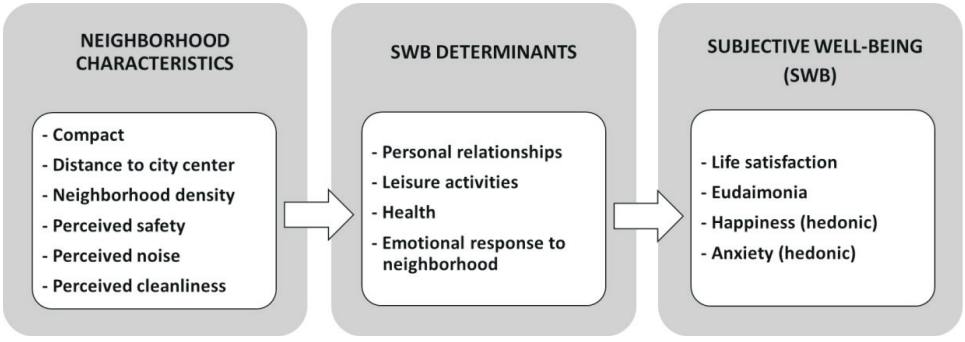


**Figure 14.** Conceptual model for empirical investigations in Paper 4 (adapted from Paper 1).

# 6. Results and discussion

## 6.1. Synthesis of the results

The results of this thesis suggest that neighborhood satisfaction, social well-being and personal relationships satisfaction, and perceived health are all higher in compact areas compared with lower density ones. On the other hand, emotional response to place is lower in compact areas. Leisure activities satisfaction is similar across different types of urban form. Subjective well-being (SWB) measures – life satisfaction, happiness, and eudaimonia – are also found to be similar across different types of urban form, while anxiety is found to be higher in compact areas.

These are relatively positive results for what is widely considered the more environmentally friendly type of urban form, the compact city (e.g. Jabareen, 2006; Meyer, 2013; Newman & Kenworthy, 1999). The results can be viewed as positive for the compact city and also quite surprising considering multiple theoretical and empirical studies suggesting that compact development is detrimental to human well-being. For example, several empirical studies claim that high density has a negative impact on neighborhood satisfaction (Bramley et al., 2009; Cook, 1988; Rodgers, 1981). Several other studies report lower SWB in high-density areas (Churchman, 1999; Cramer et al., 2004; Morrison, 2011; Neuman, 2005; Sirgy, 2012). Prominent theorists have also been very critical of high-density living (Simmel, 1903; Wirth, 1938). However, with the exception of the lower emotional response and the increased levels of anxiety in compact areas, results from Oslo have been nevertheless positive for the compact city. The reasons for this contrast with many previous studies are explained in detail in the empirical papers of this thesis. Overall, the different conclusions arrived at in the present study are due to the differences in urban form and social characteristics between Oslo and case areas of other studies and due to methodological problems in certain studies.

There is a paradox in the quantitative findings of this thesis. The positive impact of compactness on three life domains – neighborhood satisfaction, personal relationships, and perceived health – combined with its neutral impact on leisure, should logically lead to higher SWB in compact areas compared with lower-density ones. However, this is not the case. The higher neighborhood satisfaction in compact areas should be translated into higher life satisfaction according to the neighborhood satisfaction approach (see Section 3.3). The fact that it is not the case could be attributed to the limitations of this measure in capturing all the influence of urban form on SWB, as explained in Paper 1. What is more surprising is that

although the two most significant life domains (in the life domains approach), personal relationships and health, are found higher in compact areas, life satisfaction is similar in compact and lower-density areas.

This paradox could be partially attributed to the lower emotional response to place and higher levels of anxiety in compact areas which altogether might lower life satisfaction. If that is the case, then anxiety could have been alternatively considered as a life domain in the conceptual model developed in Paper 1 and applied in Paper 4, although it is also a measure of SWB. However, even in that case, the positive statistical effect of compactness on life satisfaction through personal relationships and health is much stronger than the negative one through anxiety and emotional response to place, because personal relationships and health are more strongly associated with life satisfaction.

For these reasons, it seems that there is another contributing factor or factors counterbalancing the positive impact of compactness on SWB through the identified life domains. There are two hypotheses on this, as explained in Paper 4. One hypothesis is that certain personality traits and human values which exert a negative influence on SWB might be more prominent on average in compact areas. This hypothesis is based on suggestions that personality traits and human values may differ across geographical locations thus influencing SWB (Ballas & Tranmer, 2012; Jokela et al., 2015; Morrison & Weckroth, 2017). However, we do not know whether there is a causal relationship between urban form and personality or human values, in other words, whether a compact urban environment can cultivate certain personality traits and human values or it is people with certain personalities and values who choose to live in this type of environment. The other hypothesis is that there might be some relevant SWB determinant influenced by the urban form that is not considered in the conceptual framework of Paper 1 or that is not completely captured by the survey questions on the four life domains. One example could be the feelings of connection with nature which can have a positive impact on SWB (Carrus et al., 2015; MacKerron & Mourato, 2013; Raanaas et al., 2012; White et al., 2013) and might not be completely captured by the question on emotional response to place. All these are just hypotheses however and should be further investigated in future research.

Furthermore, another important aspect that arises from the findings of this research is the relationship between the concepts of anxiety, perceived health, and SWB. In accordance with OECD's guidelines on SWB measurement (OECD, 2013), anxiety has been employed as

a measure of the hedonic well-being component of SWB in this thesis and specifically in Paper 4. As already mentioned in Section 1.4, anxiety can also be a measure of mental health, thus it could have been alternatively used as a life domain item related to health. On the other hand, as explained in Paper 4, most residents evaluated their physical health when completing the "perceived health" item of the survey. An attempt to explain this quantitatively is presented in Paper 4, and this interpretation is also supported by the discussions during the qualitative interviews. It is also theoretically justifiable and in line with several previous research studies that physical health, measured here as perceived health, can be enhanced in compact areas due to more active everyday travel (Stevenson et al., 2016; Sturm & Cohen, 2004), while anxiety can also be higher (Lederbogen et al., 2011; Peen et al., 2010) possibly due to environmental stressors and/or residents' personal characteristics (e.g. personality, human values) in denser urban areas.

In addition to comparisons between urban form typologies, this thesis has investigated detailed neighborhood attributes. The empirical findings suggest that some attributes are important for most residents: easy access to facilities and services, public transport, open public spaces, green areas, safety, quietness, cleanliness, and aesthetic quality. Despite attributes that have been examined specifically for certain life domains and are discussed in detail in the empirical papers of the thesis, two attributes have been examined for all life domains and SWB components. These are perceived safety and perceived noise. Results in Paper 4 suggest that when these two attributes are controlled for, SWB increases in compact areas, resulting in similar levels of anxiety between compact and lower density areas and higher life satisfaction in compact areas. Perceived safety is the neighborhood characteristic that is significantly associated with all life domains and SWB perspectives. This indicates that it is one of the most important attributes in urban quality of life. Besides that though, and although perceived safety is certainly important and this has also been supported by several previous studies (e.g. Ettema & Schekkerman, 2016; Won et al., 2016), it might be also associated with some personality trait (or traits) that is connected to SWB, forming a spurious relationship that might inflate its statistical effect on SWB and life domains. However, this is not a serious problem in this thesis since perceived safety is mainly used as a control variable in Papers 2 and 4, where the main independent variables are the physical urban form attributes. Perceived noise, on the other hand, is not associated with neighborhood satisfaction in Paper 2 but is negatively associated with happiness and positively associated with anxiety in Paper 4. Again, it is not clear to what extent its association with hedonic measures of SWB is due to noise itself or due to its

connection with some underlying personality trait. As with perceived safety, this is not a serious problem in this thesis since perceived noise is also mainly used as a control variable. In general, despite not knowing the exact level of their impact, the fact that these perceived attributes demonstrate significant associations with SWB and certain life domains while others do not (e.g. cleanliness) suggests that both safety and noise can play a crucial role in urban quality of life.

Juxtaposing the overall findings of this thesis with the urban theory of the compact city versus urban sprawl presented earlier (see Section 3.2), it seems that when the compact city meets certain criteria, as Oslo does to a large extent, it does not pose any significant negative influence on quality of life. It may also provide important benefits on needs satisfaction, social well-being, and health. These criteria are related to the urban form: high but not extremely high density, mid-rise development, continuous urban fabric, high public transport accessibility, mixed land uses, easy access to green spaces, low car traffic and relatively low noise as a result. And they are also related to the sociodemographic conditions of the city: relatively high social equity, low crime and relatively high perceived safety as a result. However, although compact areas such as the ones in Oslo meet these criteria to a high degree, offer several benefits, and do not pose significant negative influence on quality of life, they still have certain drawbacks. The main drawbacks are that they do not foster such a safe, peaceful, and quiet environment as the one found in many low-density suburbs and that, despite easy access to parks, they are still not felt as close to the natural environment as low-density suburbs are. All these might lead to the lower emotional response to place and higher anxiety found in compact areas of Oslo and the higher occurrence of mental health problems in high-density areas reported in previous studies (Gruebner et al., 2017; Lederbogen et al., 2011; Peen et al., 2010). Nevertheless, further research is needed to investigate whether there exists a causal relationship between compactness and mental health.

### 6.2. Environmental versus social sustainability: synergies and conflicts

The compact city, both as urban form and planning policy, promotes urban environmental sustainability as it is less land-consuming, less resource intense, and less polluting than lower-density urban forms and urban spatial expansion policies (see Section 1.2). Despite evidence on the compact city's environmental benefits being quite compelling, its social sustainability has been contested but has also been much less explored by empirical research. The findings

of this research project contribute to debates on environmental versus social sustainability of cities, by providing a better understanding on the social impacts of the compact city versus urban sprawl. Social sustainability revolves around human well-being and social justice (see Section 1.2). Although this thesis focuses primarily on human well-being, its findings offer to some extent input on social justice as well, as these are interrelated.

Environmental sustainability, through the compact city, has the following *synergies* with the human well-being perspective of social sustainability, when the aforementioned criteria of compact development (see Section 6.1) are met, as it is the case in Oslo. As the results of this thesis suggest, residents' perceived needs are covered to a higher extent (neighborhood satisfaction) in compact areas mainly because of high accessibility to people, facilities and services, public transport, cultural activities, workplaces, and the public realm, provided that there are low levels of urban problems. Different groups of people can benefit from such increased accessibility, for example low-income groups, the elderly, and people with special needs. In this regard, compact urban forms are more socially inclusive than low-density ones. Moreover, compact-city residents' social well-being (measured in the thesis with personal relationships satisfaction) is higher as they are enabled to have more close relationships, socialize more frequently, receive stronger social support, and have more opportunities to make new acquaintances. This higher social well-being is due to more people living in close proximity, higher access to other areas, and more third places. Perceived physical health also seems to be enhanced in compact areas possibly due to higher levels of moderate physical activity such as walking and cycling. Commuting time is shorter on average in compact urban forms of Oslo – as found by another study based on the same dataset (Mouratidis, 2018). This is positive for both environmental sustainability and possibly SWB, although findings of Paper 4 show that there is no significant difference between residents' satisfaction with time available for leisure. Other aspects that could be viewed as positive for urban sustainability, considering the at times idealized suburban setting in this regard, is that the levels of perceived overall aesthetic quality and place attachment are on average similar in higher and lower density areas as shown in Paper 2.

Environmental sustainability, through the compact city, has the following *conflicts* with the human well-being perspective of social sustainability. The thesis' outcomes suggest that even in relatively peaceful cities such as Oslo, fear of crime and noise are higher in compact areas. Although compact development is in general less polluting than low-density development, at a local level air pollution can be higher, with a potential negative influence on

health. Neighbor ties and community spirit at a neighborhood level are higher in less environmentally friendly forms such as sprawled suburbs. The lack of private gardens and the longer distance to natural environments such as nearby forests may contribute to a looser connection with nature for compact city residents depriving them of its important restorative benefits. This, nevertheless, should be further explored because in cities such as Oslo, nature is easily accessible in compact areas since there are parks in every neighborhood and frequent public transport to the forest. The aforementioned attributes of high-density living, combined with excessive stimuli and overcrowding, might lead to less pleasant emotions, higher anxiety levels or other mental health problems – although causality regarding anxiety and mental health should be further investigated. Some of these urban problems such as fear for crime, noise, and lower access to green space could be more prevalent for vulnerable groups as their neighborhoods tend to be more susceptible to these problems and this may induce well-being related inequalities (Gordon-Larsen et al., 2006; Ludwig et al., 2012; Wolch et al., 2014).

All things considered, we can conclude that the perception that the more environmentally sustainable urban forms are not socially sustainable (Neuman, 2005) is not accurate. As understood by the findings of this research as well as by other studies, urban social sustainability largely depends on the context: the demographic, socioeconomic, cultural, political, geographical, as well as built environment characteristics of each case. Besides this, environmental and social sustainability have both synergies and conflicts. It is very important for sustainability that the synergies identified by this research are strong. It seems that if certain problems related to high density are addressed even further, the social sustainability benefits of compactness might outweigh the drawbacks.

### 6.3. Policy implications

The policy implications of the outcomes of this thesis that are discussed in this section focus mostly on the compact city in order to provide practical insights into how to strengthen synergies and mitigate conflicts between environmental and social sustainability. The overall positive outcomes for compact areas of Oslo indicate that these areas can serve as good examples for livable compact development. The findings of this thesis suggest that to enhance human well-being in the compact city, practitioners need to strengthen its benefits while at the same time address fundamental problems associated with high-density.

To *strengthen the benefits* of the compact city, practitioners need to promote high accessibility to people, workplaces, and facilities. To achieve this, a relatively high density is necessary in order to sustain easily accessible and frequent public transport and a high concentration of people, workplaces, and facilities. At the same time, policies should promote public transport provisions and car restrictions to improve mobility and should adopt a mixed land use policy to allow a high concentration of facilities to spread across different areas. The positive impact of accessibility, public transport, facilities, and mixed land uses on quality of life in the compact city is inferred from findings in Papers 2 and 3. Moreover, provisions should be made for open public spaces, such as public squares, in every neighborhood that can attract facilities and also function as meeting points which improve sociality and community spirit.

Practitioners should also *address fundamental problems* of compact cities to the extent possible. As findings from this thesis as well as previous studies suggest these are fear of crime, noise, traffic and pollution, loss of connection with nature, and overcrowding. Although fear of crime depends only to a limited extent on urban form attributes but primarily on social conditions, as far as the physical built environment is concerned measures such as improved lighting during late hours and clean, highly maintained streets and buildings seem to help in that regard. Noise, traffic, and pollution can be addressed to a great extent by car restrictions, development of pedestrian areas, and promotion of walkability and cycling. The loss of connection with nature can be partially countered with ample green spaces in every neighborhood and easy access to surrounding natural environments (if any). Limiting city sizes also plays an important role in providing easier access to surrounding nature. To increase green space without reducing density, the space set aside for cars can be reduced (e.g. parking lots, street lanes) and replaced by trees and green zones. Climbing plants and green roofs can also be used. To address overcrowding, extremely high densities should be avoided and facilities should be to a certain degree spread across different neighborhoods.

### 6.4. Contribution to knowledge

This thesis as a whole has generated systematic theoretical and empirical knowledge that is both original and novel. It has addressed the research gaps and deficiencies presented earlier (Section 1.4). First, it has addressed the lack of *conceptual frameworks* explaining how urban form influences SWB as well as the lack of conceptual frameworks on relationships between urban form and certain life domains. The thesis has developed and empirically assessed two

conceptual frameworks and respective conceptual models: one on urban form and SWB (developed in Paper 1 and applied in Paper 4) and one on urban form and personal relationships satisfaction (developed and applied in Paper 3). These conceptual frameworks enable theoretical discourses and empirical investigations that not only examine associations between the two main elements of interest but also attempt to explain causal mechanisms. This is done with conceptual models that include intermediate factors that help reveal causal pathways and also encourage a mixed-methods research approach.

Second, this thesis has provided *new empirical evidence* that was missing from the field. By using Oslo as case, it has examined physical built environment attributes within distinct urban forms, such as compact and sprawled. Empirical studies that examine cases which include such forms comprehensively within the same city region are scarce. For example, although there are many studies on urban form and neighborhood satisfaction, very few examine cases that include such diverse urban forms. Paper 2 covers this gap by providing new empirical knowledge in that regard. Moreover, there is little empirical evidence on the impact of compact versus low-density urban forms on overall SWB. Empirical investigations that examine relevant causal pathways are even rarer. In addition, previous studies mostly focus on life satisfaction, while the hedonic and especially the eudaimonic perspectives on SWB are overlooked. This thesis covers all these gaps in knowledge in Paper 4. Finally, there is very limited empirical evidence on the influence of urban form on certain life domains: personal relationships, leisure activities, and emotional response to place. This thesis provides new empirical insights into these life domains in Papers 3 and 4. Paper 3, in specific, deeply investigates personal relationships which is one of the most important life domains of SWB, previously understudied for its relation to urban form.

Third, this thesis has employed a different *methodological strategy* from what is commonly adopted in relevant empirical studies. Most studies use cross-sectional regression approaches in their analysis. This thesis employs a mixed-methods strategy with both quantitative and qualitative methods. It therefore provides new qualitative insights into urban quality of life and attempts to stimulate future mixed-methods research in this field. This thesis also employs diverse quantitative methods that are not commonly used in previous studies and provide more holistic dimensions to the study of this topic. Longitudinal comparisons used in Paper 2 provide meaningful output and stronger indications on causality. By using structural equation modeling, Paper 3 explores causal pathways and develops and assesses the theoretical model on urban form and personal relationships.

By addressing all these gaps and deficiencies, this thesis contributes to scientific knowledge as well as to society. Its *scientific contribution* is that it has provided a better understanding of the relationship between urban form and SWB and a better understanding of the relationship between urban form and relevant life domains. Thereby, it has also contributed to debates on the compact city, sprawl, and human well-being and therefore to debates on environmental and social sustainability of urban development. The *societal contribution* of the thesis is the input that it provides for planners, designers, and policymakers on how to enhance quality of life in cities. Specifically regarding sustainable development, the knowledge produced in this thesis can be used to enhance quality of life in compact cities.

### 6.5. Limitations and future research

As the topic of this thesis is broad and complex, there exist certain limitations and needs for future research. To begin with, the relationship between urban form and human well-being could be explored using more "objective" indicators of human well-being in conjunction with the subjective ones used in this thesis. More objective assessments could be related to aspects such as human rights, healthcare and life expectancy, freedom, pollution, education, employment, income and expenses, and other basic needs. As SWB is significantly moderated by genetics and personality and is also quite adaptive to external conditions after a certain point in time (Diener, 2009), it could be cumbersome to evaluate planning policies solely using subjective measures. Despite meaningful findings with regard to several life domains and certain SWB measures in this thesis, the impact of urban form on some SWB measures (eudaimonia and happiness) seems to be relatively small. Therefore, a combination of life domains, SWB, social justice, and other more objective quality of life measures can provide an even more holistic picture of social sustainability.

As this thesis relies on data from a single city region, its findings do not necessarily represent other urban environments and other sociocultural backgrounds. Further research could explore other city sizes, urban form typologies, and sociocultural backgrounds. Moreover, although the collected sample covers several neighborhoods, urban form types, and sociodemographic conditions, it does not cover the relatively new compact neighborhoods of Oslo such as Sørenga, Løren, and Tjuvholmen. It would be interesting for future research to investigate such new compact areas and draw comparisons with traditional compact areas.

Moreover, the obtained data themselves and the subsequent analyses present certain limitations. Perceived neighborhood attributes, life domains, and SWB could have been obtained with a greater variety of measures to increase reliability and internal validity. Data on personality traits and human values could have been additionally collected and used as control variables in quantitative analyses. More interviews could have been conducted that might produce further insights into causal mechanisms and further longitudinal data, examining individuals before and after moving instead of using retrospective statements, could have provided stronger evidence on causality. Although the investigations on neighborhood satisfaction and personal relationships (Papers 2 and 3) are deep and provide strong support for causality, further research should be done on other aspects examined in this thesis such as leisure activities satisfaction, emotional response to place, and more importantly anxiety and mental well-being, which appear to be significant concerns in compact cities. Future research should investigate whether there exists a causal relationship between density and anxiety or mental well-being and look into causal mechanisms. More knowledge is needed on whether and to what extent it is the physical built environment that is causing higher levels of anxiety and mental health issues in high-density areas or this is due to the kind of people that choose to live in high-density areas (e.g. if it is due to different personalities, values, life expectations, or economic worries). Furthermore, the conceptual model on urban form and SWB could be further developed and more life domains could be explored as intermediate factors. Finally yet importantly, it should be acknowledged that this thesis has not investigated aspects such as housing satisfaction, travel satisfaction and feelings while traveling, and detailed design elements such as detailed building morphology, architectural styles, street design and typology, and design of private green space, public parks and public squares. Such investigations could provide additional important insights into urban quality of life in future research.

# 7. Conclusions

This thesis has provided answers to three overall research questions. (1) It has contributed to the conceptualization of the influence of urban form on subjective well-being (SWB) with new theories that were missing from the field. It has developed, applied, and assessed a *new theory on urban form and SWB*. According to this theory, urban form attributes, perceived built environment attributes, and sociodemographic characteristics influence certain life domains (personal relationships, leisure activities, health, and neighborhood impact on emotions and mood) which in turn influence SWB measures (life satisfaction, hedonic well-being, and eudaimonia). It has also developed, applied, and assessed a *new theory on urban form and personal relationships*, which is a major life domain of SWB that had been previously understudied for its relation to urban form. According to this theory, urban form attributes can influence opportunities to meet new people, the number of close relationships, and the frequency of meeting friends and relatives, all of which in turn influence personal relationships satisfaction. The number of close relationships and the frequency of meeting friends and relatives additionally influence personal relationships satisfaction through their impact on support from close relationships.

(2) The thesis has also provided new empirical knowledge on the influence of urban form on relevant life domains. The empirical findings have been based on a survey and interviews conducted for the purposes of this research project in the metropolitan area of Oslo. One life domain that has been investigated is *neighborhood satisfaction*. Previous investigations of neighborhood satisfaction within typical compact versus typical sprawled forms had been scarce. Compact-city residents are found to be significantly more satisfied with their neighborhood compared with residents of sprawled suburbs. Longitudinal results also suggest that moving from a sprawled neighborhood to a compact one significantly increases neighborhood satisfaction, while moving in the opposite direction does not cause significant changes. When examining the impact of compactness within a wider range of urban form typologies, findings suggest that the higher the presence of compact-city characteristics the higher the neighborhood satisfaction. Population density has a positive association with neighborhood satisfaction, as densely populated areas offer easy access to amenities, to public transport and to other areas. The higher neighborhood satisfaction in Oslo's compact areas seems to be based on their high accessibility benefits along with the limited presence of fundamental problems usually found in compact cities such as fear of crime, traffic, noise, lack

of green space, litter, and social inequalities. The other life domain that has been deeply investigated is *personal relationships*. There had been very little previous empirical evidence on urban form and overall personal relationships, since most studies have been focusing on neighbor ties. The new theory developed on this topic has been applied and assessed empirically. The theoretical model is found to successfully fit the data. Compact-city residents are found to be significantly more satisfied with their personal relationships compared with residents of sprawled suburbs. Results suggest that compact-city residents are enabled to have larger networks of close relationships, more active social life, stronger social support, and more opportunities to meet new people. Shorter distances to other areas, higher densities, and mixed land uses seem to facilitate social life and improve personal relationships. The thesis has also provided new empirical evidence on urban form and *perceived physical health*, *leisure activities satisfaction*, and *emotional response to place*. Previous empirical findings on the latter two had been scarce. The results suggest that compactness is positively associated with perceived physical health, negatively associated with emotional response to place, while it is not significantly associated with leisure activities satisfaction.

(3) The thesis has also contributed to knowledge by providing new empirical findings on urban form and the different components of SWB. There had been little empirical evidence on how SWB is shaped by compact or lower-density development. Findings from this thesis suggest that *life satisfaction*, *eudaimonia*, and *happiness* are similar in compact and lower-density neighborhoods. However, *anxiety* is found to be higher in compact neighborhoods. The higher anxiety along with the lower emotional response to place and some other contributing factor (different personality traits, human values, life expectations, economic worries in compact areas, or some other life domain that is not considered in the analysis) altogether seem to counterbalance the positive impact of urban form on SWB through personal relationships and perceived health. These outcomes are encouraging for urban sustainability as they indicate that high-density development does not negatively influence SWB (apart from a possible impact on anxiety) as it is often considered. Further results also suggest that if urban problems related to fear of crime, litter, and noise are mitigated to an even higher extent, the compact city has the potential to promote overall SWB.

This thesis has addressed these main research questions and covered several research gaps and deficiencies by providing new theory and new empirical evidence. The thesis contributes to scientific knowledge as well as to society. Its scientific contribution is that it has provided new systematic knowledge on the relationship between urban form and SWB and the

relationship between urban form and relevant life domains. Thereby, it has also contributed to debates on the compact city, sprawl, and human well-being and therefore to debates on environmental and social sustainability of urban development. The societal contribution of the thesis is the input that it provides for practitioners and policymakers on how to enhance quality of life in cities. In response to the goal of sustainable urban development, the knowledge produced in this thesis can be used to enhance quality of life in compact cities.

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# Papers

# Paper 1

# Rethinking how built environments influence subjective well-being: A new conceptual framework

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**Abstract**

This paper aims to contribute to understanding the role of the built environment in subjective well-being (SWB). The paper presents a new conceptual framework that integrates and links together: (a) different sets of objective and perceived neighborhood characteristics, (b) different perspectives on SWB – hedonic, life satisfaction, and eudaimonic, and (c) mediating factors that explain how neighborhood characteristics influence SWB. These mediating factors are personal relationships, leisure activities, health, and neighborhood impact on emotions and mood. SWB can be a new powerful tool for planning and designing livable built environments and for evaluating the social sustainability of planning policies.

**Keywords**

urban planning; sustainability; happiness; livable; city; quality of life

**Publication status**

Mouratidis, K. (2018). Rethinking how built environments influence subjective well-being: A new conceptual framework. *Journal of Urbanism: International Research on Placemaking and Urban Sustainability, 11*(1), 24-40.

## 1. Introduction

The objective of this article is to offer a new conceptual framework that explains how the neighborhood built environment influences subjective well-being (SWB). Urbanization combined with global population growth is expected to add 2.5 billion urban residents by 2050 (United Nations, 2015). The number of mega-cities is increasing and many small cities are growing rapidly. As urban populations continue to grow, rural populations are expected to decrease. At the same time, migration flows alter the sociocultural composition of cities. All these changes highlight the need to focus on how cities will adapt to subsequent environmental and social challenges. One of the most important social challenges that cities face is to maintain or improve quality of life of their residents. Enriching people's lives is one of the goals of urban planning (American Planning Association, n.d.; Myers, 1988) and quality of life and happiness have emerged as important goals among policy makers in urban planning (Thin, 2012).

Quality of life, well-being, and happiness are concepts that are being used interchangeably (Veenhoven, 2012) and can be assessed using objective or subjective indicators (Okulicz-Kozaryn, 2013; Sirgy, 2012). Subjective measurement of quality of life is usually accomplished using SWB, a cognitive and affective personal evaluation of one's life (Diener, 2000). The most prevalent way to measure SWB is by using questions on life satisfaction. SWB indicators allow us to understand how people feel about their lives and what they consider important. Nobel laurates Joseph Stiglitz and Amartya Sen urged governments to consider subjective measures of well-being in parallel with traditional economic and social measures (Stiglitz et al., 2009). SWB usage for public policy has also been strongly supported by various prominent scholars (Diener, 2009; Dolan & White, 2007; Stutzer & Frey, 2010). Thus, SWB usage for public policy has been rapidly increasing. SWB is being measured nationally by several countries such as Australia, Bhutan, Canada France, Italy, the Netherlands, Thailand, United Kingdom, and United States and is also being measured at an international level (e.g. worldwide Gallup surveys, European Social Surveys). Such is the current importance of SWB for public policy that the Organization for Economic Co-operation and Development (OECD) has recently published extensive guidelines solely focusing on SWB measurement (OECD, 2013). Guidelines for SWB measurement have also been published by national governments such as United Kingdom (Dolan & Metcalfe, 2011).

Using results from SWB measurements, researchers have been investigating associations between SWB and aspects such as health, income, and personal relationships. The

built environment is found to be an important predictor of subjective measures of well-being (Davis & Fine-Davis, 1991; Headey, 1981; Morrison, 2007; Pacione, 2003). To respond to challenges presented by urban population changes, it is crucial to investigate how the built environment influences SWB and then develop or adapt cities accordingly.

A very common approach to studies related to the built environment is to examine it at a neighborhood level within metropolitan areas. A neighborhood is a geographical area that lies between the micro level of a dwelling and the macro level of a city or region. Neighborhood-level focus has been key to the field of urban planning since its early creation (Sharifi, 2016) and research shows that neighborhood planning is important for SWB (Farrell et al., 2004; Kyttä et al., 2016; Sirgy & Cornwell, 2002). The neighborhood level is widely used as the scale addressed in public policy making, in urban planning research, and in many related disciplines such as public health (e.g. Diez Roux, 2001), child psychology (e.g. Dupéré et al., 2010), environmental psychology (e.g. Hanyu, 2000), and urban sociology (e.g. Sampson et al., 2002). The neighborhood level is often the preferred option in urban studies because neighborhoods can be selected to present homogeneity in characteristics of interest. This allows detailed comparisons between areas with different characteristics in research related to urban planning. The neighborhood scale also allows meaningful comparisons within the same geographical and cultural context.

Several previous theories exist on how cities influence aspects relevant to SWB from the field of urban sociology (Fischer, 1973, 1975, 1977; Simmel, 1903; Wirth, 1938) and research has been examining the effect of city life on happiness (Lederbogen et al., 2011; Okulicz-Kozaryn, 2015; Okulicz-Kozaryn & Mazelis, 2016). This literature suggests that living in big cities negatively affects quality of life and makes people less happy. However, since more and more people are living in cities, theories from the field of urban planning and urban design have been focusing on how to make cities more livable (Alexander et al., 1977; Carmona et al., 2003; Duany et al., 2010; Gehl, 2013; Jacobs, 1961). Other theoretical works have been focusing on how specific types of urban development, such as urban sprawl, affect quality of life (e.g. Kunstler, 1994). Researchers have also been comparing happiness between different cities (Ballas, 2013; Cloutier et al., 2013; Leyden et al., 2011).

Yet, theories that systematically focus on the relationship of the built environment and SWB at a neighborhood level are scarce and insufficient. Neighborhood-level theories can be used for empirical studies related to urban planning issues in order to deeply examine urban

environmental characteristics and their effect on SWB. Such an approach can aid our endeavors to plan and design happy cities (Montgomery, 2013) and can contribute to urban sustainability since SWB is part of social sustainability (Kyttä et al., 2016). The most relevant theoretical works are the conceptual models of Marans and Rodgers (1975) and Campbell et al. (1976). However, these conceptual models do not explain how and why neighborhood characteristics may influence SWB and they do not consider all aspects of SWB. These models as well as subsequent empirical studies are characterized by important conceptual and methodological weaknesses which will be analyzed in detail in the following section.

There is a need for a theory on built environments and SWB that focuses on a neighborhood level, includes all neighborhood characteristics and all SWB perspectives, and, most importantly, explains how these neighborhood characteristics may influence SWB. This paper contributes to knowledge by developing a new conceptual framework that aims to cover this need. The relationship between neighborhood planning and SWB is complex and indirect. Therefore, instead of simply focusing on identifying correlations between neighborhood characteristics and SWB, we need to unveil the underlying mechanisms that mediate this relationship. We also need to include all the dimensions of neighborhood characteristics and all the dimensions of SWB to achieve a more holistic and accurate portrayal of the phenomenon.

In accordance with these considerations, the framework presented here integrates and links together: (a) all potentially influential neighborhood characteristics, (b) all dimensions of SWB, and (c) mediating factors (SWB determinants) that explain how neighborhood characteristics influence SWB. Understanding the role of neighborhood built environments in SWB is essential in order to clarify vague ideas about what is a livable built environment or a space of high environmental quality. This paper emphasizes that such a space is one that promotes SWB (along with other widely accepted values such as freedom, justice, and environmental sustainability), one of the most important life goals across all different cultures (Diener & Oishi, 2006; Diener & Scollon, 2003).

The need for new conceptual foundations is explained in the next section. Then the new conceptual framework is presented and its benefits, limitations, and methodological implications are discussed. The last section discusses conclusions.

## 2. The need for new conceptual foundations

The wider literature that evaluates the quality of the built environment at a neighborhood scale focuses on neighborhood satisfaction. In particular, the majority of studies quantitatively assess the impact of neighborhood characteristics on neighborhood satisfaction (Buys & Miller, 2012; Howley et al., 2009; Hur & Morrow-Jones, 2008; Hur et al., 2010; Lovejoy et al., 2010; Yang, 2008). The logic behind the focus on neighborhood satisfaction is that it is an important component of life satisfaction along with satisfaction with work, social life, and health among others. Thereby, neighborhood characteristics that improve neighborhood satisfaction promote life satisfaction and thus a part of overall SWB – since life satisfaction is a component of SWB.

There have also been attempts to link neighborhood characteristics with life satisfaction. Sirgy and Cornwell (2002) develop and test a model connecting satisfaction with groups of neighborhood characteristics with life satisfaction. A second attempt (Cao, 2016) builds on the theoretical model of Campbell et al. (1976) and links neighborhood design characteristics with residential satisfaction (term used here interchangeably with neighborhood satisfaction) and subsequently life satisfaction. Cao very accurately points out that previous studies in the field fail to reveal causal mechanisms behind this relationship. However, by using solely neighborhood satisfaction as a mediator between neighborhood characteristics and life satisfaction, his study also encounters challenges in explaining causalities.

All this literature is characterized by common theoretical and methodological problems as well as knowledge gaps. This paper argues that the importance of these problems and knowledge gaps raises doubts over the suitability of the dominant line of thought for studying the environmental quality of built spaces. Here are the identified issues.

First, there is a problem using neighborhood satisfaction as a mediating factor between neighborhood and SWB. A neighborhood has a wide range of different characteristics influencing one's life in various direct and indirect ways. Residents may not consider a variety of life aspects, such as social life or health, influenced by the neighborhood's location and internal characteristics. They may not be aware of the enabling or constraining role of the built environment in their SWB and therefore their evaluations of neighborhood satisfaction may not adequately capture the influence of neighborhoods on SWB. Of course, neighborhood satisfaction is a useful indicator to obtain a general idea of residents' perception about a neighborhood but empirical studies should not restrict themselves only to this concept. As Hur and Morrow-Jones (2008) also observe in the discussion of their results, a more complex

approach is necessary for future studies. The few empirical studies that have focused on the relationship between neighborhood characteristics and SWB use neighborhood satisfaction as a mediating variable (Cao, 2016; Sirgy & Cornwell, 2002) or no mediating variables at all (Kyttä et al., 2016). Hence, they cannot strongly support causality nor explain the causal mechanisms behind the examined relationships.

The relationship between neighborhood characteristics and SWB is indirect. Let us consider neighborhood characteristics as X and SWB as Z. To support causality in quantitative cross-sectional research, we need to offer explanations on why and how X affects Z. In-between this relationship there exist several life aspects (Y) such as activities or personal relationships. These life aspects are the ones directly influenced by the built environment and in turn contribute to SWB. They are the mediating factors between neighborhood characteristics and SWB. The present paper argues that these life aspects constitute the explanations of the role of the built environment in SWB. Researchers must consider them in order to understand causal mechanisms behind the examined relationships. This way, they can generate an accurate portrayal of the phenomenon and provide meaningful recommendations for planning practices.

Something that also hinders identification and understanding of causality on how neighborhood planning influences SWB is the lack of qualitative studies. Almost all relevant studies are based only on quantitative data and analysis. There are few exceptions such as Mitrany's (2005) study that integrates qualitative material into an analysis on density and neighborhood satisfaction. Qualitative studies are necessary to support and explain causal relationships in urban planning related research (Næss, 2016) and especially since it is challenging to conduct longitudinal studies in this field. Regarding built environments and SWB, qualitative studies are essential to obtain insights into what are the mediating life aspects, how the built environment influences them, and how strong this influence is.

Another knowledge gap is the absence of other dimensions of SWB in previous studies and most notably the affective part that is a constituent in the basic definition of SWB. As stated above, there is no conceptual framework explaining how neighborhood characteristics can influence SWB in all its dimensions. The only relevant frameworks (Campbell et al., 1976; Marans & Rodgers, 1975) link – but do not explain – neighborhood characteristics with a cognitive dimension of SWB, life satisfaction. The importance of investigating all the dimensions of SWB is discussed in the next section. The absence of the affective part of SWB in previous studies leads to a lack of knowledge in two aspects: (a) the influence of

neighborhood characteristics on emotions and mood (affect) and (b) the importance of this interaction on the overall affect (or hedonic well-being) and overall SWB.

A final and equally important point is that many of the studies omit certain neighborhood characteristics that can be very influential. One common omission is the location of the respondent's residence in relation to other areas; for example nearby neighborhoods, facilities, the city center, and natural areas. Another frequent gap is missing data related to transport and travel. The location of a residence and the used transport modes can influence travel distances and accessibility to facilities and workplaces (Næss, 2003, 2006) and subsequently opportunities for leisure activities and social life. This way they can have an important impact on the residents' SWB. To accurately evaluate the quality of built environments, these characteristics must be considered in addition to other physical and sociodemographic characteristics of neighborhoods.

In conclusion, despite the existence of closely related theories and empirical studies, there is still a general lack of understanding of the complex relationship between neighborhood characteristics and SWB. Relevant literature does not examine sufficiently and systematically how such characteristics influence SWB. There is a need for a theory that does this, and therefore provides the necessary foundations for empirical investigations.

## 3. Developing a new conceptual framework

To respond to this need, the present study embraces a holistic approach to the relationship between neighborhood characteristics and SWB and aims to establish a framework that:

- Includes all the potentially influential neighborhood characteristics
- Focuses on all dimensions of SWB
- Explains how neighborhood characteristics influence SWB using mediating factors (SWB determinants)

### *3.1. SWB measures*

The latest dominant trend in SWB empirical research is to distinguish between three types of SWB measures that correspond to different philosophical viewpoints. SWB measures are categorized as: (a) hedonic, (b) life satisfaction, and (c) eudaimonic. These are the three

elements of SWB according to OECD's recent guidelines on SWB measurement (OECD, 2013). The distinction has also been recommended by several scholars in quality of life research (e.g. Sirgy, 2012). These three measures have been used in the largest SWB surveys such as the European Social Survey (2012) and the worldwide Gallup survey on SWB and have been recommended by guidelines for relevant national studies (Dolan & Metcalfe, 2011). The present paper suggests that research focusing on built environments and SWB may benefit from incorporating all hedonic well-being, life satisfaction, and eudaimonia in their studies. Since these three views have distinct differences, it will be interesting to see if, and how, they are affected by built environments in different ways.

According to OECD (2013) guidelines on measuring SWB, its three components are defined as:

- Hedonic well-being / affect: "a person's feelings or emotional states, typically measured with reference to a particular point in time."
- Life satisfaction / life evaluation: "reflective assessment on a person's life or some specific aspect of it."
- Eudaimonia: "a sense of meaning and purpose in life, or good psychological functioning."

Although SWB as a term is relatively new, the concepts that it encompasses have been around since ancient times. People have always been wondering and philosophizing what happiness is and how it can be achieved. A major debate on this subject is the Aristotelian eudaimonic view versus the Epicurean hedonistic one. Similarly, Graham (2012) indicates the debate between the Aristotelian versus the Benthamite perspective since Jeremy Bentham was heavily influenced by Epicurus' hedonism.

According to Aristotle, the desired life is that of eudaimonia as opposed to just living well. A eudaimonic life is a fulfilling and meaningful life, a life where one takes advantage of her rational capabilities and develops aretēs (Greek word for virtues). To achieve eudaimonia, Aristotle claimed that one may experience painful and difficult situations along the way. On the other hand, Epicurus suggested that the desired life for an individual is characterized by absence of pain, maximization of pleasure, and inner tranquility (ataraxia). Epicurus' viewpoint constitutes what we call hedonic well-being. Like Aristotle, he rejected the importance of wealth, power, and reputation to happiness. Epicurus did not consider Aristotle's virtues as

unimportant. He suggested that virtues are a means that leads to the desired life, but they are not the end goal.

Notable theories of modern times have also tried to identify what is the desired and meaningful life. Maslow (1943) with his Hierarchy of Needs suggested that the ultimate goal in one's life is self-actualization – a view similar to Aristotle's. In order to achieve this, however, one must cover four other basic groups of needs beforehand. Expanding the views of Aristotle and Maslow which contrast with hedonistic life purposes, Ryff (1989) proposes a concept for a meaningful life that she names psychological well-being. This consists of six main components: self-acceptance, personal growth, purpose in life, environmental mastery, autonomy, and positive relations with others.

The other perspective on SWB that has been widely used in research studies is that of life satisfaction (Erdogan et al., 2012). Life satisfaction is a way to cognitively assess one's life usually by evaluating several different domains such as personal relationships, work, income, health, and residence.

Contemporary philosophers and psychologists also make distinctions of SWB between hedonic well-being, life satisfaction, and eudaimonia. Haybron (2000) makes the distinction between psychological happiness (hedonic well-being), prudential happiness (life satisfaction), and perfectionist happiness (eudaimonia). Sirgy (2012) also agrees with this distinction in his book about subjective quality of life. Seligman (2002) makes a very similar categorization of the pleasant life, the engaged life, and the meaningful life. A pleasant life seems in accordance with the hedonic philosophical views of Epicurus and Bentham. An engaged life seems in accordance with a satisfying life; where, besides feelings of pleasure, one feels satisfied with all aspects of life. A meaningful life is close to the eudaimonic views of Aristotle, Maslow, and Ryff.

In survey research, hedonic well-being is assessed with questions about positive and negative affect (emotions and mood), life satisfaction with questions about how satisfied one is with life as a whole, and eudaimonia with questions about how meaningful one's life is or how worthwhile things in life are. Hedonic measures of SWB are related to the affective part of the brain and are concerned with reactions to certain stimuli. These reactions occur without cognition – thinking and awareness – and are expressed with positive and negative emotions and the experience of pleasure or displeasure. In contrast, life satisfaction and eudaimonia are cognitive evaluations of SWB and this is why there could be some overlap in responses to

relevant questions. For example, one that feels satisfied with life may also feel that this is a meaningful life or the opposite. But this is not always the case. One may feel satisfied with all the domains in life but may be unable to find a meaning and purpose. Or one may experience a meaningful life because of certain fulfilling activities but may be dissatisfied with some life domains. Therefore, as suggested by current theory and practice, it is still very useful to assess all different viewpoints in SWB-related research.

### *3.2. Neighborhood characteristics*

This framework categorizes neighborhood characteristics that can influence SWB as objective – physical and sociodemographic – and perceived (Table 1). Physical characteristics can be internal (e.g. density, land uses) and external (e.g. distances to other parts of the city). As supported by psychology and social science, a person's experience of a certain environmental attribute is based on perception. This study suggests that physical and sociodemographic neighborhood characteristics shape perceived characteristics such as perception of aesthetics, safety, opportunities for social life and leisure activities, and travel among others. These perceived characteristics subsequently influence various SWB determinants.

However, in contrast with the conceptual models of Marans and Rodgers (1975) and Campbell et al. (1976) where only perceived characteristics influence life satisfaction via neighborhood satisfaction, there are examples of objective characteristics that can directly influence SWB determinants without the interference of perception. These are characteristics related to environmental pollution, for example noise and air pollution. They can directly influence emotions and mood as well as physical and mental health. Of course, very often these characteristics are perceived as well.

Table 1 includes sociodemographic characteristics of the neighborhood and personal characteristics. The former is about the composition of age, income, occupation etc. within a neighborhood and the latter about age, income, occupation etc. of a specific person or persons whose SWB we are focusing on. Similarly to previous conceptual models, personal characteristics influence perceptions of neighborhood characteristics (e.g. a poor person living in a rich neighborhood), SWB determinants (e.g. age impact on health), and SWB (e.g. unemployment negatively affects SWB). In addition, it should be noted that personal aspirations also play a role in how we evaluate neighborhood characteristics, SWB determinants, and SWB.

It is crucial to consider all sets of neighborhood characteristics and the relationships between them when trying to understand their effect on SWB. As already discussed, strictly focusing on one type or another may lead to false assumptions and conclusions.

**Table 1.** Personal and neighborhood (physical, sociodemographic, and perceived) characteristics.

| Physical characteristics | Sociodemographic / Personal characteristics | Perceived characteristics |
|---|---|---|
| Population density | Age | Opportunities for leisure |
| Land uses | Gender | Opportunities to meet new people |
| Facilities/services | Citizenship | Proximity to friends/relatives |
| Public transport | Household size | Perceived safety |
| Location of residence/travel distances to other parts | Living with spouse/partner | Aesthetic quality |
| Street network pattern | Number of children in household | Experienced travel to work/leisure/facilities |
| Street connectivity | Education | Liveliness |
| Street design | Occupation | Neighborliness |
| Building typology | Household income | Place attachment |
| Building morphology | Time living in neighborhood/city | Sense of community in neighborhood |
| Building design | Car ownership/usage | Neighborhood reputation |
| Green areas | | Neighborhood diversity |
| Public squares | | Encourages walking/biking |
| Noise | | |
| Air pollution | | |
| Traffic in neighborhood and connecting roads | | |

### *3.3. How can neighborhood characteristics influence SWB?*

These neighborhood characteristics can influence SWB in different ways. They can influence various aspects of life that are important for overall SWB. It is necessary to identify these life aspects (SWB determinants) and include them in relevant studies in order to unveil why certain urban planning practices may enable or hinder SWB and make suggestions on causalities from empirical results. Let us consider an example of studying the impact of two neighborhoods on SWB. One neighborhood may positively influence certain SWB determinants such as leisure activities and negatively influence others such as health. And another neighborhood may have a different impact on these aspects. However, the total final outcome on overall SWB may be accidentally similar. Without knowing the impact on these SWB determinants, using this study for purposes of planning and policy making would be challenging. On the other hand, if these SWB determinants are considered in the study, appropriate corrective measures can be recommended. They will aim to improve negatively influenced SWB determinants in these or other similar neighborhoods and therefore promote overall SWB in both types of neighborhoods.

This framework considers the SWB determinants that are influenced by neighborhood planning as: (1) personal relationships, (2) leisure activities, (3) neighborhood impact on emotions and mood, and (4) health. Personal relationships, leisure activities, and health are selected among the life domains that contribute to SWB (see e.g. Caldera Sánchez & Tassot, 2014; Ngamaba, 2016; Sirgy, 2012; WHOQOL, 1998). Neighborhood impact on emotions and mood is selected since it can obviously contribute to overall hedonic well-being but might also influence the other two SWB dimensions. Of course, there are other important determinants of SWB such as job satisfaction but are not considerably influenced by neighborhood planning. There is sufficient evidence to suggest that the selected four SWB determinants are influenced by neighborhood planning. Empirical studies show that neighborhood planning has a significant impact on personal relationships (Cabrera & Najarian, 2013; Leyden, 2003; Lund, 2003; Podobnik, 2002; Wood et al., 2008), on leisure activities (Handy et al., 2002; Handy et al., 2008; Lee & Moudon, 2008), on emotions and mood (Hanyu, 2000; Lederbogen et al., 2011; Zhang & Lin, 2011), and on health (Barton, 2009; Næss, 2014; Sturm & Cohen, 2004).

This paper develops and presents a conceptual model showing the possible causal relationships between physical, sociodemographic, and perceived characteristics of neighborhoods, the four SWB determinants, and the three dimensions of SWB (Figure 1). Let

us examine how the four SWB determinants mediate the relationship between neighborhood characteristics and SWB:

(1) Personal relationships are probably the most influential factor for a happy life (Diener & Seligman, 2002; Myers & Diener, 1995; Robinson & Martin, 2008; Vaillant, 2002). Theory suggests that measures such as ones that promote walkability and liveliness in neighborhoods may lead to better social life and potentially more opportunities for strong personal relationships. Research in urban design has provided important insights on how public spaces should be designed to promote social life (e.g. Carmona et al., 2003). From a more general planning perspective, it is suggested that high density, mixed land uses, high street connectivity, and transit-oriented development can promote social life in cities. On the other hand extremely dense areas with high-rise buildings are thought to contribute to loneliness, fear of crime, and lower community spirit (Gifford, 2007). To gain clearer and more concrete knowledge on this topic, it seems essential to empirically investigate how planning practices influence social life and personal relationships and what is the importance of this influence to overall SWB. We must understand why and how physical and sociodemographic neighborhood characteristics create opportunities for socializing, for making new acquaintances or finding a partner. In addition to this, we need to understand why and how neighborhoods enable or hinder opportunities to interact with existing friends, family, or partners.

(2) Leisure activities are all the activities performed during time away from work, education, housekeeping, eating, and sleeping. They are activities that people do for pleasure or personal growth, therefore influencing SWB. Examples of leisure activities that could be influenced by the place where one lives are physical exercise and sports, cultural activities, hobbies, nature visits, and short trips. But not all leisure activities have a positive effect on SWB. There could be activities that have a neutral or even negative effect on someone's SWB, but are pursued because of the absence of opportunities for favorite leisure activities in close proximity. The availability, quality, and accessibility of options in close proximity can have a considerable impact on which leisure activities residents pursue. Another important factor that should not be neglected is the proximity to non-recreational facilities (e.g. healthcare, commercial) and workplaces. The less accessible these places are, the more time residents spend on traveling and the less time remains for leisure activities.

(3) Neighborhood planning can also have an impact on emotions and mood. Built environments may cause negative emotions when they are unsafe, isolated, impersonal,

extremely noisy, or considered of poor reputation. They can also cause negative emotions when excessive travel time is needed to reach destinations or when travel conditions are not the ones desired. Negative affective reactions may be additionally created when one feels that the necessary services and facilities for everyday purposes or for emergency purposes (e.g. health, security) are not in close proximity. On the other hand, built environments may create positive emotions when they are characterized by high aesthetic quality, when they integrate elements of nature such as trees and flowers, when they promote good neighbor relations and community spirit, or when interesting events occur in them. Place attachment may also play a role in emotions and mood (Low & Altman, 1992). Places that people are positively attached to tend to create a feeling of familiarity and contribute to a pleasant mood; whereas new unfamiliar places could make people feel estranged or stressed.

(4) Among these four SWB determinants, health is probably the only one widely studied for its relation to the built environment (see e.g. O'Campo et al., 2009; Renalds et al., 2010). Neighborhood environments can directly influence physical and mental health via air pollution and noise. Accessibility to healthcare facilities can also play a role in good health. Besides, neighborhood environments can influence health indirectly in many ways. Emotions and mood changes caused by the built environment can have an impact on health. They could be either positive (e.g. beautiful surroundings) or negative (e.g. stressful atmospheres). Isolated places or dense but impersonal places can lead to feelings of loneliness and weak or non-existent personal relationships that, besides a negative effect on happiness, have a negative effect on health. Moreover, neighborhoods that offer opportunities for physical activity in close proximity can indirectly promote better health. Figure 1 explains these associations, where physical characteristics may directly influence health (e.g. via air pollution), whereas perceived characteristics indirectly influence health through personal relationships, leisure activities, and neighborhood impact on emotions and mood.

As seen in Figure 1, the outcome of the conceptual model is SWB. This variable of the model consists of the three views on SWB: hedonic well-being, life satisfaction, and eudaimonia. It would be interesting for empirical studies to investigate if and how these three views are distinctly influenced by neighborhood characteristics. Theoretically, only assumptions can be made on this. For example, neighborhood impact on emotions and mood could be more influential on hedonic well-being and not so important to eudaimonia. Since this impact has to do with emotions and mood, pleasure and painful feelings, it is directly pertinent to hedonic well-being. But neighborhood impact on emotions and mood could also be

influential on life satisfaction. A considerably positive or negative affect may play an important role when one evaluates one of the components of life satisfaction that is satisfaction with neighborhood. The other three SWB determinants are also expected to be important to hedonic well-being and life satisfaction but it seems difficult to theoretically identify differences. The determinants that appear more pertinent to eudaimonia are leisure activities and personal relationships. These two can be influential for one's personal growth and self-actualization. However, it remains to be empirically examined if there is a significant impact of neighborhood characteristics on a meaningful life (eudaimonia) or if it solely depends on other factors such as one's cultural background, upbringing, personality, or opportunities for education.

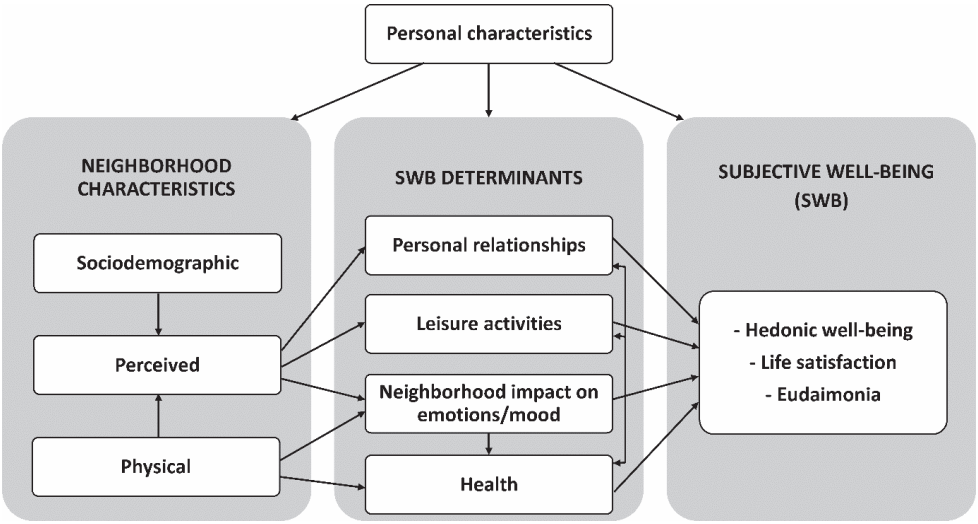


**Figure 1.** Conceptual model showing possible causal relationships between neighborhood characteristics, SWB determinants, and SWB.

## 4. Using SWB as a tool for urban planning

### *4.1. What are the benefits?*

SWB can be a powerful tool for urban planning. It is one of the basic end goals in life (Veenhoven, 2012) or at least an important means to achieve other goals and it is currently emerging as a political goal in national scales. Veenhoven (2004) explains exactly this, that the utility of happiness is twofold; both at individual as well as political level. Therefore, spaces and places that promote it are, at least partially, the answer to what is a "good", a "livable", or

a “high quality” built environment. It appears logical as well as democratic to invite residents to give input on the built environment that makes them happy.

Apart from defining what livability is, SWB can greatly contribute to decision making. It can be one of the major goals that planning policies are evaluated against in regard to their social sustainability. Planning policies can have diverse social effects on different actors making it challenging to reach well-founded decisions. By evaluating and understanding the impact of a planning policy on SWB and its determinants, decision makers can shed light into conflicting social effects and improve the understanding of their decisions. For example, knowing that a planning intervention has been found to have positive influence on some SWB determinants and negative influence on others, but the negative is less important for overall SWB, could provide useful insights to be considered. Using the framework developed in this article, we could also assess the effects of environmentally sustainable planning on SWB. By doing this, we investigate synergies and conflicts between key environmental and social dimensions of urban sustainability

After a major review of relevant literature, Van Kamp et al. (2003) point out that the field lacks a multidisciplinary theoretical framework explaining the connections between qualities of the built environment and human well-being. Since then, no complete relevant effort has emerged. The present paper aims to provide a framework in this direction. This framework can take a step further and move into interdisciplinarity. In particular, this paper suggests that a line of thought focused on SWB can offer an interdisciplinary platform for theory building and empirical research involving scholars and practitioners from various fields such as planning, design, public health, sociology, psychology, and urban geography.

### *4.2. Moving forward*

Built environments influence SWB every day as well as in the long run. Especially in extreme cases, this influence can be immense. Let us consider cases of extremely isolated, extremely stressful, or extremely unsafe environments. For example, an extremely unsafe environment would pose a very negative effect on one’s emotions and mood and would hinder opportunities for socializing and leisure activities. SWB would be very negatively influenced as a result of this. Though in less extreme, more usual cases, the importance of built environments on total SWB may be smaller. There is always this possibility because there exist so many other parallel drivers to SWB and also because people get partially adjusted to environments after a period

of time. Even in that case, nevertheless, built environments can have a considerable impact on some SWB determinants so such studies still provide useful findings.

The framework presented here focuses on a neighborhood scale within metropolitan areas. Since a neighborhood lies between the micro level of a dwelling and the macro level of a city or region, it may not capture aspects that are more relevant to other scales – dwelling, city, region, country. Existing and future studies on all different scales are necessary to obtain the complete picture on the influence of the built environment on SWB. Limitations from a neighborhood-level approach are that a neighborhood is sometimes difficult to define geographically and may have different meanings for different people. In research studies, it is up to the researcher to define it according to the needs of the study.

The framework and the conceptual model of the study can naturally be disputed and modified either theoretically or empirically. And it is one of the purposes of this study to stimulate such discussions and research activities. One may argue that there are other mediating factors between built environments and SWB or that the connections between the factors are different. Another may dispute the three views on SWB. Future theoretical discussions and empirical studies will offer the necessary insights to get a clearer portrayal of this complex phenomenon.

Future empirical studies can be based on either quantitative or qualitative data. Doing both is advisable to achieve a better understanding of the examined relationships. Quantitative data can be collected with questionnaires gathering residents' evaluations on neighborhood characteristics, the four SWB determinants, and SWB. An alternative or additional way to collect data could be smart phone based data mining (see e.g. De Nadai et al., 2016). Data can be analyzed with structural equation modeling in order to test and, potentially, modify the proposed conceptual model. Otherwise, several regression analyses could be conducted assessing the influence of neighborhood characteristics on each of the four SWB determinants and on each of the three SWB perspectives separately. Qualitative data collected via in-depth interviews with the actual actors – the residents – shed light into causal relationships, and also provide information about important neighborhood characteristics or SWB determinants not previously considered here.

## 5. Conclusions

SWB is widely considered as one of the main life goals and an indicator of social sustainability. Thus, it should be one of the ultimate goals when planning and designing cities. Previous theories do not explain sufficiently and systematically how neighborhood planning influences SWB. Closely related theoretical and empirical studies present certain weaknesses. The concept of neighborhood satisfaction, which is widely used in quantitative studies, is inadequate as a mediating variable between neighborhood and SWB. Relevant studies do not offer enough support and explanations of causal relationships because they do not consider appropriate mediating variables and are not accompanied by qualitative material. In addition, there is a complete lack of studies focusing on the affective part of SWB. Previous studies also often neglect to include in their analyses certain neighborhood characteristics that can be very influential on residents' life and overall SWB.

This paper has developed and presented a conceptual framework that explains how neighborhood characteristics influence SWB. The results of this study highlight the need: to unveil causal mechanisms providing explanations on why and how relationships are established, to investigate SWB holistically in all its dimensions, and to examine all sets of influential neighborhood characteristics. In response to this need, this framework explains how sets of objective and perceived neighborhood characteristics can influence four identified SWB determinants – personal relationships, leisure activities, neighborhood impact on emotions and mood, and health – that can in turn influence the three dominant subjective measures of well-being: hedonic well-being, life satisfaction, and eudaimonia. SWB can be a new powerful tool for planning and designing livable built environments and for evaluating the social sustainability of planning policies.

## Acknowledgements

This study is part of a research project on "Compact city or sprawl? The role of urban form in subjective well-being" supported by the Norwegian University of Life Sciences. The author is grateful to Petter Næss and Jin Xue whose comments substantially improved this article. For their useful comments, the author would also like to thank Tim Richardson, Marit Ekne Ruud, and Marian Schubert.

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**Paper 2**

# Is compact city livable? The impact of compact versus sprawled neighborhoods on neighborhood satisfaction

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**Abstract**

Low-density urban forms are often considered more livable than compact ones. Yet, studies investigating the relationship between compact cities and livability do not take into consideration the importance of public transport, accessibility, and mix of land uses along with high densities. Moreover, direct comparisons of livability between the compact city and its alternative, urban sprawl are scarce, and even more so in a European context. Investigating the metropolitan area of Oslo, which encompasses both compact and sprawled areas, this study examines the impact of the compact city on livability by employing neighborhood satisfaction as a livability measure. Three different methods are used: cross-sectional regression analysis, longitudinal comparisons, and qualitative analysis. Cross-sectional results indicate that compact-city residents are significantly more satisfied with their neighborhood than those who live in sprawled neighborhoods, even after controlling for sociodemographic and other variables. Longitudinal analysis based on residents who have lived in both neighborhood types confirms this finding. This study also examines the impact of compactness within a wider range of urban form typologies and finds that the higher the density, the higher the neighborhood satisfaction. Important components of the compact city – public transport, accessibility to city center, and land use mix – demonstrate a positive association with neighborhood satisfaction. Findings from this study suggest that, when common urban problems are addressed and when planned to integrate all its essential characteristics, the compact city has a positive influence on livability.

**Keywords**

compact city; urban sprawl; livability; population density; sustainability

**Publication status**

Mouratidis, K. (2017). Is compact city livable? The impact of compact versus sprawled neighbourhoods on neighbourhood satisfaction. *Urban Studies, 55*(11), 2408-2430.

## 1. Introduction

This article aims to provide insights into the fundamental question of whether the compact city paradigm can promote livability. The compact city is widely considered the most environmentally sustainable option for urban form as well as public policy (Jabareen, 2006; Newman & Kenworthy, 1999). It has been endorsed by several leading institutions worldwide (American Planning Association, 1999; European Commission, 2007; United Nations, 2012). However, despite being considered more environmentally sustainable, a compact urban environment is often associated with lower livability. This has been called the compact city paradox (Neuman, 2005). The common perception that compact development is detrimental to livability is based on the negative effects of high-density living suggested by various theoretical (Fischer, 1973; Simmel, 1903; Wirth, 1938) and empirical (Bramley et al., 2009; Cao, 2016; Cook, 1988; Okulicz-Kozaryn, 2015; Okulicz-Kozaryn & Mazelis, 2016; Rodgers, 1981) studies.

Nevertheless, there are significant deficiencies in the current empirical evidence in support of the existence of a compact city paradox. In other words, there is not sufficient knowledge to conclude that compact urban forms are indeed less livable than other urban forms. Firstly, the aforementioned empirical studies focus largely on the effect of population densities. Yet, there are other characteristics of the compact city apart from high density, which have not been fully examined. There is a lack of studies considering the synergies of several components of the compact city such as public transport, accessibility, and mixed land uses (Burton et al., 2003; Jacobs, 1961; Lee et al., 2015) along with high densities. Little is known about the impact of compact areas encompassing all these characteristics on livability. Secondly, most relevant empirical studies have been conducted on US cases, which do not usually entail all compact-city characteristics to a sufficient degree. Some studies of European cities suggest that high density per se does not have a negative impact on neighborhood satisfaction (Arundel & Ronald, 2017; Howley et al., 2009). Thirdly, there is very scarce empirical research that directly compares livability in sprawled areas versus their antidote, compact ones. One relevant study conducted in Detroit, US, suggests that, contrary to common belief, suburban residents were not found to be more satisfied with their neighborhood than urban residents (Adams, 1992). However, Detroit's urban areas cannot be characterized as typical compact. To understand any livability differences between compact and low-density suburban neighborhoods, we need more studies on cases where typical compact and sprawled environments are found in the same geographical and cultural context.

This article examines the impact of the compact city on livability by addressing these gaps in knowledge. The basic research questions are as follows: (1) Which residents have higher levels of neighborhood satisfaction, other things being equal: those living in compact areas or those living in sprawled ones? (2) How does compactness (density, public transport, accessibility, and mixed land uses) affect neighborhood satisfaction among residents of various types of areas? (3) How does neighborhood satisfaction change for residents who have moved from sprawled to compact areas compared to residents who have moved from compact to sprawled areas? For these research questions, the article also investigates causal mechanisms that explain the main outcomes.

This study employs the following conceptual and methodological strategies. It uses Oslo as the case location, a city which encompasses both compact and sprawled urban forms to a great extent. Thus, large samples from areas that exhibit all the characteristics of the compact city as well as areas that are typical sprawled suburbs are analyzed, allowing meaningful investigations and comparisons within the same geographical and sociocultural context. In that regard, compactness is investigated as a measure not only of population density, but also of public transport provision, accessibility, and mixed land uses. To conduct the analysis, the study uses survey data from 45 neighborhoods in Greater Oslo and qualitative data from in-depth interviews with local residents. This research is based on a mixed-methods approach comprising cross-sectional regression analysis, longitudinal comparisons, and qualitative data analysis. The combination of different analyses and different methods is used to provide measurement triangulation and more strongly support claims of causality. Furthermore, by analyzing qualitative data, which are scarce on this subject but crucial for this type of research (Næss, 2016a), this article sheds light on causal mechanisms behind the examined relationships. This article is structured as follows: theoretical background; data and methods; results from the analysis; discussion and interpretation of the results, as well as limitations and takeaways for practice and research; and conclusions.

## 2. Theoretical background

Neighborhood satisfaction is the most common measure used in empirical studies that assess livability within built environments for urban planning purposes. It is based on the conceptual models of Marans and Rodgers (1975) and Campbell et al. (1976) and has been used ever since as a measure of urban livability in numerous studies (e.g. Arundel & Ronald, 2017; Davis &

Fine-Davis, 1991; Howley et al., 2009; Yang, 2008). Some empirical research suggests that high population density leads to lower neighborhood satisfaction (Bramley et al., 2009; Cook, 1988; Rodgers, 1981), supported by theorists from urban sociology (Fischer, 1973; Simmel, 1903; Wirth, 1938). Yet, other research suggests that high density by itself is not detrimental to neighborhood satisfaction (Adams, 1992; Arundel & Ronald, 2017; Howley et al., 2009). Yang (2008) finds that the impact of density on neighborhood satisfaction depends on the context. Lovejoy et al. (2010) find that characteristics which promote accessibility play a positive role in neighborhood satisfaction when population densities are similar. High accessibility has been found to have a positive effect on livability in other recent studies (Leyden et al., 2011).

Numerous studies have investigated determinants of neighborhood satisfaction (Buys & Miller, 2012; Cook, 1988; Davis & Fine-Davis, 1991; Grogan-Kaylor et al., 2006; Gruber & Shelton, 1987; Hur & Morrow-Jones, 2008; Hur et al., 2010; Lu, 1999; Parkes et al., 2002). Examples of characteristics consistently found to have a positive relationship with neighborhood satisfaction are safety, quietness, neighbor ties, and attractiveness. Neighborhood attachment has also been found to be very important when one evaluates a neighborhood (Low & Altman, 1992). In high-density neighborhoods, public transport, open spaces, and accessibility to facilities emerge as important neighborhood characteristics (Arundel & Ronald, 2017; Kyttä et al., 2016; Mitrany, 2005). One aspect which has been found to negatively affect neighborhood satisfaction and livability is social inequalities between and within neighborhoods (Ballas, 2013; Fried, 1982).

The social impact of compact versus sprawled urban forms has also been investigated in multiple other ways. Some studies indicate that high-density urban forms have the potential to be more beneficial to social equity than low-density ones (Burton, 2000; Power, 2001). Evidence also suggests that residents of denser urban forms walk more (Ewing et al., 2003; Rodríguez et al., 2006; Sung et al., 2015) and have better health (Barton, 2009; Sturm & Cohen, 2004). However, other research suggests that compact-city residents may present more health problems (Næss, 2014) and that excessively dense high-rise forms may cause several psychological problems (Gifford, 2007). Some studies indicate that compact-city characteristics such as high accessibility may promote social capital (Cabrera & Najarian, 2013; Leyden, 2003), which has been found to be an important determinant of happiness (Leung et al., 2011).

All these studies show that there is a series of multiple characteristics of the urban form contributing to aspects related to livability. This is in accordance with prominent theories of urban planning and design (Alexander et al., 1977; Carmona et al., 2003; Duany et al., 2010; Gehl, 2013; Jacobs & Appleyard, 1987; Jacobs, 1961). Therefore, all these characteristics should be taken into consideration when conducting empirical studies that robustly assess the impact of a certain type of urban form on livability.

## 3. Data and methods

### *3.1. Study area*

This study examines the metropolitan area of Oslo (Greater Oslo). Oslo is one of the fastest growing major cities in Europe and a subject of densification policies that have been employed to accommodate its increasing population whilst simultaneously protecting surrounding forests and farmlands. It also has an extensive multi-modal public transportation system, which allows limited car usage and traffic within the city's central areas. Oslo is considered a city that focuses on sustainable planning principles, receiving the European Sustainable City award in 2003. Nevertheless, although the central part of the city (inner city) is mostly characterized by compact-city features – high density, public transport, and mixed land uses among others – the suburban and peripheral areas are mostly characterized by single-family housing, car reliance, and separated land uses. This dichotomy of Oslo's urban form is emphasized by empirical evidence on traveling distances and its transport modal split (Næss, 2016b).

The coexistence of both typical compact and typical sprawled areas in Oslo is very useful for the purposes of this study. Unlike previous relevant studies that either focus only on urban central areas without including sprawled ones (Arundel & Ronald, 2017; Howley et al., 2009; Mitrany, 2005) or on cities that do not include any areas that meet all compact-city criteria (Adams, 1992; Cao, 2016; Lovejoy et al., 2010), this study involves participants who live in both types of urban form, providing meaningful comparisons between the two. In addition, Oslo's high variation in physical and perceived environmental attributes removes concerns about omitted variables that could lead to biased estimates. This enables deep investigations of the effect of compact-city characteristics on livability and expands the relevance of the findings to other geographical contexts.

### *3.2. Data sources*

This study relies on data obtained from a survey based on a self-administered online questionnaire and from 10 qualitative in-depth interviews. Both were conducted in the metropolitan area of Oslo. A total of 45 residential areas covering several central, suburban, and peripheral parts were included in the survey (Figure 1). These areas were selected aiming to generate a geographically and socioeconomically representative sample. A request for participation in the survey was mailed to households in May 2016, including a link to an electronic questionnaire. A full list of addresses was obtained for selected postal zones in the preferred areas. Addressees for invitation letters were randomly selected within these postal zones. The only selection criteria were that participants should be 18 years of age or above and that only one person per household would receive a letter. The survey did not include any incentives such as gift cards and no reminder letter was sent to participants.

The questionnaire was pre-tested and revised accordingly. Ten-thousand letters were sent, 9730 of which were sent to valid recipients. The number of valid responses was 1344, equivalent to a 13.8% response rate. The 10 interview participants were selected using the results of the survey. Their selection was based on residential areas of interest; five were from compact and five from sprawled neighborhoods. Among interested participants, there was an effort to select a sample that varied in demographic and socioeconomic characteristics. Among other topics, interviewees were asked about the influence of their neighborhood on their life, and things they like and dislike about the neighborhood, and were asked to discuss differences with other types of residential areas.

There are several potential sources of bias in the current study. Since the response rate is 13.8%, non-response bias might be relevant. In addition, although the sample's representativeness is satisfactory, it is not perfect (Table A1 in Appendix). Respondents to the survey are relatively older, relatively more educated, and have slightly higher incomes on average compared to the averages in their respective neighborhoods. Immigrant populations are also underrepresented. Nonetheless, the effect of these biases on the present study is expected to be insignificant as both the survey response rate and the sociodemographic differences between respondents and the population are similar across neighborhoods and relevant sociodemographic variables are controlled for in multivariate analysis. Since the main purpose of the study is not to describe the univariate distribution of neighborhood satisfaction but to explore its conditional relationship with built environment characteristics using

multivariate analysis, any geographical over- or underrepresentation of certain groups of people in the sample would not be expected to materially affect the results (Crano et al., 2015).

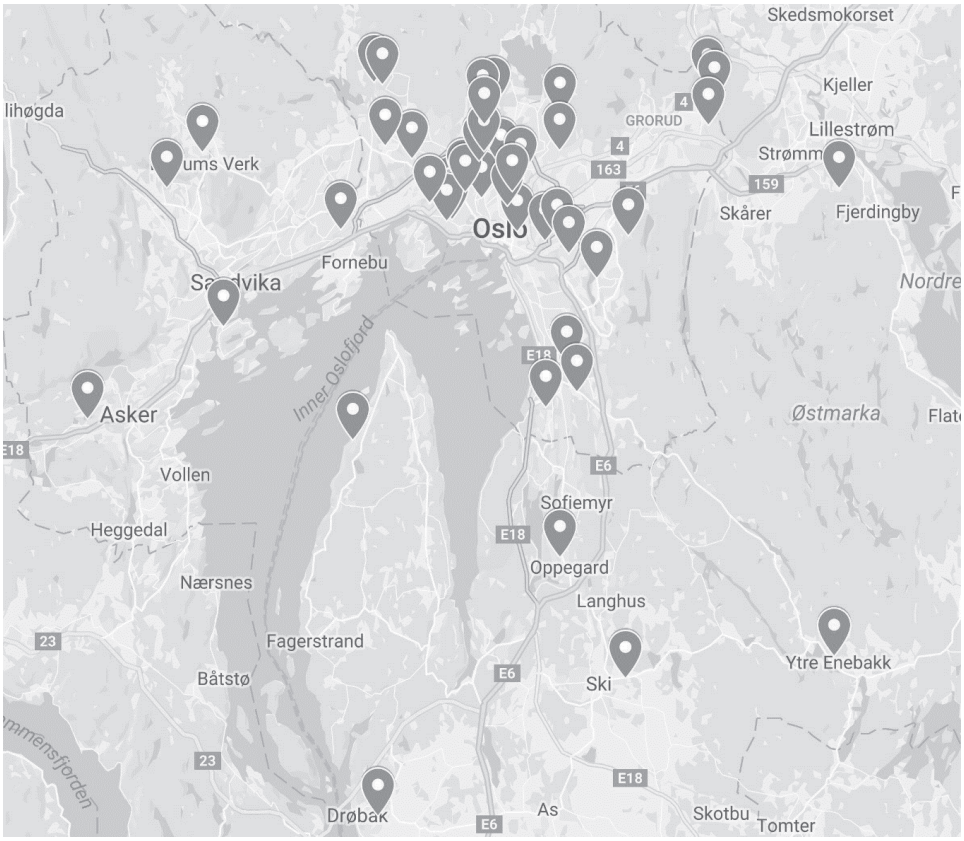


**Figure 1.** Selected residential areas within the metropolitan area of Oslo. *Source*: Map data: Google.

### *3.3. Variable descriptions*

Table 1 shows descriptive statistics for all variables. The dependent variable in the study is neighborhood satisfaction and this was measured by responses to a question in the survey. Neighborhood was defined in the questionnaire as the local area within 15 minutes' walking distance from the respondent's dwelling, to achieve greater consistency among respondents. To measure neighborhood satisfaction, participants were asked to evaluate how well their neighborhood meets their current needs on a scale from "extremely poorly" (0) to "extremely well" (10). They were asked to consider their neighborhood's internal (physical and social) and external (accessibility to other areas) characteristics. Respondents were requested to fill in not

only their current residential address but also their previous one in case they had moved during the last five years. In that case, they evaluated their satisfaction with their previous neighborhood as well. These responses are used for longitudinal comparisons.

This study uses both objective and perceived neighborhood characteristics as independent variables. Physical form variables are objectively measured. Neighborhood population density is measured by dividing the population of each postal zone by the area coverage in hectares. Distances to city center and to Marka forest (Oslo's forested zone and major outdoor recreation area) are measured from the centroid of each neighborhood. Public transport is calculated as the aggregate number of departures per hour in the peak period from all public transit stops within a radius of 500 m from the centroid of each neighborhood. The number of grocery stores is also calculated within a 500 m buffer. The number of cafés, restaurants, and bars is similarly measured but within a 1000 m buffer as people are willing to travel longer distances to visit such places (Næss et al., 2017).

Besides detailed neighborhood characteristics (density, public transport, accessibility, and mixed land uses) employed to evaluate the effect of compact-city principles on neighborhood satisfaction, the study also examines a dichotomous variable "compact neighborhood" where 0 is sprawled neighborhood and 1 is compact neighborhood. This variable is used only in models that include residents solely from compact and sprawled neighborhoods, with other types of neighborhoods excluded. Compact neighborhoods are categorized as the ones with high population densities, apartment blocks, and a mix of commercial and residential land uses (Table A2 in Appendix). Sprawled neighborhoods are categorized as the ones with low population densities, detached housing, and separate land uses (Table A3 in Appendix). Mean population densities are 211 persons per hectare for compact neighborhoods and 29 persons per hectare for sprawled neighborhoods. Other neighborhoods that fall between these two categories, and are not part of the analysis for this approach, are neighborhoods with mixed types of housing or medium densities, or low-density neighborhoods within the inner city (Table A4 in Appendix). All these neighborhoods have mostly separate land uses. Of course, the boundaries for such categorizations could be slightly different, but as tested in preliminary analysis the trends of the results are similar.

To obtain neighborhood perceived measures, this study uses responses to the survey. Respondents were asked to evaluate neighborhood characteristics on a rating scale from "very low" (1) to "very high" (5) or from "nonexistent" (1) to "very high" (6). The latter scale was

used for quality of open public spaces since such spaces may not be present at all in some areas. For the rest of the characteristics – neighborhood attachment, overall aesthetic quality, neighborhood safety, neighbor ties, cleanliness, noise, and traffic – a scale from 1 to 5 was used.

The study also uses sociodemographic characteristics as control variables, including age, employment status, household income, citizenship, and living with partner or spouse. Household income was adjusted for household size using one of the most frequently employed equivalence scales, the square-root transformation of household size (Francoeur, 2002). Sociodemographic variables that provided no significant contribution in preliminary analyses include respondent's gender, education level, household size, number of children in household, and presence of children in household.

**Table 1.** Descriptive statistics of all variables.

| Variables | N | Min/Max | All (N=1344) | | Compact (N=535) | | Sprawl (N=504) | | *t*-Test |
|---|---|---|---|---|---|---|---|---|---|
| | | | Mean | s.d. | Mean | s.d. | Mean | s.d. | |
| Neighborhood satisfaction | 1339 | 0/10 | 8.23 | (1.83) | 8.51 | (1.63) | 7.96 | (2.00) | * |
| *Compactness* | | | | | | | | | |
| Compact neighborhood | 1039 | 0/1 | 0.51 | (0.50) | 1.00 | (0.00) | 0.00 | (0.00) | * |
| *Neighborhood physical form measures* | | | | | | | | | |
| Population density (persons/ha) | 1341 | 14/306 | 112.93 | (88.04) | 211.23 | (44.12) | 28.73 | (9.11) | * |
| Distance to city center (km) | 1344 | 0.70/46.20 | 10.22 | (10.84) | 2.39 | (0.87) | 20.47 | (11.04) | * |
| Public transport (departures within 500 m per hour in peak period) | 1341 | 0/279 | 115.23 | (91.46) | 213.85 | (40.59) | 36.88 | (32.30) | * |
| Grocery stores (within 500 m) | 1341 | 0/20 | 6.55 | (6.10) | 13.10 | (4.28) | 1.75 | (1.21) | * |
| Cafés, restaurants, and bars (within 1000 m) | 1341 | 0/272 | 68.97 | (79.98) | 152.84 | (63.32) | 8.45 | (7.70) | * |
| Distance to Marka forest (km) | 1342 | 0/14.78 | 2.72 | (2.49) | 3.38 | (0.75) | 2.66 | (3.68) | * |
| *Neighborhood perceived measures* | | | | | | | | | |
| Neighborhood attachment | 1326 | 1/5 | 3.91 | (1.01) | 3.88 | (1.01) | 3.93 | (1.02) | |
| Quality of open public spaces | 1343 | 1/6 | 5.29 | (0.94) | 5.26 | (0.87) | 5.25 | (1.04) | |
| Overall aesthetic quality | 1324 | 1/5 | 3.87 | (0.92) | 3.86 | (0.88) | 3.86 | (0.94) | |
| Neighborhood safety | 1330 | 1/5 | 4.22 | (0.82) | 3.94 | (0.83) | 4.44 | (0.74) | * |
| Neighbor ties | 1329 | 1/5 | 2.99 | (1.18) | 2.64 | (1.16) | 3.29 | (1.11) | * |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Cleanliness | 1325 | 1/5 | 3.81 | (0.91) | 3.48 | (0.88) | 4.09 | (0.80) | * |
| Noise | 1341 | 1/5 | 2.46 | (1.14) | 2.99 | (1.02) | 2.06 | (1.07) | * |
| Traffic | 1341 | 1/5 | 2.67 | (1.15) | 3.24 | (0.97) | 2.29 | (1.11) | * |
| *Sociodemographic variables* | | | | | | | | | |
| Age | 1344 | 19/94 | 50.16 | (15.71) | 43.06 | (14.40) | 55.78 | (14.18) | * |
| Unemployed | 1339 | 0/1 | 0.03 | (0.16) | 0.03 | (0.17) | 0.02 | (0.14) | |
| Living with partner/spouse | 1329 | 0/1 | 0.61 | (0.49) | 0.49 | (0.50) | 0.74 | (0.44) | * |
| Non-Norwegian | 1342 | 0/1 | 0.09 | (0.28) | 0.11 | (0.31) | 0.08 | (0.27) | |
| Adjusted household income (1000s NOK)[1, 2] | 1259 | 35/4330 | 642.20 | (321.08) | 625.02 | (288.68) | 669.09 | (361.27) | * |
| Household size (persons) | 1335 | 1/6 | 2.22 | (1.15) | 1.95 | (1.05) | 2.56 | (1.21) | * |
| Number of children in household | 1334 | 1/4 | 0.54 | (0.88) | 0.33 | (0.71) | 0.77 | (1.00) | * |
| Household with children | 1334 | 0/1 | 0.32 | (0.47) | 0.20 | (0.40) | 0.43 | (0.50) | * |
| Respondent is female | 1331 | 0/1 | 0.53 | (0.50) | 0.52 | (0.50) | 0.54 | (0.50) | |
| Respondent has college degree or higher | 1341 | 0/1 | 0.79 | (0.41) | 0.84 | (0.37) | 0.74 | (0.44) | * |

*Notes*: *A t-test of difference in mean shows significant differences between compact and sprawl at $p < 0.05$.

[1]Houshold income divided by the square root of household size.

[2]Median adjusted household income is 635,000 NOK for compact and 636,000 NOK for sprawled neighborhoods.

## 4. Results

### *4.1. Cross-sectional analysis*

Cross-sectional regression analysis attempts to answer the first two research questions of the study. Regression tables summarize the standardized regression coefficients from models that predict individual residents' neighborhood satisfaction.

Results in Table 2 include four models. Models A and B estimate the effect of the dummy variable "compact neighborhood" on neighborhood satisfaction and Models C and D examine the effect of population density. Models A and B use sample solely from compact and sprawled neighborhoods while C and D use sample from all neighborhoods. Models A and C are base models in which only sociodemographic variables are being controlled for. In Models B and D, three neighborhood characteristics are added as predictors of neighborhood satisfaction. These three – neighborhood attachment, quality of open public spaces (green spaces, public squares etc.), and overall aesthetic quality – are predictors that have no significant difference in means between compact and sprawled areas (Table 1). Therefore, they are used as "neutral" predictors, added as robustness check for each base model.

Models A and B in Table 2 suggest that residents of compact neighborhoods are significantly more satisfied with their neighborhood than residents of sprawled neighborhoods, even after controlling for sociodemographic variables and "neutral" neighborhood characteristics. Similarly, Models C and D show a significant positive association between density and neighborhood satisfaction. After adding "neutral" neighborhood characteristics, the coefficients of both variables used to examine compactness (compact neighborhood and population density) become lower but still significant, both statistically and practically. The coefficient of density alone is smaller than the coefficient of the "compact neighborhood" variable. This is because density by itself is necessary but not sufficient to guarantee the presence of other compact-city characteristics such as public transport, accessibility, and mixed land uses. When all components are present, the positive influence of compactness is stronger.

**Table 2.** Regression models of neighborhood satisfaction.

| Variables | A | B | C | D |
|---|---|---|---|---|
| *Compactness* | | | | |
| Compact neighborhood | 0.223*** | 0.183*** | | |
| Population density | | | 0.163*** | 0.145*** |
| *Neighborhood perceived measures* | | | | |
| Neighborhood attachment | | 0.336*** | | 0.342*** |
| Quality of open public spaces | | 0.186*** | | 0.200*** |
| Overall aesthetic quality | | 0.107*** | | 0.126*** |
| *Sociodemographic variables* | | | | |
| Age | 0.135*** | 0.037 | 0.132*** | 0.032 |
| Unemployed | -0.082* | -0.046 | -0.091** | -0.059* |
| Living with partner/spouse | 0.078* | 0.028 | 0.073* | 0.023 |
| Non-Norwegian | 0.048 | 0.070* | 0.017 | 0.037 |
| Adjusted household income | 0.039 | 0.035 | 0.046 | 0.039 |
| *Summary statistics* | | | | |
| N | 957 | 938 | 1236 | 1212 |
| R-squared | 0.053 | 0.271 | 0.043 | 0.288 |

*Notes*: *p<0.05, **p<0.01, ***p<0.001.
All coefficients shown are standardized. The sample size varies across different models due to item non-response. Sociodemographic variables tested but excluded due to nonsignificant contribution (p>0.10) are household size, number of children in household, household with children, gender, and education level.

Table 3 presents models examining the effect of five individual measures of compactness: density, distance to city center, public transport, grocery stores, and cafés, restaurants, and bars. Since they are highly correlated with density and to avoid multicollinearity problems, public transport, grocery stores, and cafés, restaurants, and bars are examined in independent models. For these three variables, the logarithm is taken to ensure

that the normal distribution assumption holds. In Models A to D, "neutral" perceived measures and sociodemographic variables are included. Model E examines all significant predictors of neighborhood satisfaction, including two additional variables: neighborhood safety and neighbor ties. These two neighborhood characteristics differ between compact and sprawled neighborhoods. Sprawled neighborhoods are perceived as safer and foster closer neighbor ties (Table 1).

All measures of compactness – density, proximity to city center, public transport, grocery stores, and cafés, restaurants, and bars – are found to be positively associated with neighborhood satisfaction. Results in Table 3 show that when accessibility benefits of density are accounted for, density has a nonsignificant effect on neighborhood satisfaction and not a strong negative one as suggested in other studies (e.g. Rodgers, 1981). When both distance to city center and density are included in the analysis, distance to city center exhibits a strong statistical effect while density is nonsignificant. This means that neighborhood satisfaction increases as one moves closer to the city center, independently of whether the neighborhood is dense or not. However, distance to city center and density are closely related since higher densities reduce distances, and the city center and the areas around it are mostly dense, thus offering accessibility benefits. Results indicate that when both distance and density are controlled for, public transport has a positive but statistically nonsignificant effect, while measures of land use mix (grocery stores and cafés, restaurants, and bars) have a considerably stronger and significant positive effect.

**Table 3.** Regression models of neighborhood satisfaction on detailed compact form measures.

| Variables | A | B | C | D | E |
|---|---|---|---|---|---|
| *Compact form measures* | | | | | |
| Population density | 0.050 | 0.016 | -0.031 | -0.038 | -0.011 |
| Distance to city center | -0.152*** | -0.131*** | -0.132*** | -0.120*** | -0.130*** |
| Public transport (log) | | 0.065 | | | |
| Grocery stores (log) | | | 0.142*** | | |
| Cafés, restaurants, and bars (log) | | | | 0.153*** | 0.176*** |
| *Neighborhood perceived measures* | | | | | |
| Neighborhood attachment | 0.339*** | 0.337*** | 0.337*** | 0.336*** | 0.290*** |
| Quality of open public spaces | 0.197*** | 0.195*** | 0.195*** | 0.197*** | 0.172*** |
| Overall aesthetic quality | 0.121*** | 0.122*** | 0.125*** | 0.118*** | 0.076* |
| Neighborhood safety | | | | | 0.101** |
| Neighbor ties | | | | | 0.098*** |
| *Sociodemographic variables* | | | | | |
| Age | 0.046 | 0.049 | 0.050 | 0.049 | 0.050 |
| Unemployed | -0.057* | -0.057* | -0.054* | -0.054* | -0.058* |
| Living with partner/spouse | 0.023 | 0.026 | 0.023 | 0.027 | 0.021 |
| Non-Norwegian | 0.039 | 0.041 | 0.043 | 0.039 | 0.043 |
| Adjusted household income | 0.032 | 0.033 | 0.049 | 0.040 | 0.040 |
| *Summary statistics* | | | | | |
| N | 1212 | 1212 | 1212 | 1212 | 1194 |
| R-squared | 0.301 | 0.303 | 0.312 | 0.312 | 0.323 |

*Notes*: *p<0.05, **p<0.01, ***p<0.001.
All coefficients shown are standardized. The sample size varies across different models due to item non-response. Sociodemographic and neighborhood variables tested but excluded due to nonsignificant contribution (p>0.10) are household size, number of children in household, household with children, gender, education level, distance to Marka forest, cleanliness, noise, and traffic.

Table 4 presents the analysis of the impact of density on neighborhood satisfaction for different age groups and for households with and without children. Age groups were divided based on the sample's median age, which is 50 years. Results show that density is positively associated with neighborhood satisfaction for all four groups. However, the statistical effect is stronger for younger groups in Model A than for older groups in Model B. What stands out though is that density has a small, statistically nonsignificant, positive effect on neighborhood satisfaction for households with children in Model C, while it has a considerably stronger, statistically significant, effect for households without children in Model D. This may partially explain the fact that many families with children choose to live in low-density suburban settings. Having different needs than households without children, many households with children appreciate the quieter, safer, and greener environment of the suburbs. From another perspective, it is also noteworthy that for households with children choosing to live in denser areas – and able to afford it since compact areas are usually more expensive in Oslo –

neighborhood satisfaction is similarly high as in less dense areas. This suggests that compact areas of Oslo are livable even for families with children.

**Table 4.** Regression models of neighborhood satisfaction for different groups.

| Variables | A<br>Ages 18-49 | B<br>Ages 50-94 | C<br>Household with children | D<br>Household without children |
|---|---|---|---|---|
| *Compactness* | | | | |
| Population density | 0.160*** | 0.103** | 0.060 | 0.164*** |
| *Neighborhood perceived measures* | | | | |
| Neighborhood attachment | 0.310*** | 0.373*** | 0.338*** | 0.356*** |
| Quality of open public spaces | 0.187*** | 0.214*** | 0.187*** | 0.204*** |
| Overall aesthetic quality | 0.167*** | 0.082* | 0.164** | 0.113** |
| *Sociodemographic variables* | | | | |
| Age | 0.023 | 0.044 | 0.036 | 0.024 |
| Unemployed | -0.039 | -0.079* | -0.053 | -0.062* |
| Living with partner/spouse | -0.003 | 0.053 | -0.009 | 0.044 |
| Non-Norwegian | 0.035 | 0.031 | 0.028 | 0.046 |
| Adjusted household income | 0.070 | 0.017 | 0.034 | 0.033 |
| *Summary statistics* | | | | |
| N | 593 | 619 | 387 | 819 |
| R-squared | 0.292 | 0.292 | 0.303 | 0.288 |

*Notes*: *p<0.05, **p<0.01, ***p<0.001.

All coefficients shown are standardized. The sample size varies across different models due to item non-response.

### *4.2. Longitudinal analysis*

In addition to cross-sectional analysis, this study includes analysis of longitudinal data, which answers the third research question of the article. Out of a sample of 1344 respondents, 64 survey respondents were identified as having lived in both compact and sprawled neighborhoods during the last five years. Twenty-eight respondents moved from compact to sprawled neighborhoods and 36 moved from sprawled to compact ones. Responses on satisfaction with previous and current neighborhood were used to conduct longitudinal comparisons. Longitudinal analysis has more power to provide support for causal relationships than does cross-sectional analysis. Consequently, in this article longitudinal analysis is performed to test the main outcome of the cross-sectional analysis, which is that a compact city has a positive effect on neighborhood satisfaction, providing further evidence for causality. Analysis is performed with t-tests of difference in means. Regression analysis is not employed in this case due to the lack of sociodemographic data for the previous point in time. The current sociodemographic characteristics of the respondents are presented in Table A1 (Appendix)

showing that "sprawl to compact" movers are typically younger and without children. As seen in Table 4, these residents are relatively more satisfied with compact neighborhoods than other groups so this might lead to a certain overestimation of the general impact of moving from sprawl to compact neighborhoods.

Results in Table 5 indicate three main points. The first point is that among the 64 respondents who have lived in both types of neighborhoods, those who had previously lived in compact neighborhoods were significantly more satisfied with their neighborhood than those who used to live in sprawled neighborhoods. The difference in means is 7.57 versus 6.00. The second point is that current compact-city residents are significantly more satisfied compared to current residents of sprawled neighborhoods. The difference in means is 8.69 versus 7.29. The third and final point is that residents who moved from sprawled to compact neighborhoods experienced a significant positive change in neighborhood satisfaction, whereas residents who moved from compact to sprawled neighborhoods did not experience any significant change. What is also noteworthy here is that the increase in mean neighborhood satisfaction for "sprawl to compact" movers is substantial since it rises from 6.00 to 8.69. These longitudinal results further strengthen cross-sectional results suggesting that the compact city has a positive influence on neighborhood satisfaction.

**Table 5.** Longitudinal comparisons of neighborhood satisfaction.

| | Satisfaction with previous neighborhood | | Satisfaction with current neighborhood | | *t*-Test | N |
|---|---|---|---|---|---|---|
| | Mean | s.d. | Mean | s.d. | | |
| Compact to sprawl | 7.57 | (1.87) | 7.29 | (1.90) | | 28 |
| Sprawl to compact | 6.00 | (1.99) | 8.69 | (1.70) | * | 36 |
| *t*-Test | * | | * | | | |

*A t-test of difference in mean shows significant differences at $p < 0.05$.

### *4.3. Qualitative analysis*

Qualitative interviews in this study can provide insights into causal mechanisms. In other words, they can help us understand why compact-city residents are more satisfied with their neighborhoods than urban sprawl residents in the case of Oslo. The qualitative interviews show that the most important benefit for residents of compact areas is high accessibility. Compact-city interviewees highlight the importance of accessibility to people, workplaces, facilities, public transport, and shops among others. As some compact-city interviewees explained:

> The most important thing is the short distances to everything. (Male, compact area resident, 76 years)

> It makes it easier to relations and stuff. More urban… (Female, compact area resident, 39 years)

> If I lived outside of Oslo, I would have to spend so much time travelling by train or by car. And then wouldn't have time that I want to spend with my child and my husband. (Female, compact area resident, 33 years)

One interviewee living in an outer suburb plans to move to a more compact urban area because she wants to be in closer proximity to work and friends. She explains the importance of high accessibility here:

> The most important is that I have easy access to things, that's really the most important. […] I think it will be easier [when I move to a compact urban area] to get to meet friends for maybe a cup of coffee or something. You just don't have to plan it a week ahead. (Female, sprawled area resident, 30 years)

Another interviewee who lives in the same suburb spends about an hour commuting to work – but is nevertheless satisfied with her neighborhood overall – and explains the attitude to lower accessibility associated with suburban areas here:

> Because I have colleagues, they live in Oslo. They always go to something. And it's very nice. But when you live in Ski [outer suburb of Oslo], it's too troublesome. (Female, sprawled area resident, 62 years)

Common urban problems are related to safety, cleanliness, traffic, and noise (Breheny, 1997; Burton, 2000; Howley et al., 2009; Hur & Morrow-Jones, 2008). Three out of five compact-city interviewees did not mention any of these as a problem in their neighborhood. Two interviewees who live in streets used as primary routes for public transport explained that there is noise and traffic coming from buses and trams. However, they both stated that they would still probably choose to live in a compact neighborhood if they were to move. Compact-city interviewees also underlined that inner courtyards of perimeter blocks are used for kids playing safely and adults socializing. Yet, as Table 1 shows, sprawled areas are generally perceived as safer and more conducive to creating ties with neighbors. These closer ties with neighbors in sprawled areas are highlighted for example here:

> I feel that many of these neighbors are my closest friends. (Male, sprawled area resident, 46 years)

> My next-door neighbor, we've even been on holiday together. She's a little younger than me though. But we went to Crete. Yeah. (Female, sprawled area resident, 62 years)

However, one commonly mentioned problem of living in suburban environments, apart from lower accessibility, is maintaining the larger interior spaces and gardens. This is more problematic as people grow older. One interviewee who lives in an inner suburb explained that, for this reason, she and her husband might have to leave their single-family detached home and move to a smaller space in an apartment block. She discusses house maintenance by referring to a brief previous experience of living in an apartment in a compact area of Oslo:

> It was wonderful to live there [in a compact area]. That was a flat, this is a house with everything around. And you have to keep up with that [maintenance of a single-family home]. You have to do something every day, you have to walk out and you have to cut the lawn, mow the lawn and you have to… Yeah. Everything, and the snow. (Female, sprawled area resident, 74 years)

Then she discusses easy access to amenities and public transport when living in a compact area:

> … and then it was easy to reach everything, cafés and movies and theater and things. And also you have all these facilities with buses and tram cars and whatever. And you could take the metro and just come into the… (Female, sprawled area resident, 74 years)

Another interviewee who used to live in an inner suburb of Oslo but now lives in a compact area explains that although her previous neighborhood was beautiful and close to nature, low accessibility was problematic. When asked about why she changed neighborhood she explains:

> It was beautiful; it was close to the forests. I mean I had roe deer walking past my kitchen window and I could go up behind my house and pick blueberries for dessert if I wanted to do that, but it was so far away from everything and everyone, even though it was just 20 minutes by subway down to the city center. (Female, compact area resident, 52 years).

## 5. Discussion

Findings indicate that compactness may have a positive influence on neighborhood satisfaction and hence on livability, since neighborhood satisfaction is used as a measure of livability. This outcome contradicts suggestions about the existence of a compact city paradox (Neuman, 2005). It shows that sustainable urban forms can coincide with livability. In other words, urban forms characterized by high density, public transport, high accessibility, and mixed land uses

can be livable and even more so than low-density urban forms. This contradicts the common perception that high-density living is detrimental to livability, as suggested by various theoretical (Fischer, 1973; Simmel, 1903; Wirth, 1938) and empirical (Bramley et al., 2009; Cao, 2016; Cook, 1988; Okulicz-Kozaryn, 2015; Okulicz-Kozaryn & Mazelis, 2016; Rodgers, 1981) studies. On the other hand, this finding supports studies suggesting that high accessibility has a positive effect on livability (Leyden et al., 2011), that density per se is not a source of dissatisfaction (Adams, 1992; Arundel & Ronald, 2017; Howley et al., 2009), and that urban sprawl can be detrimental to livability (Kunstler, 1994). It demonstrates that high density should be accompanied by other important elements in order to be livable as also supported by various theoretical studies (e.g. Carmona et al., 2003; Duany et al., 2010; Gehl, 2013; Jacobs, 1961).

This study also investigates causal mechanisms that explain its main outcomes. Despite possible personal preferences for high accessibility and urban atmosphere in the case of compact city, or for single-family detached homes, gardens, and quietness in the case of sprawl, neighborhood satisfaction appears to be higher in compact areas. The results of the quantitative and qualitative analyses indicate that the main reason for this is that common sources of urban dissatisfaction are addressed or found only to a limited degree in Oslo. Noise, traffic, litter, lack of services and facilities, and lack of greenery are usual urban problems according to previous studies (Breheny, 1997; Burton, 2000; Howley et al., 2009; Hur & Morrow-Jones, 2008). However, for this study, none of these characteristics emerged as a significant problem in compact areas. Oslo's compact areas are instead characterized by low levels of traffic, noise, and litter compared with other cities of the same size. They are also characterized by mixed commercial and residential land uses, parks in proximity to every neighborhood, as well as proximity to the sea and the forest. The only two predictors of neighborhood satisfaction for which compact areas score lower than sprawled ones are perceived safety and neighbor ties. However, their effect on neighborhood satisfaction is relatively small, especially compared with the positive effects of compactness or neighborhood attachment, as seen in Table 3. Both the relatively small coefficient of safety in Table 3, which would otherwise be larger considering the importance of safety in neighborhood satisfaction (Lovejoy et al., 2010; Parkes et al., 2002), and the qualitative interviews show that Oslo's compact areas are perceived as relatively safe. Another frequent problem detrimental to livability in dense urban areas can be poverty (Fischer, 1973). Social inequalities between and within neighborhoods have been found to negatively affect neighborhood satisfaction (Fried, 1982) and happiness in cities

(Ballas, 2013). In Oslo, nevertheless, income levels are high and similar on average in compact and sprawled areas, as median values for adjusted annual household incomes are 635,000 NOK and 636,000 NOK respectively (Table 1).

Since compact areas of Oslo appear to be more livable, one might wonder why people would choose to live in low-density suburbs. But before answering this, we need to consider that, in the case of Oslo, both compact and sprawled areas are generally of high quality and are viewed as such by their residents, something that can be seen from the high scores in neighborhood satisfaction for both types of areas (Table 1). Thus, despite the difference in scores between the two (which is however important considering the country's high living standards), it is not surprising that persons who prefer a suburban lifestyle might choose to live in a sprawled area. Apart from this consideration, a main reason for residents choosing to live in suburbs is housing prices. Compact areas are found mostly in the inner city of Oslo while the rest of the city has a higher proportion of detached housing. The city's fast population growth inflates housing prices especially in the inner city where demand is higher. Therefore, dwellings in compact areas are considerably more expensive than dwellings in sprawled areas. Besides this, there is a shortage of spacious dwellings in the inner city. As a result, when residents decide to start a family or when their family expands they often necessarily move to the suburbs in search of larger and more affordable housing. In addition to having lower housing prices, low-density suburbs are viewed by many as more suitable for families, due to being perceived as calmer and safer and offering private outdoor spaces where children can play. The fact that residents who start or expand their families may often move to sprawled neighborhoods is also highlighted in both Table 1 and Table A1, as household size and number of children in household are substantially larger in sprawled neighborhoods. Indeed, although for all other groups livability seems to be considerably higher in denser areas, for households with children it is almost similarly high in denser and less dense areas (Table 4). Criteria for neighborhood preference and selection, such as the ones discussed here, have not been tested in the empirical investigations of this article since the main scope of the article is to examine how livable or satisfying neighborhoods are and not how preferable they are or why they were preferred. The article thus mainly aims to test the outcomes of a decision and not the reasoning behind it.

Most previous relevant studies that examine the impact of density on livability do not focus on cases where both compact and sprawled areas are present. For example, Rodgers' (1981) study investigates Detroit while both Cook's (1988) and Cao's (2016) studies

investigate the Minneapolis-Saint Paul metropolitan area. All these studies find a negative association between density and livability, but neither Detroit nor Minneapolis-Saint Paul encompass typical compact areas to a high degree. On the other hand, in their study of Amsterdam, Arundel and Ronald (2017) find no significant association between density and neighborhood satisfaction. However, this study does not include low-density suburbs with detached housing. One study that provides evidence in the direction of the present article is Yang's (2008). This study examines Portland, whose central parts are relatively compact and whose outer parts are low-density suburbs, finding a small positive association between density and neighborhood satisfaction. Still, Portland, compared to Oslo, has fewer car restrictions in central areas and lower walkability, so this association might be even stronger if relevant policy measures were applied. A positive influence of compactness on livability might be expected in other compact areas within the US, for example certain areas of San Francisco or New York. Along the lines of the present study's findings, we could expect that compact areas in cities of other Nordic countries have equivalent livability to the ones in Oslo, due to many similarities among them (e.g. densities, building typology, safety, walkability, public transport, and socioeconomic characteristics). And compact areas in several other European cities could be expected to be rated highly on livability because of the long tradition Europe has in the compact city combined with a strong culture of public transport usage, walkability, and cycling. In contrast, extremely dense and large cities, such as certain Asian or, perhaps to a lesser degree, European metropolises, may not be as livable. In these cases, negative aspects of compactness, namely overcrowding, traffic, noise, lack of adequate open public space, lack of access to nature and to its restorative effects, and problems related to high-rise living, could be so significant that they might outweigh any benefits of accessibility. Replicating such a study for other building typologies, building heights and subsequently other population densities than the ones examined by the existing literature would be interesting for future research. Moreover, it would be useful to replicate this type of study in different geographical and cultural settings, but for similar types of urban forms to allow examination of the impact of cultural differences.

The three methodological approaches in this article provide measurement triangulation, which increases the validity of the results. Thereby, there is stronger evidence to support that a positive causal relationship exists between compactness and neighborhood satisfaction for the case of Oslo. Furthermore, the qualitative interview material shows examples of ways in which interviewees assess their neighborhood characteristics and how this contributes to their satisfaction with their neighborhoods. This, together with the longitudinal analysis, constructs

a stronger support for claims of causality in this study than in most research on the topic, where usually only cross-sectional statistical analyses have been applied. Nonetheless, since cross-sectional regression is the main analytical approach employed in the present study, the statistical effects identified indicate associations and not necessarily causal relationships and, thus, should be interpreted with caution. Other sources of uncertainty are that the study might have omitted other variables relevant to an individual's assessment of neighborhood satisfaction and that perceived neighborhood characteristics used in the analysis might be subject to biases.

What is also noteworthy is that although neighborhood satisfaction is a good overall indicator for a first level assessment of environmental quality and livability, it does present certain limitations. It may not on its own be sufficient to explain the whole impact of the built environment on livability. It may not capture the full range of ways in which the built environment affects various aspects of residents' lives such as personal relationships or health. For in-depth investigations, more sophisticated conceptual models and methodologies (see Mouratidis, 2017) are necessary.

## 6. Conclusion

Based on a study in Greater Oslo, this article has examined whether, and to what extent, the compact city is livable. The results provide answers to the three main research questions. Firstly, compact-city residents appear to be significantly more satisfied with their neighborhood compared with residents of sprawled suburbs. Secondly, when examining the impact of compactness within a wider range of urban form typologies, findings suggest that the higher the presence of compact-city characteristics the higher the neighborhood satisfaction. Population density has a positive association with neighborhood satisfaction as densely populated areas offer easy access to amenities, to public transport, and to other areas. However, particularly for households with children, neighborhood satisfaction is almost similarly high in denser and less dense neighborhoods. Thirdly, longitudinal results suggest that moving from a sprawled neighborhood to a compact one significantly increases neighborhood satisfaction, while moving in the opposite direction does not cause significant changes. In addition, residents who have lived in both compact and sprawled neighborhoods during the last five years seem to be significantly more satisfied when they live in compact neighborhoods.

Findings do not support claims for a compact city paradox. A compact city has the potential to be both an environmentally sustainable and a livable option. In contrast with previous studies, higher population densities are found to be neither detrimental nor irrelevant to livability. On the contrary, higher densities are found to positively influence livability. These results underline the fact that several physical and social characteristics need to be present for a livable dense urban environment. Apart from essential compact-city features such as public transport, accessibility, and mixed land uses, quantitative and qualitative material has also provided insights into other important characteristics in that regard. This material suggests that safety, the existence of parks and squares, limited noise, traffic, and litter, and limited social inequalities between and within neighborhoods may all contribute to livable compact cities.

**Acknowledgements**

This study is part of a research project on "Compact city or sprawl? The role of urban form in subjective well-being" supported by the Norwegian University of Life Sciences. I am grateful to Petter Næss and Jin Xue whose comments and suggestions substantially improved this article. For their valuable input, I would also like to thank Rolf Barlindhaug, Elaine McIntyre, Kostadis Papaioannou, Ioannis Skoulis, Anne-Karine Halvorsen Thoren and the participants of the AESOP Congress in Lisbon, Portugal (July 2017).

## Appendix

**Table A1.** Comparison of sociodemographic characteristics.

| Sociodemographic variables | Survey respondents (N=1344) | Respondents who moved from compact to sprawl (N=28) | Respondents who moved from sprawl to compact (N=36) | Population |
|---|---|---|---|---|
| | Mean | Mean | Mean | Mean |
| Age (for aged 18 or older)[1] | 50.16 | 43.75 | 37.83 | 46.30 |
| Unemployed[2] | 2.5% | 3.6% | 2.8% | 3.5% |
| Living with partner/spouse[3] | 61% | 93% | 47% | 62% |
| Non-Norwegian[1] | 9% | 7% | 8% | 21% |
| Adjusted household income (1000s NOK)[1] | 642.20 | 648.79 | 618.79 | 582.98 |
| Household size (persons)[1] | 2.22 | 2.79 | 1.89 | 1.94 |
| Number of children in household[3] | 0.54 | 0.89 | 0.19 | 0.47 |
| Household with children[3] | 32% | 61% | 14% | 27% |
| Respondent is female[1] | 53.4% | 46% | 56% | 50.3% |
| Respondent has college degree or higher[2] | 79% | 82% | 72% | 47% |

*Notes*:
[1]Population mean refers to the counties of Oslo and Akershus.
[2]Population mean refers to Oslo municipality.
[3]Population mean refers to the whole Norway.

*Sources*: Statistics Norway (2017) and European Commission (2016).

**Table A2**. Compact neighborhoods of the study.

| Neighborhood name | Neighborhood type | Population density (persons/ha) | Distance to city center (km) | Main building type | Land uses | Sample size (persons) |
|---|---|---|---|---|---|---|
| St. Hanshaugen | Compact | 203 | 2.3 | Apartment block | Mixed | 62 |
| Grønland | Compact | 205 | 1.0 | Apartment block | Mixed | 100 |
| Frogner A | Compact | 135 | 2.8 | Apartment block | Mixed | 8 |
| Frogner B | Compact | 306 | 2.6 | Apartment block | Mixed | 20 |
| Majorstuen A | Compact | 221 | 3.1 | Apartment block | Mixed | 57 |
| Majorstuen B | Compact | 247 | 2.9 | Apartment block | Mixed | 35 |
| Sagene | Compact | 267 | 3.5 | Apartment block | Mixed | 57 |
| Torshov | Compact | 135 | 3.3 | Apartment block | Mixed | 71 |
| Grünerløkka A | Compact | 171 | 1.5 | Apartment block | Mixed | 53 |
| Grünerløkka B | Compact | 244 | 2.3 | Apartment block | Mixed | 72 |

*Note*: Total sample size for compact neighborhoods N = 535.

**Table A3**. Sprawled neighborhoods of the study.

| Neighborhood name | Neighborhood type | Population density (persons/ha) | Distance to city center (km) | Main building type | Land uses | Sample size (persons) |
|---|---|---|---|---|---|---|
| Holmen | Low-density suburban | 30 | 6.0 | Detached house | Separate | 13 |
| Lofthus | Low-density suburban | 50 | 5.6 | Detached house | Separate | 17 |
| Hellerud | Low-density suburban | 44 | 7.7 | Detached house | Separate | 33 |
| Holmenkollen A | Low-density suburban | 24 | 10.5 | Detached house | Separate | 19 |
| Korsvoll | Low-density suburban | 31 | 6.5 | Detached house | Separate | 11 |
| Nordberg | Low-density suburban | 26 | 5.8 | Detached house | Separate | 13 |
| Stovner | Low-density suburban | 36 | 13.1 | Detached house | Separate | 7 |
| Nordstrand | Low-density suburban | 38 | 8.4 | Detached house | Separate | 14 |
| Hauketo | Low-density suburban | 32 | 10.1 | Detached house | Separate | 12 |
| Rykkinn | Low-density suburban | 26 | 19.2 | Detached house | Separate | 44 |
| Bærums Verk | Low-density suburban | 42 | 17.7 | Detached house | Separate | 38 |
| Stabekk | Low-density suburban | 26 | 8.6 | Detached house | Separate | 11 |
| Asker | Low-density suburban | 23 | 25.0 | Detached house | Separate | 41 |
| Nesøya | Low-density suburban | 14 | 21.6 | Detached house | Separate | 45 |
| Ski | Low-density suburban | 22 | 26.4 | Detached house | Separate | 42 |
| Oppegård | Low-density suburban | 27 | 17.6 | Detached house | Separate | 51 |
| Drøbakk | Low-density suburban | 38 | 36.0 | Detached house | Separate | 26 |
| Bjørnemyr | Low-density suburban | 26 | 46.0 | Detached house | Separate | 35 |
| Ytre Enebakk | Low-density suburban | 22 | 32.6 | Detached house | Separate | 32 |

*Note*: Total sample size for sprawled neighborhoods N = 504.

**Table A4**. Other neighborhoods of the study.

| Neighborhood name | Neighborhood type | Population density (persons/ ha) | Distance to city center (km) | Main building type | Land uses | Sample size (persons) |
|---|---|---|---|---|---|---|
| Frogner C | Inner-city mixed | 94 | 2.8 | Mixed | Mostly separate | 17 |
| Skøyen | Inner-city low density | 46 | 4.2 | Mixed | Separate | 16 |
| Grefsen | Suburban mixed | 97 | 7.6 | Mixed | Separate | 26 |
| Vålerenga | Inner-city mixed | 130 | 2.5 | Mixed | Mostly separate | 52 |
| Etterstad | Inner-city medium density | 72 | 3.2 | Apartment block | Separate | 14 |
| Høyenhall | Inner-city low density | 52 | 4.4 | Detached house | Separate | 13 |
| Østenjø | Suburban mixed | 55 | 6.4 | Mixed | Separate | 16 |
| Holmenkollen B | Suburban mixed | 60 | 10.6 | Mixed | Separate | 20 |
| Hovseter | Suburban mixed | 76 | 7.4 | Mixed | Separate | 22 |
| Ullevål | Inner-city mixed | 57 | 4.0 | Mixed | Separate | 22 |
| Berg | Inner-city low density | 35 | 4.6 | Detached house | Separate | 20 |
| Kringsjå | Suburban mixed | 73 | 6.8 | Mixed | Separate | 12 |
| Vestli | Suburban medium density | 126 | 13.6 | Apartment block | Separate | 3 |
| Tokerud | Suburban mixed | 81 | 13.8 | Mixed | Separate | 16 |
| Holmlia | Suburban mixed | 62 | 10.8 | Mixed | Separate | 13 |
| Blystadlia | Suburban mixed | 88 | 20.0 | Mixed | Separate | 23 |

*Note*: Total sample size for other types of neighborhoods N = 305.

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**Paper 3**

# Built environment and social well-being: How does urban form affect social life and personal relationships?

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**Abstract**

Personal relationships are among the most influential factors for achieving a happy life. Yet, there is insufficient empirical evidence on the role of the built environment in social life and personal relationships. This paper investigates how the urban form affects social life and personal relationships by applying structural equation models to survey data collected in Oslo metropolitan area. Results indicate that residents of compact neighborhoods are significantly more satisfied with their personal relationships compared with residents of low-density suburban neighborhoods. Shorter distances to the city center, higher densities, and mixed land uses are found to positively contribute to overall social well-being. Path analysis as well as qualitative analysis suggest that compact urban forms enable residents to maintain larger networks of close relationships, socialize more frequently with friends and family, receive stronger social support, and enjoy increased opportunities to make new acquaintances.

**Keywords**

built environment; compact city; sprawl; social relationships; quality of life; subjective well-being

**Publication status**

Mouratidis, K. (2018). Built environment and social well-being: How does urban form affect social life and personal relationships? *Cities, 74*, 7-20.

## 1. Introduction

Empirical studies examining relationships between the built environment and social well-being have been focusing on neighborhood social capital (Cabrera, 2013; Leyden, 2003; Wood et al., 2008; Ziersch et al., 2005), neighborhood sense of community (Brown & Cropper, 2001; Kim & Kaplan, 2004; Nasar, 2003; Rogers & Sukolratanametee, 2009; Wood et al., 2010), and neighbor ties (Farrell et al., 2004; Hipp & Perrin, 2009; Lund, 2003). This paper, rather than focusing on neighborhood social interactions, investigates the impact of the built environment on overall social well-being. For this purpose, the study focuses on personal relationships; an individual's relationships with friends, romantic partners, and relatives. Empirical research examining how the built environment affects an individual's overall social life and eventually personal relationships is scarce. And since strong personal relationships are considered to be one of, if not the single most important life domain in subjective well-being (Diener & Seligman, 2002; Myers & Diener, 1995; Vaillant, 2002), it is crucial to understand if and how they are influenced by the built environment and by prevalent urban forms such as the compact city and low-density suburbs (Mouratidis, 2017b).

This paper aims to develop and test models that empirically investigate if, and how, the urban form affects personal relationships. The paper answers two main research questions: (1) How does the compact city affect personal relationships? (2) How do urban form characteristics affect personal relationships? The case for this research is the metropolitan area of Oslo. This study explores its research questions by employing structural equation modeling (SEM) combined with qualitative analysis of in-depth interviews and direct comparisons of survey respondents' evaluations of the impact of neighborhood on social life. SEM allows the inclusion of mediating variables between the two main elements of interest, in this case the urban form and personal relationships. These mediating variables, along with the analysis of interviews with residents of Oslo, help explain causal relationships and provide further support for causality.

## 2. Theoretical background

### *2.1. The compact city and personal relationships*

The compact city may have well-established benefits for environmental sustainability (Jabareen, 2006; Meyer, 2013; Newman & Kenworthy, 1999), but its social impact is a subject

of academic debate (see e.g. Cao, 2016; Churchman, 1999; Lederbogen et al., 2011; Neuman, 2005; Okulicz-Kozaryn, 2015; Okulicz-Kozaryn & Mazelis, 2016). Early urban sociologists expressed their fears over the impact of large and dense cities on human relationships. Simmel (1903) observed that cities create impersonal social interactions since residents strive to adapt to the intense rhythms of urban life. He argued that big-city residents encounter numerous people in their every-day lives compared with residents of small towns or rural areas, and since they cannot engage with everyone, they eventually become emotionally detached. Similarly, Wirth (1938) noted that urbanism generates impersonal and superficial relationships between residents. Indeed empirical research suggests that social relationships at a neighborhood level are weaker in high-density urban forms (Bramley et al., 2009; Fischer, 1982; Milgram, 1970; Mouratidis, 2017a). High-rise buildings are also found to generate impersonal relationships between neighbors (Gifford, 2007).

On the other hand, Glass (1949) observed that lower densities increase physical distance which can lead to greater social distance and eventually higher social isolation and loneliness. Later on, Jacobs (1961) argued that a high concentration of people is necessary for all functions of a city. She also underlined the importance of sidewalk life for social contact and as she explains, sidewalk life is not possible in low-density suburbia. In addition to high densities, as both Jacobs (1961) and Alexander (1965) point out, neighborhoods with mixed functions are also key to increase social interaction. Mixed functions enable the movement of people locally for various reasons, increasing the use of local public spaces such as sidewalks and parks and offering opportunities for people to meet and interact. Putnam (2001) argues that sprawled development, typically found in suburbs, contributes to lower levels of social interaction. The reasoning is that as suburban dwellers travel longer distances to approach workplaces and facilities, they have less time for involvement in groups for leisure activities. In that regard, Mitrany's (2005) empirical study suggests that one of the advantages of high-density urban forms is that they offer increased opportunities for socializing. A study by Balducci and Checchi (2009) demonstrates that friends and neighbors may play a catalytic role in subjective well-being, and suggests that this relationship is affected by the accessibility to shops and meeting places as well as local opportunities for meeting people and for volunteering. Accessibility to so called "third places" (e.g. community centers, cafés, restaurants, parks, and malls), which is higher in compact areas (Burton, 2000), has been suggested to have a positive impact on quality of life (Jeffres et al., 2009). Likewise, this is supported by Leyden et al. (2011) finding that local facilities have a positive impact on quality of life in cities. Leyden and

coauthors attribute the importance of local facilities for quality of life to increased opportunities for social activities and gatherings.

Talen and Koschinsky (2014) conducted a literature review of the impact of compact neighborhoods on neighborhood social relationships observing that most empirical findings suggest that this impact is positive and significant. However, most studies examined in the review, and most existing studies in general, focus on cases relevant to New Urbanism rather than typical high-density urban cases. The cases examined are, in other words, walkable and mixed land use suburbs or small towns which are compared with typical sprawled suburbs. Limited relevant research exists on high-density neighborhoods found in cities.

What is even more important though is that most relevant empirical studies still focus on neighborhood social interactions rather that switching focus to overall social well-being. The importance of local social relationships is declining (Popenoe, 2005). As Dunkelman (2014) explains, in the past people paid more attention to neighbor ties since they did not have other alternatives, but nowadays they have the opportunity to spend time with those they love the most. This can be achieved either through face-to-face contact enabled by the increase of mobility or from distance via the rise of technology. Furthermore, since education levels and levels of specialization increase, social relationships are not built primarily based on residential proximity but rather based on common interests (Pløger, 1997). Therefore, empowered by high mobility and technology, people can develop and maintain friendships and romantic relationships with those they share common interests with, independently of whether they live in the same neighborhood. Taking all these aspects into consideration, it seems necessary that urban researchers do not only investigate neighborhood social life, which is of course still important, but pay greater attention to the impact of the built environment on all relationships with friends, family, and romantic partners.

To sum up, it seems that compact urban forms – characterized by high density, high accessibility, public transport, and mixed land uses (Burton et al., 2003; Lee et al., 2015) – may create more opportunities for socializing; whereas, suburban forms may foster closer social ties at the neighborhood level. These two aspects, opportunities for socializing and neighbor ties, are, however, just some of the components of overall social well-being. There is still little evidence on how urban form affects overall social well-being. This issue could be assessed by investigating satisfaction with personal relationships, which is a more inclusive measure – since

it encompasses relationships with friends, family, and romantic partners – and thus a stronger predictor of happiness (Diener & Seligman, 2002; Vaillant, 2002).

### *2.2. Predictors of personal relationships*

Marriage or intimate relationships and relationships with family and friends, defined as personal relationships, are important predictors of subjective well-being (Dolan et al., 2008). The happiest people tend to have stronger personal relationships (Diener & Seligman, 2002). On the other hand, loneliness is increasing (Wilson & Moulton, 2010), posing threats to physical and mental health (Hawkley & Cacioppo, 2010; Holwerda et al., 2014) and affecting mortality similarly to other well-established risk factors (Holt-Lunstad et al., 2010). But what are the predictors of strong, satisfying personal relationships?

Marital status, number of close relationships, frequency of meeting friends and relatives, support received from close relationships, and opportunities for social contact are all relevant indicators (Masi et al., 2011; McDowell, 2006; Sirgy, 2012). Empirical evidence shows that marriage and romantic relationships have an important impact on subjective well-being (Blanchflower & Oswald, 2004; Helliwell, 2003; Lucas & Dyrenforth, 2006; Myers, 1999). Furthermore, people who have many friends are found to have higher levels of subjective well-being than those who have few friends, and people who see friends more often are happier than those who spend more time alone (Lucas & Dyrenforth, 2006). Those with more friends are also found to have less mental distress (Hintikka et al., 2000). In addition to socializing with friends, spending time with family members is also positively associated with subjective well-being (Dolan et al., 2008). Positive relationships with both friends and family are suggested to have a positive impact on health (Seeman, 2000). Improving social support – which depends on both the number of relationships as well as the frequency of socializing (McDowell, 2006) – and enhancing opportunities for social contact have both been suggested as measures to address loneliness and its associated risks (Masi et al., 2011).

Conceptual models explaining the influence of urban form on personal relationships satisfaction have not been developed and examined adequately in previous empirical research. This study aims to develop and empirically examine such models. The number of close relationships, frequency of socializing, social support, and opportunities to meet new people are all aspects relevant to personal relationships that play a role in subjective well-being. Since personal relationships satisfaction is a strong predictor of subjective well-being and these

aspects are all relevant to personal relationships, this study will examine these aspects as intermediate variables between urban form and personal relationships satisfaction. In other words, they will be examined as predictors of personal relationships satisfaction that could be influenced by the urban form. Living with a spouse or partner will also be examined as a control variable as it may influence some of these intermediate variables as well as personal relationships satisfaction.

## 3. Data and methods

### *3.1. Study area*

The study area for this paper is the metropolitan area of Oslo. The inner city of Oslo contains predominantly compact neighborhoods characterized by high density, public transport, and mixed land uses, while the inner and outer suburban neighborhoods are mostly characterized by single-family housing, car reliance, and separate land uses. This contrast in Oslo's urban structure is highlighted by research on residents' traveling distances and transport modal split (Næss, 2016b). The strong presence of both typical compact and typical low-density suburban neighborhoods allows us to examine the possible influence of urban form on personal relationships within a diverse range of neighborhood attributes.

### *3.2. Data sources*

This study uses data collected through a questionnaire survey and 10 qualitative in-depth interviews, both conducted in May-June 2016. Participants in both the survey and the interviews were residents of the metropolitan area of Oslo. The survey covered 45 neighborhoods in total, within various central and suburban locations (Figure 1). Selected residents were invited to participate by letter with a link to an online questionnaire. The choice of neighborhoods as well as the number of letters sent to each neighborhood was made aiming to generate a socioeconomically representative sample that includes large numbers of both compact-city and low-density suburban residents. Thus, the study aims to achieve high representativeness in diverse urban forms, and not necessarily a highly representative sample within each of the 45 neighborhoods. The questions of the survey were addressed at the individual level and only one person per household received a letter. Participants were 18 years or older, but apart from this they were randomly selected within each case neighborhood. The

survey did not include any incentives or reminder letter. The questionnaire was pilot-tested firstly and then revised accordingly. The number of valid responses was 1344 and the response rate was 13.8%. Survey respondents were asked whether they would also be willing to participate in a personal interview. Based on this, 10 interviewees were selected, 5 from compact and 5 from low-density suburban areas.

The sample's sociodemographic characteristics do not deviate much from the population, but there are some differences (Table A1 in Appendix). Survey participants are on average slightly older and slightly more highly educated than the population. Immigrant populations are underrepresented in the survey as their response rate is lower. Altogether, these aspects contribute to relatively higher incomes among the respondents than among the population. Moreover, couples are overrepresented in the survey. Nevertheless, because relevant variables are controlled for in SEM analysis, these biases are not expected to significantly affect results in the present study.

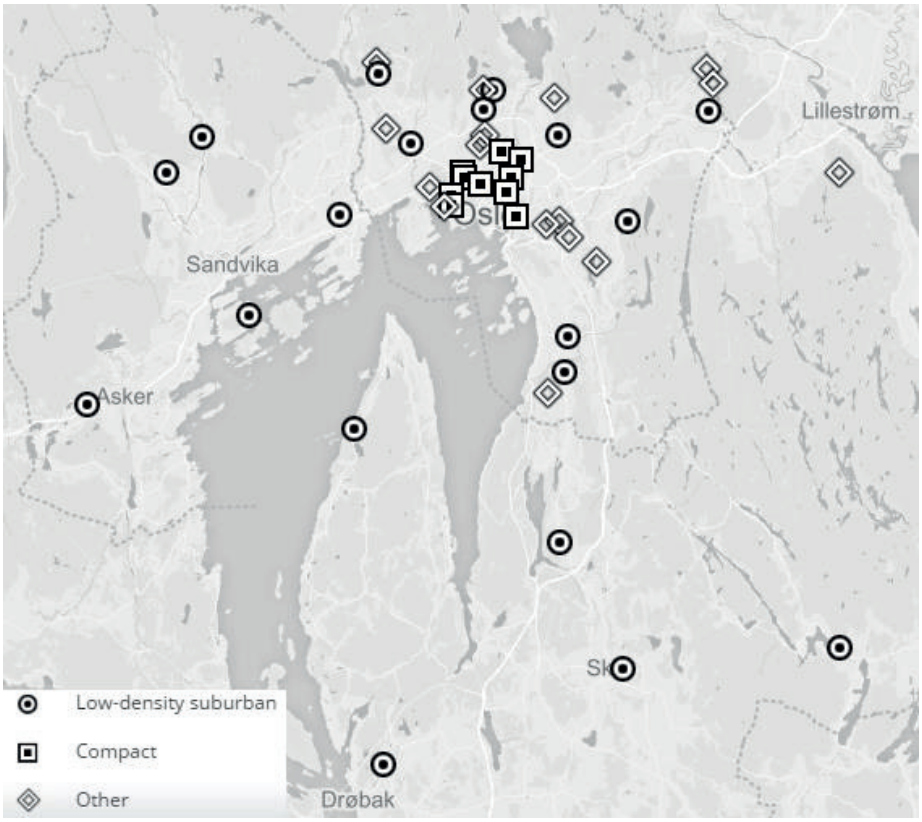



**Figure 1.** Selected neighborhoods within the metropolitan area of Oslo.

### *3.3. Variable descriptions*

Table 1 shows descriptive statistics for all variables used in the quantitative analysis. The main endogenous variable used is satisfaction with personal relationships, and this was measured through the survey. Participants were asked to evaluate how satisfied they are with their personal relationships on a scale from "extremely dissatisfied" (0) to "extremely satisfied" (10). In addition, they were asked to evaluate determinants of personal relationships satisfaction: support from close relationships, number of close relationships, and frequency of socializing with friends or relatives (who do not live in the same dwelling). The phrasing used for these questions is similar to the one used in the European Social Survey (2012). Survey participants also evaluated opportunities to meet new people on a rating scale from "very low" (1) to "very high" (5).

The study employs two approaches to examine the impact of the urban form on personal relationships. The first approach uses an exogenous dichotomous variable "compact neighborhood" where 0 is low-density suburban neighborhood and 1 is compact neighborhood. This variable is used to evaluate the effect of compact-city principles on personal relationships and applies to analysis with participants solely from compact and low-density suburban neighborhoods. Sample from other types of urban forms is excluded when this variable is used. The categorization of a neighborhood into compact, low-density suburban, or other (see Appendix for details) is based on each respondent's residential address. A neighborhood is classified as compact when high population densities, apartment blocks, and mixed commercial and residential land uses are all present, and as low-density suburban when low population densities, detached housing, and separate land uses are all present. Mean population densities are 211 persons per hectare for compact neighborhoods and 29 persons per hectare for low-density suburban neighborhoods. Other types of neighborhoods that fall between these two categories, and are not included in the analysis for this approach, are neighborhoods with mixed types of housing or medium densities, or low-density neighborhoods within the inner city. All these neighborhoods have mostly separate land uses. Of course, the boundaries for such categorizations could be slightly different, but as tested in preliminary analysis the trends of the results would not materially change.

The second approach employed to examine the impact of the urban form on personal relationships investigates detailed urban form characteristics and draws sample from all types of neighborhoods. Three basic characteristics of the physical form are assessed: density,

accessibility, and land use mix. Density is examined with neighborhood population density, measured by dividing the population of each area by the area coverage in hectares. Accessibility is examined with distance to city center, measured from the centroid of each neighborhood. Land use mix is examined with the number of cafés, restaurants, bars, and community centers within a radius of 1000 m from the centroid of each neighborhood. For this variable, the logarithm is taken in the SEM analysis to ensure that the normal distribution assumption holds.

SEM analysis also controls for the following sociodemographic variables: age, employment status, living with partner or spouse, household income, and gender. Household income has been adjusted for household size with one of the most commonly used equivalence scales, the square-root transformation of household size (Francoeur, 2002). Other sociodemographic variables, such as citizenship, education level, household size, presence of children in household, and number of children in household were assessed in preliminary analysis but did not demonstrate any significant effect on personal relationships satisfaction.

**Table 1.** Descriptive statistics of all variables.

| Variables | N | Min/Max | All (N=1344) | | Compact (N=535) | | Suburban (N=504) | | *t*-Test |
|---|---|---|---|---|---|---|---|---|---|
| | | | Mean | s.d. | Mean | s.d. | Mean | s.d. | |
| Satisfaction with personal relationships | 1315 | 0/10 | 7.57 | (1.91) | 7.57 | (1.91) | 7.53 | (1.90) | |
| Support from close relationships | 1229 | 1/5 | 4.16 | (0.87) | 4.19 | (0.85) | 4.09 | (0.92) | |
| Number of close relationships | 1316 | 1/7 | 4.17 | (1.47) | 4.44 | (1.36) | 3.88 | (1.52) | * |
| Frequency meeting friends/relatives | 1339 | 1/7 | 4.48 | (1.31) | 4.82 | (1.30) | 4.17 | (1.25) | * |
| Opportunities to meet new people | 1276 | 1/5 | 3.54 | (0.96) | 3.87 | (0.89) | 3.30 | (0.94) | * |
| Neighborhood influence on social life | 1289 | 1/5 | 3.81 | (0.75) | 3.96 | (0.72) | 3.64 | (0.74) | * |
| *Compactness* | | | | | | | | | |
| Compact neighborhood | 1039 | 0/1 | 0.51 | (0.50) | 1.00 | (0.00) | 0.00 | (0.00) | * |
| *Urban form measures* | | | | | | | | | |
| Population density (persons/ha) | 1341 | 14/306 | 112.93 | (88.04) | 211.23 | (44.12) | 28.73 | (9.11) | * |
| Distance to city center (km) | 1344 | 0.70/46.20 | 10.22 | (10.84) | 2.39 | (0.87) | 20.47 | (11.04) | * |
| Cafés, restaurants, and bars (within 1000 m) | 1341 | 0/272 | 68.97 | (79.98) | 152.84 | (63.32) | 8.45 | (7.70) | * |
| *Sociodemographic variables* | | | | | | | | | |
| Age | 1344 | 19/94 | 50.16 | (15.71) | 43.06 | (14.40) | 55.78 | (14.18) | * |
| Unemployed | 1339 | 0/1 | 0.03 | (0.16) | 0.03 | (0.17) | 0.02 | (0.14) | |
| Living with partner/spouse | 1329 | 0/1 | 0.61 | (0.49) | 0.49 | (0.50) | 0.74 | (0.44) | * |
| Adjusted household income (1000s NOK)[1, 2] | 1259 | 35/4330 | 642.20 | (321.08) | 625.02 | (288.68) | 669.09 | (361.27) | * |
| Respondent is female | 1331 | 0/1 | 0.53 | (0.50) | 0.52 | (0.50) | 0.54 | (0.50) | |
| Non-Norwegian | 1342 | 0/1 | 0.09 | (0.28) | 0.11 | (0.31) | 0.08 | (0.27) | |
| Household size (persons) | 1335 | 1/6 | 2.22 | (1.15) | 1.95 | (1.05) | 2.56 | (1.21) | * |
| Number of children in household | 1334 | 1/4 | 0.54 | (0.88) | 0.33 | (0.71) | 0.77 | (1.00) | * |
| Household with children | 1334 | 0/1 | 0.32 | (0.47) | 0.20 | (0.40) | 0.43 | (0.50) | * |
| Respondent has college degree or higher | 1341 | 0/1 | 0.79 | (0.41) | 0.84 | (0.37) | 0.74 | (0.44) | * |

*Notes*: *A t-test of difference in mean shows significant differences between compact and low-density suburban at $p < 0.05$.
[1]Household income divided by the square root of household size.
[2]Median adjusted household income is 635,000 NOK for compact and 636,000 NOK for low-density suburban residents.

### *3.4. Analysis approach*

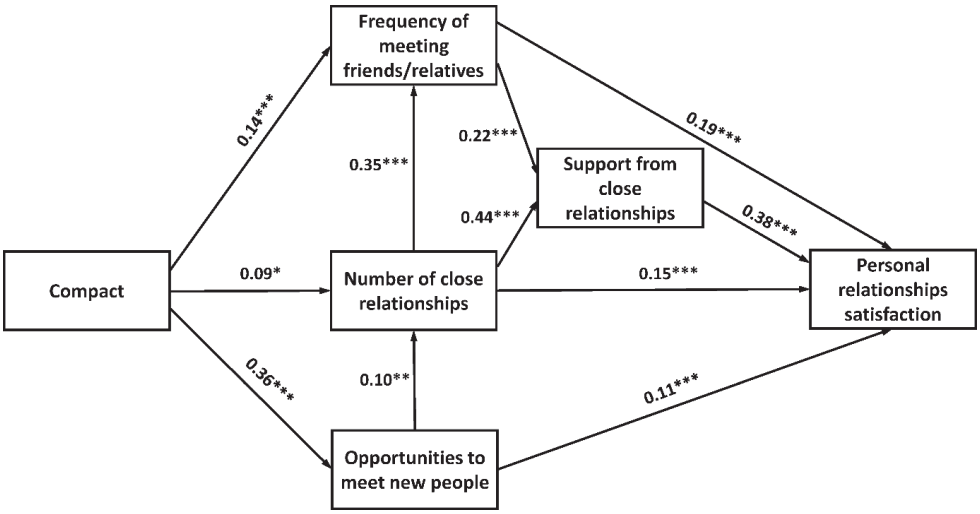
To investigate its research questions, this study employs SEM (see e.g. Byrne, 2016) along with qualitative analysis of in-depth interviews and direct comparisons of survey respondents' evaluations of the impact of neighborhood on social life. For SEM analysis, software AMOS (version 24) is used. SEM is the preferred main analytical approach in this study because the examined relationships are complex, consisting of mediating factors besides the main variables of interest. SEM calculates both direct and indirect effects as well as total effects (direct plus indirect) specified in the theoretical model. These capabilities of SEM allow testing theoretical models that attempt to explain causal mechanisms.

Structural equation models comprise path analysis and potentially latent variables. For the purposes of this study, only path analysis is employed. Maximum likelihood estimation is used along with bootstrap of 1000 replications. Bootstrapping allows the calculation of approximate significance levels of total effects in SEM. Two structural equation models are developed and path analysis is conducted for each of them. Model 1 examines the effect of compactness on personal relationships and on several mediating factors between the two. This model uses sample only from compact and low-density suburban neighborhoods (N = 867). Model 2 is more detailed and examines the influence of detailed urban form measures on personal relationships and on mediating factors. This model uses sample from all neighborhoods (N = 1081). Sample sizes are reduced due to excluding cases with missing values, as required by bootstrapping. Results, nevertheless, remain equivalent to those without such exclusion. Control variables and error terms are not shown in the model diagrams to reduce complexity and present parsimonious diagrams.

## 4. Results

### *4.1. Compactness and personal relationships*

Figure 2 shows the standardized direct statistical effects of the path analysis for Model 1. Results confirm theoretical considerations on the mediating factors between the urban form and personal relationships satisfaction. As shown in the diagram, compactness is found to have statistically significant direct positive effects on opportunities to meet new people, number of close relationships, and frequency of socializing. Results also suggest that opportunities to meet new people have a direct positive effect on the number of close relationships, which in turn has a direct positive effect on the frequency of socializing. As expected, the number of close relationships and the frequency of socializing are found to directly influence social support. These three variables along with opportunities to meet new people have statistically significant direct positive effects on personal relationships satisfaction.




*Notes*: † p<.10, * p < .05, **p < .01, ***p < .001. Sociodemographics are controlled for but for simplicity are not shown in the diagram. The direct effects of compactness on support from close relationships and personal relationships satisfaction are included in the analysis, but, as they are nonsignificant, are not shown in the diagram to reduce complexity.

**Figure 2.** Model 1: Compactness and personal relationships.

Table 2 summarizes the standardized total (direct plus indirect) statistical effects. The fit indices RMSEA = 0.041 and CFI = 0.995 indicate a good fit for this model. The squared multiple correlation (SMC) for satisfaction with personal relationships is 0.408, thus a large amount of variance is explained in the model.

After controlling for sociodemographics, compactness has positive and significant standardized total effects on the number of close relationships, on the frequency of meeting friends and relatives, on support from close relationships, on opportunities to meet new people, and ultimately on satisfaction with personal relationships (Table 2). In other words, results suggest that residents of compact neighborhoods are in general more satisfied with their personal relationships as they have larger networks of close relationships, meet friends and relatives more regularly, receive stronger social support, and have more opportunities to meet new people compared with residents of low-density suburban neighborhoods. The standardized total effect of compactness on personal relationships satisfaction (0.105) is significant both statistically and practically since personal relationships are affected by a variety of factors.

Sociodemographic variables also contribute to personal relationships satisfaction (Table 2). Age is negatively associated with the number of close relationships, the frequency

of meeting friends and relatives, and support from close relationships. Nonetheless, it is positively associated with personal relationships satisfaction. This may seem paradoxical but is explained by the fact that although the evaluation of determinants of personal relationships may decrease with age, personal expectations may also decrease. Therefore, an older person might be less demanding when evaluating satisfaction with personal relationships. As expected, unemployment is found to negatively contribute to personal relationships satisfaction and all relevant determinants, since it not only negatively affects income but also social interactions and psychological well-being (Darity & Goldsmith, 1996). On the other hand, as expected, living with a partner or spouse positively affects personal relationships satisfaction as well as social support. It is, nevertheless, negatively associated with the frequency of meeting friends and family. This is reasonable and consistent with relevant research (e.g. Demir, 2010) as having an intimate relationship may decrease the needs for socializing with others. Females are found to be more satisfied with their personal relationships than males since they have a larger number of close relationships, meet friends and relatives more frequently, and receive stronger social support. Income is also found to have a positive association with personal relationships satisfaction and most relevant determinants.

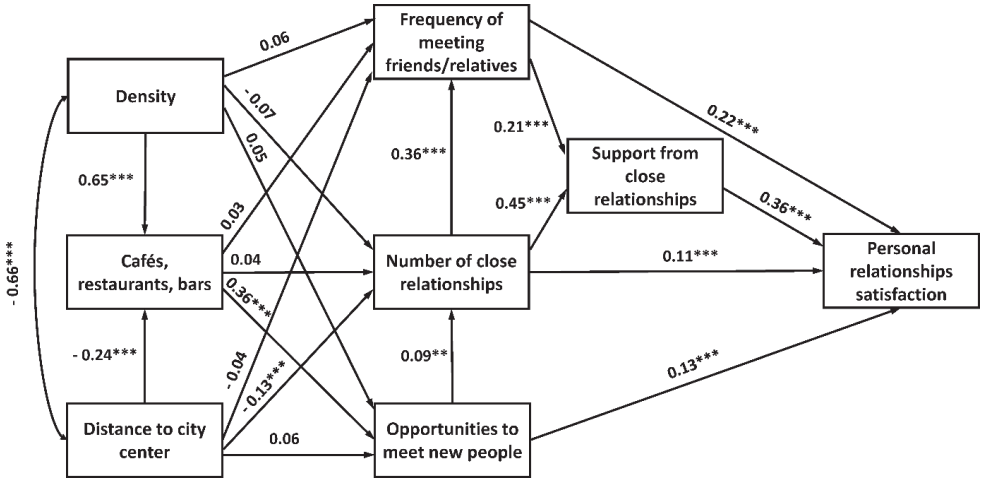
**Table 2.** Standardized total (direct and indirect) effects of Model 1.

| | Endogenous variable | | | | |
|---|---|---|---|---|---|
| | Opportunities to meet new people | Frequency meeting friends/relatives | Number of close relationships | Support from close relationships | Personal relationships satisfaction |
| *Compactness* | | | | | |
| Compact neighborhood | 0.361** | 0.177** | 0.120*** | 0.094* | 0.105** |
| *Determinants of personal relationships* | | | | | |
| Opportunities to meet new people | | 0.034** | 0.098** | 0.051** | 0.152** |
| Frequency meeting friends/relatives | | | | 0.217*** | 0.271** |
| Number of close relationships | | 0.352** | | 0.519** | 0.414** |
| Support from close relationships | | | | | 0.381** |
| *Controls* | | | | | |
| Age | 0.065 | -0.135** | -0.207** | -0.070† | 0.079* |
| Unemployed | -0.002 | -0.092* | -0.078† | -0.129** | -0.154*** |
| Living with partner/spouse | 0.098** | -0.080* | 0.010** | 0.076** | 0.126** |
| Female | -0.020 | 0.099* | 0.227** | 0.171** | 0.147** |
| Adjusted household income | -0.034 | 0.074* | 0.057† | 0.089* | 0.107** |
| *Summary statistics* | | | | | |
| Squared multiple correlation | 0.109 | 0.209 | 0.142 | 0.346 | 0.408 |

*Notes*: † p<.10, * p < .05, **p < .01, ***p < .001. Significance levels for total effects are bootstrap approximations.
Number of observations = 867. Bootstrap replications = 1000.
Goodness-of-fit measures: $X^2 = 12.422$, df = 5, p = 0.029; Root Mean Squared Error of Approximation (RMSEA) = 0.041 < 0.08; Comparative Fit Index (CFI) = 0.995 > 0.93.

### *4.2. Urban form measures and personal relationships*

Figure 3 shows the standardized direct statistical effects of the path analysis for Model 2. Table 3 summarizes the standardized total (direct plus indirect) statistical effects. The fit indices RMSEA = 0.036 and CFI = 0.996 indicate a good fit for this model. The squared multiple correlation (SMC) for satisfaction with personal relationships is 0.390.




*Notes*: † p<.10, * p < .05, **p < .01, ***p < .001. Sociodemographics are controlled for but for simplicity are not shown in the diagram. The direct effects of urban form measures on support from close relationships and personal relationships satisfaction are included in the analysis, but, as they are nonsignificant, are not shown in the diagram to reduce complexity.

**Figure 3.** Model 2: Urban form measures and personal relationships.

Table 3 suggests that density has significant positive total effects on opportunities to meet new people and frequency of socializing, while its effect on other variables is nonsignificant. Cafés, restaurants, bars, and community centers exhibit significant positive total effects on opportunities to meet new people and considerable, but not statistically significant, positive effects on the other variables. Results suggest that when all three main urban form measures are examined in the same model, it is distance to city center that has the strongest and most significant total effect on personal relationships satisfaction. Residents living closer to the city center are found to be significantly more satisfied with their personal relationships and to have larger networks of close relationships, meet friends and relatives more regularly, and receive stronger social support.

An additional analysis conducted for different groups suggests that the positive effect of shorter distances to city center on number of close relationships, frequency of socializing, and social support is slightly stronger for households without children compared with households with children. On the other hand, the effect on opportunities to meet new people is significantly stronger for households with children, which may explain why the effect on personal relationships satisfaction is found to be slightly stronger for households with children. Since it is not easy for parents with young children to travel to other areas for leisure (due to time restrictions, organizing babysitting etc.), they may evaluate long distances to places where they can meet new people more negatively than nonparents do. And nonparents, who in general tend to socialize at a larger geographical scale, are more negatively influenced by long distances regarding the frequency of social gatherings or the number of friends compared with parents, who in any case tend to socialize locally.

It should be mentioned that distance to city center and density are closely related since higher densities reduce distances, and the city center and the areas around it are mostly dense, thus offering accessibility benefits. As results in Table 3 indicate, a low or medium density neighborhood in the inner city (see examples in Table A4) yields similar personal relationships satisfaction as a high-density inner-city (compact) neighborhood because of similar distance to city center, but the high-density neighborhood may offer more opportunities to meet new people and may enable more frequent socializing. Neighborhood density may not play a direct role in personal relationships satisfaction, but it plays an indirect role by contributing to overall density which can significantly increase or decrease distances and accessibility. To achieve the desirable short distances and high accessibility, high densities and less spatially dispersed development are required. The significant positive effects of short distances found here in the results of Model 2 confirm that compactness positively influences personal relationships as also found in the results of Model 1, providing measurement triangulation and increasing the validity of the study.

**Table 3.** Standardized total (direct and indirect) effects of Model 2.

| | Endogenous variable | | | | | |
|---|---|---|---|---|---|---|
| | Cafés, restaurants, and bars (log) | Opportunities to meet new people | Frequency meeting friends/ relatives | Number of close relationships | Support from close relationships | Personal relationships satisfaction |
| *Urban form measures* | | | | | | |
| Population density | 0.652** | 0.285** | 0.072† | -0.019 | -0.004 | 0.016 |
| Distance to city center | -0.243*** | -0.028 | -0.094* | -0.138** | -0.089* | -0.093* |
| Cafés, restaurants, and bars (log) | | 0.358** | 0.058 | 0.074 | 0.066 | 0.058 |
| *Determinants of personal relationships* | | | | | | |
| Opportunities to meet new people | | | 0.032* | 0.091* | 0.047* | 0.168** |
| Frequency meeting friends/relatives | | | | | 0.206** | 0.290** |
| Number of close relationships | | | 0.356** | | 0.518** | 0.374** |
| Support from close relationships | | | | | | 0.360** |
| *Controls* | | | | | | |
| Age | | 0.048 | -0.146** | -0.219** | -0.110** | 0.062* |
| Unemployed | | -0.025 | -0.086** | -0.071* | -0.104** | -0.145** |
| Living with partner/spouse | | 0.125** | -0.081** | 0.011** | 0.080** | 0.131** |
| Female | | 0.002 | 0.082** | 0.231** | 0.173*** | 0.159** |
| Adjusted household income | | 0.010 | 0.070* | 0.077** | 0.089** | 0.106** |
| *Summary statistics* | | | | | | |
| Squared multiple correlation | 0.693 | 0.123 | 0.198 | 0.148 | 0.344 | 0.390 |

*Notes*: † p<.10, * p < .05, **p < .01, ***p < .001. Significance levels for total effects are bootstrap approximations.
Number of observations = 1081. Bootstrap replications = 1000.
Goodness-of-fit measures: $X^2 = 29.081$, df = 12, p = 0.004; Root Mean Squared Error of Approximation (RMSEA) = 0.036 < 0.08; Comparative Fit Index (CFI) = 0.996 > 0.93.

### *4.3. Impact of distance to city center on social life*

To compound stronger support for claims of causality, this study also examines the impact of the distance to the city center on social life by directly questioning survey participants. In particular, they were asked to evaluate how their neighborhood influences their social life on a scale of 1 (*very negatively*) to 5 (*very positively*). To achieve greater consistency, survey participants were asked to identify their neighborhood as the local area within 15 minutes walking distance from their residence. Social life, although closely related, should not be interpreted as satisfaction with personal relationships. This question is more relevant to the endogenous variables on opportunities to meet new people, the number of close relationships, the frequency of meeting friends and relatives, all of which are however significant determinants of personal relationships satisfaction. Results in Figure 4 suggest that social life is positively influenced by shorter distances to the city center. This finding provides further

support to the results of SEM which indicate that compact urban forms may increase opportunities to meet new people and enable residents to maintain more close relationships and to socialize more often with friends and relatives.

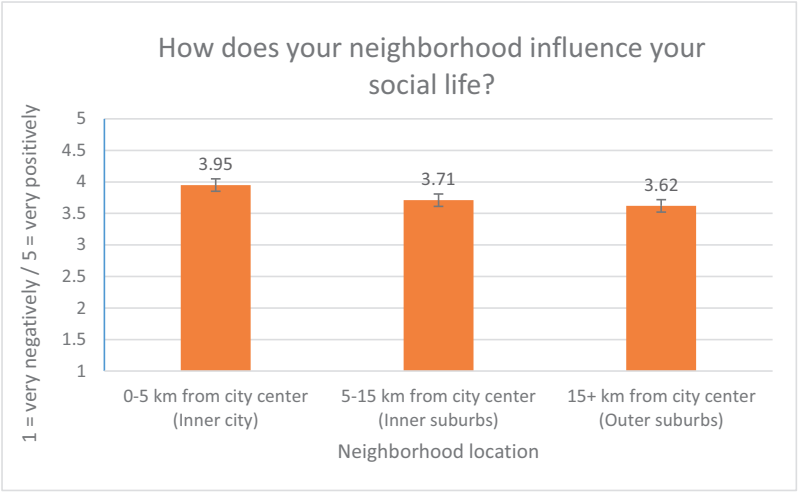



**Figure 4.** Impact of distance to city center on social life.

### *4.4. Qualitative analysis*

Analysis of in-depth qualitative interviews is important for this type of study since it can provide insights into causality and causal mechanisms (Næss, 2015, 2016a). Particularly in this study, qualitative analysis can help further discern whether there exists a causal relationship between compactness and satisfaction with personal relationships and, in that case, why and how this relationship is shaped. As cities are complex and different from each other both structurally and culturally, qualitative material may additionally shed light on the context of social life in the specific case of the Oslo metropolitan area.

The first part of the analysis examines the value placed on personal relationships by both compact and low-density suburban residents. The interviewees were asked what is important to them when defining a good life. As expected, personal relationships emerge as a major contributor to quality of life. Six out of ten interviewees mentioned personal relationships and social life first when responding to this question. Three of these respondents live in compact and three live in low-density suburban areas. Their responses are as follows:

> Friends, social… Social life is very important. I think that is the most important of all. (Male, suburban area resident, 46 years)
>
> …it's more of a personal nature. You know… You know… Relationships and stuff like that. (Male, suburban area resident, 36 years)
>
> To have good friends, to have a nice job. Good colleagues. To feel important. To feel that you are part of society and you can contribute and give something back. (Female, suburban area resident, 62 years)
>
> Time to spend with my friends and family. And… (Female, compact area resident, 32 years)
>
> The people are the most important things to me. Nice, interesting people around me. (Female, compact area resident, 52 years)
>
> Friends, family… (Female, compact area resident, 39 years)

The other four participants provided differing views. These responses not only confirm claims of how important personal relationships are for quality of life, but also suggest that they are similarly important to both residents of compact as well as low-density suburban areas.

Quantitative results from SEM and direct questioning in the present study imply that compactness facilitates social life and personal relationships. This is further highlighted by several interviewees' responses such as:

> I hope I will have more time to do things after work [*when I move more centrally*]. And that would be easier. But mostly I hope I can catch up with my friends more often. (Female, suburban area resident, 30 years)
>
> I'm more social there [*in compact area*] than I was before [*in low-density suburban area*] so I do like that, yeah. (Female, compact area resident, 52 years)
>
> It makes it easier to relations and stuff. More urban… (Female, compact area resident, 39 years)

As with results from direct questioning in the previous section, all these qualitative findings, at least partially, contribute to dismissing possible claims that compactness is positively associated with satisfaction with personal relationships primarily due to neighborhood self-selection. In other words, it does not seem that people who place lower value on relationships choose to live in low-density suburbs, while socially inclined extroverts prefer compact areas. Indeed, as residents' responses suggest, it is the urban form that seems to play a major part in the fact that suburban dwellers have smaller social networks, socialize less frequently, and have fewer opportunities to meet new people compared with compact-city dwellers.

But why does the structure of the compact city facilitate social life and personal relationships ? Interview data analysis suggests that this can be attributed to three factors: (1) more people within close proximity due to high density and centrality, (2) higher access to third places, and (3) higher access to and from other areas due to centrality and public transport.

The fact that having *more people within close proximity* makes socializing more accessible is explained by Festinger et al. (1950) at the micro-level of a student dormitory. In the present study, this effect is extended to the macro-level of the city region and is supported by the quantitative findings from SEM which show that compactness is positively associated with the number of close relationships and the frequency of socializing. This effect is also qualitatively implied for example here:

> Easy to get to everyone and everything. (Female, compact area resident, 52 years)

> The people make the area to a great extent because if nobody uses cafés there wouldn't be any social life here, it wouldn't help if they [*the cafés*] were here. But then again, if the cafés and the outdoor spaces weren't here, people wouldn't have any place to gather. (Female, compact area resident, 52 years)

This final quote suggests that to facilitate social life both a high concentration of people and *third places* for them to gather are necessary. Third places vary from cafés, restaurants, and parks, to hair salons and public libraries, and are thought to nourish sociability (Oldenburg, 1999). Indeed, local amenities are found to be positively associated with social life and personal relationships in the quantitative results presented earlier. Third places seem to influence social life and personal relationships in multiple ways. They may provide motivation for people to simply meet socially or participate in leisure activities together, and they also increase chances of spontaneously meeting preexisting or new acquaintances. Local residents may visit these places and meet other local residents or residents from other areas who are attracted by these places. Hence, third places offer opportunities for local residents to more frequently meet friends and relatives and also to make new friends or meet a new partner. These insights emerge from interviewees' responses such as the examples below:

> …socially it's very good. With all the cafés and restaurants and the parks that are around here. It's easy to find something to do. And also, most of the times if we have friends visiting or we are going out to meet friends, we end up here. Because this is where everything is happening more or less. (Female, compact area resident, 32 years)

> …we can meet [*with friends*] here [*at home*] or at the restaurant. And that offer is very good. We can choose. (Male, compact area resident, 76 years)

> …that's been very practical with living here because there are so many nice places to go out, so then I can go home. So that's still an advantage. (Female, compact area resident, 39 years)

The third factor explaining why social life is facilitated in compact neighborhoods is *higher access to and from other areas*. Shorter distances to other parts of the city due to centrality, and higher accessibility due to better public transport, make it easier for compact-city residents to socialize with friends and relatives. They can more easily travel to other parts of the city or other parts of the country and, in addition to this, meet suburban acquaintances who visit compact areas for work or leisure. The role of higher access to and from other areas for compact-city residents is expressed below:

> …it's easy for me to meet my friends. And also because I live so close to like the real central part, it's easy for me to go back home to my family, that is important. And just having everything I need in the area. And having people around me. (Female, compact area resident, 33 years)

> … I have some friends [*in other areas of Oslo*], but mainly our friends are in this area. […] we meet people from here or in the neighborhood. And even my friends, old friends from Grefsen area they… We don't have any contact with them apart from one that moved to this area. (Male, suburban area resident, 46 years)

The second quote may imply that low-density suburban dwellers tend to maintain relationships in a local context because of lower access to other areas, and this can additionally explain why low-density suburban dwellers maintain smaller social networks and enjoy fewer opportunities for socializing.

## 5. Discussion

Findings of this study suggest that the built environment can influence social life and personal relationships. Such findings can contribute to academic and policy debates on quality of life and urban sustainability (Mouratidis, 2017b), considering the lack of previous in-depth empirical investigations on this topic. Although associated with impersonal social interactions (Simmel, 1903; Wirth, 1938) and weaker ties at the neighborhood level (Bramley et al., 2009; Mouratidis, 2017a), compactness has been found to promote significantly higher overall social

well-being. Indeed, even though compact-city residents may not even know the people living in the same apartment block, they do have more close relationships, with which they socialize more frequently, and they receive more emotional and functional support as compared with residents of low-density suburbs. The larger social network and support found in compact areas could lead to a decreased need for developing strong social bonds with neighbors. In fact, compact-city residents seem to have better chances of making a new friend or meeting a new partner despite weak neighbor ties. For all these reasons, they seem to be happier with their personal relationships.

These findings confirm claims that there are more opportunities for socializing in dense, mixed land use areas (Balducci & Checchi, 2009; Gehl, 2013; Jacobs, 1961; Mitrany, 2005), in contrast to low-density suburban areas where people may spend less time in social activities (Putnam, 2001). The study confirms that compact urban forms facilitate access to people, which has been found to be one of the reasons compact-city residents can be more satisfied with their neighborhood than low-density suburban residents (Mouratidis, 2017a). Results may also implicitly support Festinger's idea of "propinquity effect" which indicates that people who live closer to one another are more likely to develop close relationships (Festinger et al., 1950). Findings are also in agreement with the idea that local facilities are important for quality of life (Jeffres et al., 2009; Leyden et al., 2011) and that mixed land uses may positively affect social ties (Cabrera & Najarian, 2013; Duany et al., 2001; Duany et al., 2010; Leyden, 2003). Likewise, findings empirically confirm the significance of third places on sociability and quality of life as it has been theoretically emphasized (Carmona, 2015; Carmona et al., 2010; Gehl, 2011; Oldenburg, 1999), thus providing necessary empirical evidence to urban theories (Bettencourt & West, 2010; Marshall, 2012).

One limitation of the study is that its quantitative part is based on a cross-sectional research design. In this paper, it is suggested that there are causal relationships between the urban form, social life, and satisfaction with personal relationships, and the results were generalized to suggest effects and influences. Since the quantitative data analyzed here are cross-sectional, the statistical effects identified indicate correlations and not necessarily causal relationships and, thus, should be interpreted with caution. Although detailed SEM, qualitative analysis, and direct questioning offer strong support for causality in this study, future research could explore this topic further using longitudinal data. Moreover, future qualitative research could provide additional insights into this topic by further exploring the role of urban form in social networks and community involvement.

It should be noted that findings reflect Oslo's context, which does not necessarily represent other urban environments and other sociocultural backgrounds. It cannot be assumed that the results would be equivalent if the examined area possessed different structural characteristics such as extremely high densities with high-rise buildings or if there were not sufficient public transport provisions and limited car usage in compact areas. Furthermore, the social context must be taken into consideration for the case of Norway and Oslo in particular. Perhaps the results might be different for a city where social inequalities are high between and within neighborhoods. Social equality is recognized as being very important for happiness in cities (Ballas, 2013) and for neighborhood quality (Fried, 1982). Income inequalities in Oslo are relatively low, with income levels being high and similar on average for compact and low-density suburban areas. Median values for adjusted household incomes among survey participants from these two neighborhood types are almost identical (635,000 NOK and 636,000 NOK respectively). Since other cities may differ from Oslo in terms of physical form or socioeconomic characteristics, future studies should continue to explore the relationship between the built environment and social well-being in different cities in order to provide insights from a wider set of contexts.

## 6. Conclusion

This paper investigates the impact of the urban form on overall social well-being by focusing on social life and personal relationships. This contribution is important because prior empirical evidence on this topic is insufficient, with most relevant studies examining social relationships only between local residents at a neighborhood level. In modern times of high education, specialization, and mobility, such local social ties are of less significance (Pløger, 1997; Popenoe, 2005) and people are enabled to have multiple relationships all over the city region. In fact, this study of the metropolitan area of Oslo suggests that compact-city residents have higher overall social well-being than suburban residents, despite having shallower relationships at a local neighborhood level (Mouratidis, 2017a).

Another contribution of this study is that it has developed and empirically examined new conceptual models that attempt to explain how urban form may influence personal relationships satisfaction. Compared with their low-density suburban counterparts, compact-city residents are found to have a larger network of close relationships, more active social life, and stronger social support, which altogether contribute to higher satisfaction with personal

relationships. As this study empirically finds, shorter distances to the city center, higher densities, and mixed land uses seem to facilitate overall social well-being, as also supported by some urban theories (e.g. Jacobs, 1961). Based on SEM results and qualitative analysis, the fact that social life and personal relationships are facilitated by compactness can be attributed to three factors relevant to its structural characteristics: (1) more people within close proximity due to high density and centrality, (2) higher access to "third places" (community centers, cafés, restaurants etc.), and (3) higher access to and from other areas due to centrality and public transport.

The outcomes of this study suggest that urban planning and design matter to quality of life as they may affect personal relationships. Based on the above findings, practitioners and decision makers may positively influence people's lives. It seems that when planned and designed appropriately, compact urban environments are beneficial for both existing personal relationships as well as for developing new ones. At a time when loneliness is increasing, this insight is especially important because of the strong influence personal relationships have on health and happiness. Moreover, the importance of these findings lies not only in their contribution to debates on quality of life, but also in their implications for environmental sustainability. These are encouraging signs for environmental sustainability, since the compact-city model, although widely acclaimed for its environmental benefits, has been largely contested for its social impact. Thus, such results could strengthen support for its implementation.

**Acknowledgements**

This study is part of a research project on "Compact city or sprawl? The role of urban form in subjective well-being" supported by the Norwegian University of Life Sciences. I am grateful to Petter Næss and Jin Xue whose comments and suggestions substantially improved this article. For their valuable input, I would also like to thank Nikolai Olavi Czajkowski, Elaine McIntyre, Anja Standal, Tilmann von Soest, and the participants of the 3rd International Conference on "Changing Cities", Syros, Greece (June 2017).

## Appendix

**Table A1.** Comparison of sociodemographic characteristics.

| Sociodemographic variables | Survey respondents (N=1344) | Population |
|---|---|---|
| | Mean | Mean |
| Age (for aged 18 or older)[1] | 50.16 | 46.30 |
| Unemployed[2] | 2.50% | 3.50% |
| Living with partner/spouse[1] | 61% | 48% |
| Non-Norwegian[1] | 9% | 21% |
| Adjusted household income (1000s NOK)[1] | 642.2 | 582.98 |
| Household size (persons)[1] | 2.22 | 1.94 |
| Number of children in household[1] | 0.54 | 0.46 |
| Household with children[1] | 32% | 26% |
| Respondent is female[1] | 53.40% | 50.30% |
| Respondent has college degree or higher[2] | 79% | 47% |

*Notes*:

[1]Population mean refers to the counties of Oslo and Akershus.

[2]Population mean refers to Oslo municipality.

*Sources*: Statistics Norway (2017) and European Commission (2016).

**Table A2**. Compact neighborhoods of the study.

| Neighborhood name | Neighborhood type | Population density (persons/ha) | Distance to city center (km) | Main building type | Land uses | Sample size (persons) |
|---|---|---|---|---|---|---|
| St. Hanshaugen | Compact | 203 | 2.3 | Apartment block | Mixed | 62 |
| Grønland | Compact | 205 | 1.0 | Apartment block | Mixed | 100 |
| Frogner A | Compact | 135 | 2.8 | Apartment block | Mixed | 8 |
| Frogner B | Compact | 306 | 2.6 | Apartment block | Mixed | 20 |
| Majorstuen A | Compact | 221 | 3.1 | Apartment block | Mixed | 57 |
| Majorstuen B | Compact | 247 | 2.9 | Apartment block | Mixed | 35 |
| Sagene | Compact | 267 | 3.5 | Apartment block | Mixed | 57 |
| Torshov | Compact | 135 | 3.3 | Apartment block | Mixed | 71 |
| Grünerløkka A | Compact | 171 | 1.5 | Apartment block | Mixed | 53 |
| Grünerløkka B | Compact | 244 | 2.3 | Apartment block | Mixed | 72 |

*Note*: Total sample size for compact neighborhoods N = 535.

**Table A3**. Low-density suburban neighborhoods of the study.

| Neighborhood name | Neighborhood type | Population density (persons/ha) | Distance to city center (km) | Main building type | Land uses | Sample size (persons) |
|---|---|---|---|---|---|---|
| Holmen | Low-density suburban | 30 | 6.0 | Detached house | Separate | 13 |
| Lofthus | Low-density suburban | 50 | 5.6 | Detached house | Separate | 17 |
| Hellerud | Low-density suburban | 44 | 7.7 | Detached house | Separate | 33 |
| Holmenkollen A | Low-density suburban | 24 | 10.5 | Detached house | Separate | 19 |
| Korsvoll | Low-density suburban | 31 | 6.5 | Detached house | Separate | 11 |
| Nordberg | Low-density suburban | 26 | 5.8 | Detached house | Separate | 13 |
| Stovner | Low-density suburban | 36 | 13.1 | Detached house | Separate | 7 |
| Nordstrand | Low-density suburban | 38 | 8.4 | Detached house | Separate | 14 |
| Hauketo | Low-density suburban | 32 | 10.1 | Detached house | Separate | 12 |
| Rykkinn | Low-density suburban | 26 | 19.2 | Detached house | Separate | 44 |
| Bærums Verk | Low-density suburban | 42 | 17.7 | Detached house | Separate | 38 |
| Stabekk | Low-density suburban | 26 | 8.6 | Detached house | Separate | 11 |
| Asker | Low-density suburban | 23 | 25.0 | Detached house | Separate | 41 |
| Nesøya | Low-density suburban | 14 | 21.6 | Detached house | Separate | 45 |
| Ski | Low-density suburban | 22 | 26.4 | Detached house | Separate | 42 |
| Oppegård | Low-density suburban | 27 | 17.6 | Detached house | Separate | 51 |
| Drøbakk | Low-density suburban | 38 | 36.0 | Detached house | Separate | 26 |
| Bjørnemyr | Low-density suburban | 26 | 46.0 | Detached house | Separate | 35 |
| Ytre Enebakk | Low-density suburban | 22 | 32.6 | Detached house | Separate | 32 |

*Note*: Total sample size for sprawled neighborhoods N = 504.

**Table A4**. Other neighborhoods of the study.

| Neighborhood name | Neighborhood type | Population density (persons/ ha) | Distance to city center (km) | Main building type | Land uses | Sample size (persons) |
|---|---|---|---|---|---|---|
| Frogner C | Inner-city mixed | 94 | 2.8 | Mixed | Mostly separate | 17 |
| Skøyen | Inner-city low density | 46 | 4.2 | Mixed | Separate | 16 |
| Grefsen | Suburban mixed | 97 | 7.6 | Mixed | Separate | 26 |
| Vålerenga | Inner-city mixed | 130 | 2.5 | Mixed | Mostly separate | 52 |
| Etterstad | Inner-city medium density | 72 | 3.2 | Apartment block | Separate | 14 |
| Høyenhall | Inner-city low density | 52 | 4.4 | Detached house | Separate | 13 |
| Østenjø | Suburban mixed | 55 | 6.4 | Mixed | Separate | 16 |
| Holmenkollen B | Suburban mixed | 60 | 10.6 | Mixed | Separate | 20 |
| Hovseter | Suburban mixed | 76 | 7.4 | Mixed | Separate | 22 |
| Ullevål | Inner-city mixed | 57 | 4.0 | Mixed | Separate | 22 |
| Berg | Inner-city low density | 35 | 4.6 | Detached house | Separate | 20 |
| Kringsjå | Suburban mixed | 73 | 6.8 | Mixed | Separate | 12 |
| Vestli | Suburban medium density | 126 | 13.6 | Apartment block | Separate | 3 |
| Tokerud | Suburban mixed | 81 | 13.8 | Mixed | Separate | 16 |
| Holmlia | Suburban mixed | 62 | 10.8 | Mixed | Separate | 13 |
| Blystadlia | Suburban mixed | 88 | 20.0 | Mixed | Separate | 23 |

*Note*: Total sample size for other types of neighborhoods N = 305.

**Table A5.** Means of main variables for compact neighborhoods of the study.

| Neighborhood name | Satisfaction with personal relationships (0-10) | Support from close relationships (1-5) | Number of close relationships (1-7) | Frequency meeting friends/ relatives (1-7) | Opportunities to meet new people (1-5) | Neighborhood influence on social life (1-5) |
|---|---|---|---|---|---|---|
| St. Hanshaugen | 7.72 | 4.14 | 4.50 | 4.74 | 3.79 | 3.92 |
| Grønland | 7.66 | 4.36 | 4.37 | 5.09 | 3.73 | 3.82 |
| Frogner A | 7.75 | 4.57 | 4.63 | 5.25 | 3.63 | 4.38 |
| Frogner B | 6.74 | 3.74 | 4.32 | 4.90 | 3.32 | 4.05 |
| Majorstuen A | 7.81 | 4.18 | 4.19 | 4.40 | 3.82 | 3.92 |
| Majorstuen B | 7.89 | 4.16 | 4.43 | 4.66 | 4.10 | 4.03 |
| Sagene | 7.24 | 4.26 | 4.61 | 5.00 | 3.60 | 3.88 |
| Torshov | 7.38 | 3.97 | 4.52 | 4.73 | 4.00 | 4.06 |
| Grünerløkka A | 7.58 | 4.23 | 4.56 | 4.86 | 4.20 | 3.98 |
| Grünerløkka B | 7.56 | 4.20 | 4.37 | 4.72 | 4.09 | 4.06 |

**Table A6.** Means of main variables for low-density suburban neighborhoods of the study.

| Neighborhood name | Satisfaction with personal relationships (0-10) | Support from close relationships (1-5) | Number of close relationships (1-7) | Frequency meeting friends/ relatives (1-7) | Opportunities to meet new people (1-5) | Neighborhood influence on social life (1-5) |
|---|---|---|---|---|---|---|
| Holmen | 8.09 | 4.17 | 4.08 | 4.31 | 2.58 | 3.75 |
| Lofthus | 7.75 | 4.31 | 4.25 | 5.12 | 3.19 | 3.69 |
| Hellerud | 7.31 | 4.00 | 3.87 | 3.72 | 3.43 | 3.63 |
| Holmenkollen A | 7.78 | 3.88 | 3.94 | 4.05 | 3.00 | 3.67 |
| Korsvoll | 7.70 | 4.30 | 4.27 | 3.91 | 3.22 | 3.78 |
| Nordberg | 7.46 | 3.92 | 4.31 | 4.54 | 2.83 | 3.85 |
| Stovner | 7.71 | 4.50 | 2.50 | 4.43 | 3.29 | 3.43 |
| Nordstrand | 8.00 | 4.31 | 4.21 | 4.07 | 3.50 | 3.79 |
| Hauketo | 7.08 | 4.25 | 3.82 | 4.42 | 3.17 | 3.73 |
| Rykkinn | 7.80 | 3.90 | 4.14 | 4.16 | 3.66 | 3.76 |
| Bærums verk | 7.82 | 4.24 | 3.92 | 4.16 | 3.43 | 3.62 |
| Stabekk | 7.91 | 4.20 | 4.40 | 4.36 | 3.18 | 3.91 |
| Asker | 7.37 | 4.08 | 3.90 | 4.27 | 3.82 | 3.82 |
| Nesøya | 7.89 | 4.03 | 3.79 | 4.45 | 3.27 | 3.70 |
| Ski | 7.34 | 4.14 | 3.66 | 4.10 | 3.27 | 3.44 |
| Oppegård | 7.53 | 4.16 | 3.90 | 4.29 | 3.10 | 3.54 |
| Drøbakk | 6.72 | 3.86 | 3.54 | 3.88 | 3.36 | 3.52 |
| Bjørnemyr | 6.79 | 4.08 | 3.55 | 3.51 | 3.27 | 3.43 |
| Ytke Enebakk | 7.80 | 4.10 | 3.90 | 4.25 | 3.03 | 3.67 |

**Table A7.** Means of main variables for other neighborhoods of the study.

| Neighborhood name | Satisfaction with personal relationships (0-10) | Support from close relationships (1-5) | Number of close relationships (1-7) | Frequency meeting friends/ relatives (1-7) | Opportunities to meet new people (1-5) | Neighborhood influence on social life (1-5) |
|---|---|---|---|---|---|---|
| Frogner C | 8.00 | 4.08 | 4.00 | 4.27 | 3.43 | 3.64 |
| Skøyen | 7.69 | 4.20 | 4.94 | 4.63 | 3.56 | 4.06 |
| Grefsen | 7.38 | 4.08 | 3.73 | 4.42 | 3.27 | 3.96 |
| Vålerenga | 7.69 | 4.48 | 4.39 | 4.44 | 3.43 | 3.76 |
| Etterstad | 7.86 | 4.23 | 4.86 | 4.29 | 3.67 | 3.79 |
| Høyenhall | 7.33 | 3.75 | 4.00 | 3.85 | 3.50 | 3.69 |
| Østenjø | 7.50 | 4.21 | 4.00 | 3.94 | 2.69 | 3.57 |
| Holmenkollen B | 7.85 | 4.40 | 4.65 | 4.75 | 3.10 | 3.47 |
| Hovseter | 6.95 | 4.20 | 3.95 | 4.73 | 3.29 | 3.82 |
| Ullevål | 8.81 | 4.60 | 4.71 | 5.14 | 4.00 | 4.14 |
| Berg | 7.95 | 4.25 | 4.50 | 4.70 | 3.65 | 4.25 |
| Kringsjå | 7.75 | 4.00 | 4.08 | 4.25 | 3.50 | 3.92 |
| Vestli | 9.67 | 5.00 | 4.00 | 6.00 | 2.67 | 4.00 |
| Tokerud | 6.92 | 3.73 | 3.63 | 3.69 | 3.06 | 3.33 |
| Holmlia | 7.46 | 4.25 | 3.62 | 3.38 | 3.18 | 3.62 |
| Blystadlia | 7.23 | 4.05 | 3.30 | 4.39 | 3.27 | 3.65 |

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**Paper 4**

# Compact city and subjective well-being: The role of urban form in life satisfaction, hedonic well-being, and eudaimonia

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**Abstract**

Understanding the role of urban form in subjective well-being (SWB) can provide important input to urban planning debates on synergies and conflicts between environmental and social sustainability of cities. Hitherto, there is little empirical evidence on how SWB is shaped by compact or lower-density development. This paper investigates this topic using survey data collected in Oslo metropolitan area. In addition to SWB measures, the paper examines determinants of SWB as intermediate variables between urban form and SWB. Findings suggest that, compared with residents of lower-density neighborhoods, compact-city residents have higher levels of personal relationships satisfaction and perceived physical health, similar levels of leisure activities satisfaction, but also lower levels of emotional response to place and higher levels of anxiety. Potential benefits of the compact city on personal relationships and physical health seem to be at least partially cancelled out by lower emotional response to place and increased anxiety. As a result, compactness has nonsignificant associations with life satisfaction, eudaimonia, and happiness. However, when additionally controlling for variables relevant to urban problems – perceived safety, cleanliness, and noise – emotional response becomes more positive and the impact of anxiety diminishes, resulting in a significant positive association of compactness with life satisfaction. This study's outcomes are encouraging for urban sustainability as they indicate that high-density development does not negatively influence SWB, as often claimed, and that by addressing problems such as fear of crime, litter, and noise, it has the potential to promote SWB.

**Keywords**

built environment; compact city; sprawl; subjective well-being; happiness; quality of life

**Publication status**

Mouratidis, K. (2018). Compact city and subjective well-being: The role of urban form in life satisfaction, hedonic well-being, and eudaimonia. *Paper under review*.

## 1. Introduction

Does urban form influence subjective well-being (SWB)? If so, how is this influence shaped? These are crucial questions for the future development of human settlements as they concern both their environmental and social sustainability. On the one hand, the form of cities can affect environmental sustainability as there is plenty of evidence showing that compact forms are in general friendlier to the environment than dispersed ones (Meyer, 2013; Newman & Kenworthy, 1999). On the other hand, achieving high levels of SWB, a personal evaluation of one's life (Diener, 2000), is one of the most important life as well as political goals (Stiglitz et al., 2009; Veenhoven, 2012), a major goal of urban planning (Thin, 2012), and a key indicator of social sustainability (Kyttä et al., 2016; Moser, 2009). Examining the relationship between urban form and SWB can therefore unveil synergies or conflicts between environmental and social sustainability, with various implications for environmental issues such as climate change, environmental degradation, pollution, and depletion of natural resources in relation to human well-being and human development.

Although these are such important questions, empirical research has only recently started to systematically explore the relationship between the built environment and SWB. Urban researchers have been investigating this relationship at large geographical scales comparing different settlements at a country level (Ballas & Tranmer, 2012; Morrison & Weckroth, 2017; Okulicz-Kozaryn & Mazelis, 2018) but also at smaller scales within city regions (Cao, 2016; Ettema & Schekkerman, 2016; Feng et al., 2017; Kyttä et al., 2016). Despite some indications that residents of larger metropolitan areas are less happy compared with residents of smaller metropolitan areas, we still do not have enough evidence on how the urban form within a given city region affects SWB. Our knowledge on whether denser or more disperse, sprawled urban forms promote higher SWB is limited. Even more importantly, we lack understanding of the mechanisms under which different urban forms influence SWB. Statistical associations between urban form measures and SWB provide useful insights but do not offer in-depth understanding of the different ways residents' lives are affected by denser or less dense urban forms. Such an understanding would not only provide theoretical advancements in the field but also well-founded input for policymakers.

This paper aims to offer relevant empirical insights by investigating how the compactness of the urban form within a given metropolitan area may influence SWB. To investigate this issue, the conceptual framework by Mouratidis (2018b) on built environments

and SWB is applied to survey data collected in the metropolitan area of Oslo. This framework links together built environment characteristics with relevant SWB determinants – life domains that are influenced by the built environment and in turn influence SWB – and measures of SWB. The paper answers two main research questions: (1) How does compactness affect relevant SWB determinants (personal relationships, leisure activities, health, emotional response to place) and eventually SWB itself (life satisfaction, eudaimonia, hedonic well-being)? (2) How does this effect change when we additionally control for common urban problems: fear of crime, litter, noise?

Oslo's inner city is mostly characterized by compact development and its suburbs are mostly characterized by low-density sprawled development. By examining the role of compact versus more dispersed urban forms in SWB, the paper aims to provide important input to urban planning debates about the social sustainability merits of more versus less environmentally friendly urban development, namely densification versus outward urban expansion. Although previous research in Oslo suggests that, compared with low-density suburban residents, compact-city residents feel that their neighborhood covers their needs to a higher degree (Mouratidis, 2017) and have higher social well-being (Mouratidis, 2018a), it remains to be seen if this is translated into higher overall subjective well-being.

With the world population rapidly increasing and urban populations growing, the compact city paradigm is widely considered as a necessity for controlling relevant environmental consequences, and thus has been endorsed as a future development strategy by several leading institutions (European Commission, 2007; United Nations, 2012). Similarly, Oslo's population is quickly growing, and in order to preserve farmlands and forests, protect biodiversity from a potential urban expansion and avoid an increase in car driving, the city has decided to focus on densification policies. Based on these considerations of environmental sustainability, this study explores the second aforementioned research question, examining the role of common problems of high-density urbanized areas in SWB. Fear of crime, litter, and noise are important urban problems (Howley et al., 2009) that have been found to be significantly higher in compact areas (Mouratidis, 2017). Assessing the impact of these problems along with measures of urban form compactness can provide indications on how important they are for SWB but also on how SWB in compact areas might change in case they are mitigated.

To sum up, the contribution of the paper is threefold: (1) It offers new insights into whether it is compact or low-density forms that influence SWB more positively, revealing synergies and conflicts between environmental and social sustainability. (2) It investigates the ways in which urban form shapes SWB by applying a new conceptual and methodological approach that examines the indirect effects of urban form attributes on SWB through relevant SWB determinants. Thus, it attempts to unveil causal mechanisms and offer a new paradigm for further relevant research. (3) By additionally assessing the role of common urban problems, it provides input for practitioners and policymakers on how to improve the livability of compact cities.

## 2. Literature review

### *2.1. Urban form and SWB determinants*

Major viewpoints on SWB and relevant suggested measures are classified as life satisfaction, eudaimonia, and hedonic well-being (or emotional well-being or affect) (Dolan & Metcalfe, 2011; OECD, 2013; Sirgy, 2012). These components of SWB are strongly moderated by personality traits such as extraversion and neuroticism (Diener & Lucas, 1999). Various life domains also contribute to SWB. The built environment can influence some of these, namely personal relationships, leisure activities, health, and emotional response to place (Mouratidis, 2018b).

High-density urban forms are associated with looser neighbor ties (Bramley et al., 2009; Fischer, 1982; Milgram, 1970), but also with larger social networks, more opportunities to make new acquaintances, higher frequency of socializing, stronger social support, and higher personal relationships satisfaction (Mouratidis, 2018a). Residents of compact cities have been found to walk more compared with residents of low-density areas (Ewing et al., 2003), possibly leading to physical health benefits (Stevenson et al., 2016; Sturm & Cohen, 2004). However, urban life has also been associated with higher stress (Lederbogen et al., 2011) and high-rise living with psychological problems (Gifford, 2007). Despite previous research works examining impacts of the urban form on personal relationships, leisure, health, and emotional response to place, there is little evidence on how these impacts may contribute to overall SWB.

### *2.2. Urban form and SWB*

Regional studies have been investigating relationships between urban form measures and SWB measures at a high scale by comparing different regions within a country. There is plenty of evidence suggesting that residents of smaller settlements, usually villages or small towns, are happier compared with residents of big metropolitan areas (Ballas & Tranmer, 2012; Berry & Okulicz-Kozaryn, 2011; Morrison, 2011; Okulicz-Kozaryn & Mazelis, 2018; Sørensen, 2014). This negative association between large cities and SWB has been attributed to the different values that their residents hold, for example a possible excessive desire for power and achievement (Morrison & Weckroth, 2017).

Urban studies, on the other hand, have been exploring the relationship between the built environment and SWB at a finer scale within specific city regions. Some studies suggest that neighborhood environmental quality and safety positively contribute to SWB (Ettema & Schekkerman, 2016; Kyttä et al., 2016). Findings from studies on Bandung, London, and Beijing indicate that shorter distances to city center may positively influence SWB (Arifwidodo & Perera, 2011; MacKerron & Mourato, 2009; Wang & Wang, 2016). This positive influence could be due to facilitated travel (Næss, 2005) and higher access to facilities (Burton, 2000; Mouratidis, 2017), which has been found to be positively associated with SWB in cities (Leyden et al., 2011). Nevertheless, despite useful evaluations of accessibility and SWB, the cases on Bandung, London, and Beijing do not include low-density areas to a large extent in order to evaluate potential benefits of living in such places and draw comparisons with compact areas.

Few studies have been assessing the role of compact versus low-density urban forms in SWB. Compact development can offer easy access to facilities, people, and workplaces but low-density development, in contrast, can offer quietness, access to nature, higher perceived safety and cleanliness, and stronger neighbor ties (Mouratidis, 2017). An analysis based in Oslo finds a negative association between population density and SWB (Cramer et al., 2004). However, the researchers of this study use physical health as a control variable in their regression models. This was also done by Okulicz-Kozaryn and Mazelis (2018) who control for health as well as social support. As described above, both health and personal relationships have been found to be influenced by the built environment, therefore they should be used as intermediate variables between the built environment and SWB and not as control variables. One study comparing two high-rise urban neighborhoods with a low-density suburban

neighborhood in Chicago finds that life satisfaction is higher in the high-rise neighborhoods (Du et al., 2017). Another study examining the relationship between the built environment and SWB focuses on elderly populations in Nanjing, China and includes neighborhoods of diverse densities and also intermediate variables (Feng et al., 2017). Findings from that study suggest that density has nonsignificant effects on satisfaction with health, residence, transport, and social interaction and eventually nonsignificant effects on SWB among elderly populations (Feng et al., 2017). To understand how compactness may influence SWB, further research is needed in this direction: more comparisons between diverse urban forms in the same geographical and cultural context and more in-depth investigations of the role of SWB determinants mediating the relationship between urban form and SWB.

## 3. Data and methods

### *3.1. Data sources*

This study relies on data collected through a questionnaire survey conducted in May-June 2016 in the metropolitan area of Oslo. Survey participants were residents of 45 neighborhoods within central and suburban locations (Figure 1). The choice of neighborhoods as well as the number of questionnaires sent to each neighborhood aimed at generating a socioeconomically representative sample that includes residents from a diverse range of urban forms (see Appendix for details).

The questions of the survey were addressed at the individual level and only one person per household received a letter. Participants were 18 years or older, but apart from this they were randomly selected within each case neighborhood. The survey did not include any incentives or reminder letter. The questionnaire was pilot-tested firstly and then revised accordingly. The number of valid responses was 1344. The sample's characteristics do not deviate much from the population, but there are some differences (Table A4 in Appendix). Survey participants are on average slightly older and more highly educated than the population. Immigrant populations are underrepresented in the survey, as their response rate is lower. Incomes are higher among the respondents than among the population. Couples are overrepresented in the study. However, because relevant variables are controlled for in multivariate regression analysis, these biases are not expected to significantly affect results in the present study (Crano et al., 2015).

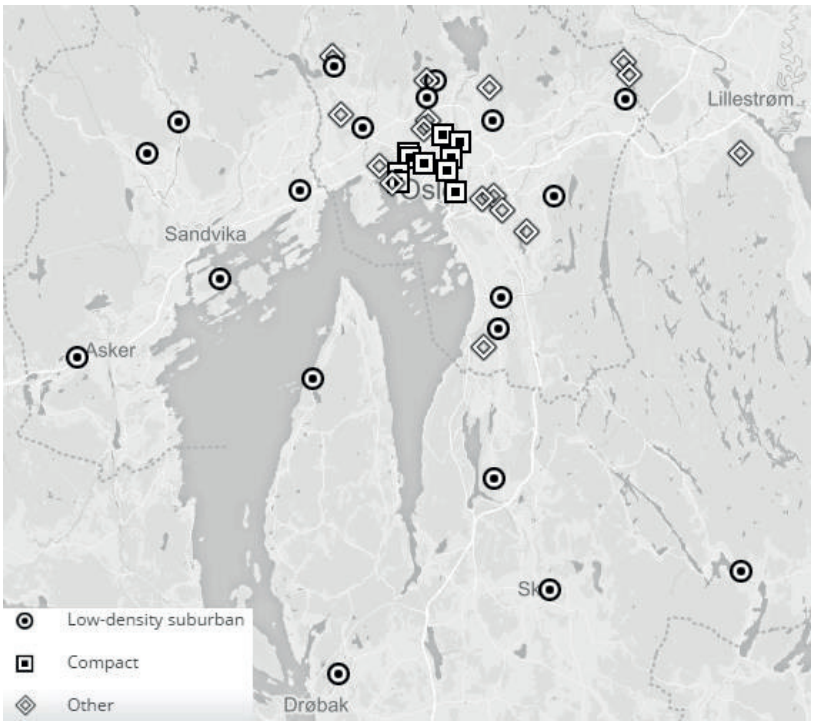


**Figure 1.** Selected residential areas within the metropolitan area of Oslo.

### *3.2. Conceptual model and variable descriptions*

Figure 2 presents the conceptual model of this study as adapted from the conceptual framework by Mouratidis (2018b). Descriptive statistics for all variables are shown in Table 1. SWB is measured following the state-of-the-art guidelines of OECD (2013) and the European Social Survey (2012). Life satisfaction is measured by asking participants to evaluate how satisfied they are with their lives as a whole nowadays on a scale from "extremely dissatisfied" (0) to "extremely satisfied" (10). On the same scale, eudaimonia is measured by asking to what extent the participants feel that the things they do in their lives are worthwhile. Hedonic well-being (or emotional well-being or affect) is examined by asking participants to evaluate the frequency of emotions of happiness and anxiety over the past week on a scale from "very rarely or never" (1) to "very often or always" (5).

SWB determinants are also measured on similar scales. Personal relationships satisfaction is measured by asking how satisfied residents are with their personal relationships on a scale from "extremely dissatisfied" (0) to "extremely satisfied" (10). On the same scale,

leisure activities satisfaction is measured by asking residents to evaluate how satisfied they are with the time spent on favorite leisure activities. Health is measured by asking residents to describe their general health on a scale from "extremely poor" (0) to "extremely good" (10). Emotional response to place is measured by asking residents to describe their feelings created when walking or biking within their neighborhood on a scale from "very negative" (1) to "very positive" (5).

The study uses two approaches to investigate the role of the urban form in SWB. The first approach employs an exogenous dichotomous variable "compact" where 0 is low-density suburban neighborhood and 1 is compact neighborhood. This variable applies to analysis with participants only from compact and low-density suburban neighborhoods. Sample from other types of urban forms is excluded when this variable is used. The categorization of a neighborhood into compact, low-density suburban, or other (see Appendix for details) is based on the following characteristics. A neighborhood is classified as compact when high population densities, apartment blocks, and mixed commercial and residential land uses are all present, and as low-density suburban when low population densities, detached housing, and separate land uses are all present. Mean population densities are 211 persons per hectare for compact neighborhoods and 29 persons per hectare for low-density suburban neighborhoods. Other types of neighborhoods that fall between these two categories, and are not included in the analysis for this approach, are neighborhoods with mixed types of housing or medium densities, or low-density neighborhoods within the inner city. These "other" neighborhoods have mostly separate land uses. Of course, the boundaries for the three categorizations (compact, low-density suburban, other) could be slightly different, but as tested in preliminary analysis the trends of the results would not materially change.

The second approach employed to examine the role of the urban form in SWB focuses on specific urban form characteristics and draws sample from all types of neighborhoods. Two characteristics of the physical form are assessed: distance to city center and neighborhood density. Distance to city center is measured from the centroid of each neighborhood in kilometers, along the pedestrian network. Neighborhood density is measured by dividing the population of each neighborhood by the area coverage in hectares.

The three urban problems (fear of crime, noise, and litter) examined in the study are evaluated by survey respondents at a neighborhood level. Neighborhood was defined in the questionnaire as the local area within 15 minutes' walking distance from the respondent's

dwelling, to achieve greater consistency among respondents. Respondents were asked to evaluate their neighborhood's safety, noise, and cleanliness on a scale from "very low" (1) to "very high" (5).

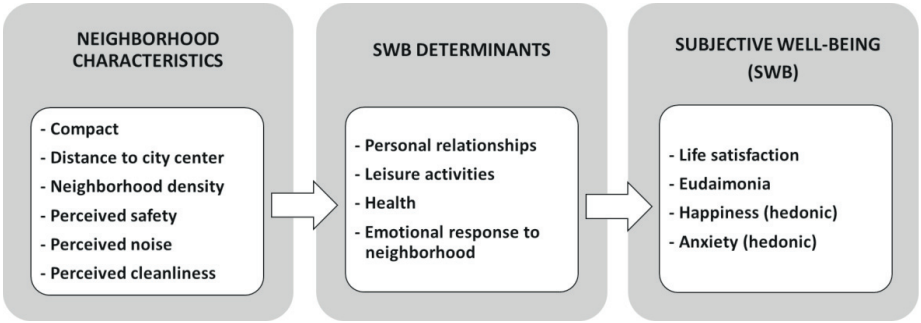


**Figure 2.** Conceptual model adapted from Mouratidis (2018b).

**Table 1.** Descriptive statistics of all variables.

| Variables | N | Min/Max | Mean | s.d. |
|---|---|---|---|---|
| *SWB* | | | | |
| Life satisfaction | 1340 | 0/10 | 7.88 | (1.71) |
| Eudaimonia | 1329 | 0/10 | 7.85 | (1.70) |
| Happiness (hedonic) | 1318 | 1/5 | 3.67 | (0.84) |
| Anxiety (hedonic) | 1324 | 1/5 | 2.02 | (1.01) |
| *SWB determinants* | | | | |
| Personal relationships satisfaction | 1315 | 0/10 | 7.57 | (1.91) |
| Leisure activities satisfaction | 1309 | 0/10 | 7.15 | (2.09) |
| Health | 1338 | 0/10 | 7.72 | (1.82) |
| Emotional response to neighborhood environment | 1322 | 1/5 | 4.11 | (0.75) |
| *Neighborhood characteristics* | | | | |
| Compact (low-density suburban = 0, compact = 1) | 1039 | 0/1 | 0.51 | (0.50) |
| Distance to city center (km) | 1344 | 0.7/46.2 | 10.22 | (10.84) |
| Neighborhood density (persons/ha) | 1341 | 14/306 | 112.93 | (88.04) |
| Perceived safety | 1330 | 1/5 | 4.22 | (0.82) |
| Perceived noise | 1341 | 1/5 | 2.46 | (1.14) |
| Perceived cleanliness | 1325 | 1/5 | 3.81 | (0.91) |
| *Sociodemographic variables* | | | | |
| Age | 1344 | 19/94 | 50.16 | (15.71) |
| Unemployed | 1339 | 0/1 | 0.03 | (0.16) |
| Living with partner/spouse | 1329 | 0/1 | 0.61 | (0.49) |
| Non-Norwegian | 1342 | 0/1 | 0.09 | (0.28) |
| Adjusted household income (1000s NOK)[1] | 1259 | 35/4330 | 642.2 | (321.08) |
| Respondent is female | 1331 | 0/1 | 0.53 | (0.50) |
| Respondent has college degree or higher | 1341 | 0/1 | 0.79 | (0.41) |
| Household with children | 1334 | 0/1 | 0.32 | (0.47) |

*Note*: [1]Houshold income divided by the square root of household size.

## 4. Results

Based on the conceptual model presented in Figure 2, this study examines the relationships between three groups of variables. Specifically, it firstly examines associations between SWB determinants and SWB, then between built environment characteristics and SWB determinants, and finally between built environment characteristics and SWB. The method used is multivariate ordinary least squares (OLS) regression analysis. The coefficients shown in the regression tables are standardized (beta) coefficients.

Sociodemographic variables are used as control variables throughout the study. Table 2 presents the statistical effects of sociodemographics on SWB measures. The results confirm that life satisfaction and happiness are U-shaped with age (Blanchflower & Oswald, 2008, 2011). This means that younger and older individuals are happier than middle-aged individuals, possibly because during mid-life individuals realize and suppress unachievable life aspirations (Blanchflower & Oswald, 2008). Since there are no theoretical or empirical insights in support of a U-shaped pattern of other SWB measures or SWB determinants over the life cycle, age squared is only included in models of life satisfaction and happiness. Results generally indicate that SWB is higher for those who are employed, wealthier, and live with a partner or spouse, as supported by previous research (Blanchflower & Oswald, 2011). Immigrant populations appear to have higher levels of anxiety, and lower life satisfaction as in Liu et al. (2017), though the latter is nonsignificant. Interestingly, females exhibit higher levels of SWB. Tertiary education has a significant positive contribution only to eudaimonia. Having children in the household is found to have a modest, but nonsignificant, positive association with eudaimonia and a modest, but nonsignificant, negative association with anxiety.

**Table 2.** Regression models examining the impact of sociodemographic variables on SWB.

| Variables | A<br>Life Satisfaction | B<br>Eudaimonia | C<br>Happiness (hedonic) | D<br>Anxiety (hedonic) |
|---|---|---|---|---|
| *Sociodemographic variables* | | | | |
| Age | -0.603*** | 0.204*** | -0.638*** | -0.170*** |
| Age squared | 0.769*** | | 0.616*** | |
| Unemployed | -0.163*** | -0.146*** | -0.090** | 0.131*** |
| Living with partner/spouse | 0.161*** | 0.092** | 0.141*** | 0.016 |
| Non-Norwegian | -0.029 | 0.004 | 0.027 | 0.072* |
| Adjusted household income | 0.178*** | 0.106*** | 0.111*** | -0.126*** |
| Female | 0.050[a] | 0.106*** | 0.055[a] | 0.014 |
| College degree or higher | 0.039 | 0.113*** | 0.008 | -0.042 |
| Household with children | 0.018 | 0.044 | -0.004 | -0.046 |
| *Summary statistics* | | | | |
| N | 1221 | 1214 | 1206 | 1210 |
| R-squared | 0.148 | 0.123 | 0.055 | 0.079 |

*Notes*: [a]p<0.10, *p<0.05, **p<0.01, ***p<0.001. All coefficients shown are standardized.

### *4.1. SWB determinants and SWB*

Results in Table 3 include four models, one for each measure of SWB. The models examine four SWB determinants along with sociodemographic variables. As results indicate, the four SWB determinants examined significantly contribute to SWB. Personal relationships satisfaction, leisure activities satisfaction, and health are all positively associated with life satisfaction, eudaimonia, and happiness, and negatively associated with anxiety. Personal relationships satisfaction has by far the highest statistical effect on life satisfaction, eudaimonia, and happiness, confirming that it is the most influential life domain of SWB (Diener & Seligman, 2002; Vaillant, 2012). Health has the strongest association with anxiety. Emotional response to place has smaller but still significant positive effects on life satisfaction and happiness, while it has nonsignificant effects on eudaimonia and anxiety.

**Table 3.** Regression models examining the impact of SWB determinants on SWB.

| Variables | A | B | C | D |
|---|---|---|---|---|
| | Life Satisfaction | Eudaimonia | Happiness (hedonic) | Anxiety (hedonic) |
| *SWB determinants* | | | | |
| Personal relationships | 0.402*** | 0.405*** | 0.340*** | -0.138*** |
| Leisure activities | 0.164*** | 0.149*** | 0.123*** | -0.069* |
| Health | 0.217*** | 0.189*** | 0.112*** | -0.184*** |
| Emotional response to neighborhood | 0.053* | 0.027 | 0.072** | -0.038 |
| *Sociodemographic variables* | | | | |
| Age | -0.289[a] | 0.202*** | -0.545** | -0.176*** |
| Age squared | 0.423** | | 0.502** | |
| Unemployed | -0.088*** | -0.068** | -0.031 | 0.100*** |
| Living with partner/spouse | 0.117*** | 0.046[a] | 0.090*** | 0.046 |
| Non-Norwegian | -0.044* | -0.016 | 0.019 | 0.095*** |
| Adjusted household income | 0.080*** | 0.026 | 0.044 | -0.085** |
| Female | -0.017 | 0.046* | -0.009 | 0.046[a] |
| College degree or higher | -0.009 | 0.080*** | -0.028 | -0.006 |
| Household with children | 0.030 | 0.079*** | 0.012 | -0.058* |
| *Summary statistics* | | | | |
| N | 1164 | 1160 | 1149 | 1154 |
| R-squared | 0.506 | 0.453 | 0.269 | 0.175 |

*Notes*: [a]p<0.10, *p<0.05, **p<0.01, ***p<0.001. All coefficients shown are standardized.

### *4.2. Urban form and SWB determinants*

Table 4 presents the regression results examining the statistical effects of urban form characteristics on the four relevant SWB determinants. Model C includes only residents living for 5 years or longer in their present dwelling, so that there is sufficient time for a potential impact of the urban form on health. Results in Table 4 suggest that compared with low-density suburban forms, compact urban forms are associated with significantly higher personal relationships satisfaction and higher perceived health (marginally significant with p = 0.108), but also with significantly more negative emotional response to neighborhood. The statistical effect of compactness on leisure activities satisfaction is nonsignificant. In particular, the results suggest that shorter distances to city center, which are enabled by higher overall density of the city, facilitate higher personal relationships satisfaction and higher perceived health. On the other hand, in the case of emotional response to neighborhood, it is the high local neighborhood density that induces negative emotions, while the short distances to city center induce positive emotions but less strong compared with the negative ones induced by neighborhood density.

**Table 4.** Regression models examining the impact of urban form on SWB determinants.

| Variables | Personal relationships | | Leisure activities | | Health | | Emotional response to neighborhood | |
|---|---|---|---|---|---|---|---|---|
| | A1 | A2 | B1 | B2 | C1 | C2 | D1 | D2 |
| *Urban form attributes* | | | | | | | | |
| Compact | 0.090* | | -0.043 | | 0.075[b] | | -0.103** | |
| Distance to city center | | -0.117** | | 0.001 | | -0.079[a] | | -0.065[a] |
| Neighborhood density | | -0.028 | | -0.061 | | -0.019 | | -0.169*** |
| *Sociodemographic variables* | | | | | | | | |
| Age | 0.077* | 0.056[a] | 0.131*** | 0.090** | 0.010 | -0.030 | 0.080* | 0.071* |
| Unemployed | -0.144*** | -0.142*** | -0.055[a] | -0.048 | -0.028 | -0.047 | -0.005 | -0.001 |
| Living with partner/spouse | 0.133*** | 0.135*** | -0.023 | -0.004 | 0.013 | -0.001 | 0.058[a] | 0.066* |
| Non-Norwegian | 0.010 | -0.006 | 0.053 | 0.038 | 0.100* | 0.065[a] | -0.039 | -0.033 |
| Adjusted household income | 0.109** | 0.097*** | 0.079* | 0.067* | 0.148*** | 0.132*** | 0.075* | 0.087** |
| Female | 0.140*** | 0.155*** | 0.010 | 0.009 | -0.011 | -0.025 | 0.086** | 0.098*** |
| College degree or higher | 0.009 | 0.007 | -0.016 | 0.013 | 0.102* | 0.069[a] | 0.036 | 0.076** |
| Household with children | -0.022 | -0.050 | -0.086* | -0.126*** | 0.044 | 0.010 | 0.101** | 0.077* |
| *Summary statistics* | | | | | | | | |
| N | 930 | 1203 | 918 | 1190 | 551 | 729 | 936 | 1209 |
| R-squared | 0.085 | 0.094 | 0.047 | 0.042 | 0.056 | 0.043 | 0.066 | 0.079 |

*Notes*: [a]$p<0.10$, *$p<0.05$, **$p<0.01$, ***$p<0.001$. ([b]$p = 0.108$). All coefficients shown are standardized.

Sample for Model C includes solely residents living for 5 or more years in their present dwelling.

Table 5 examines the urban form characteristics along with three perceived variables related to common problems in dense urbanized areas. This analysis attempts to estimate whether the influence of urban form on SWB determinants changes in case these problems are mitigated. Models A and B do not include noise and cleanliness, as there is no theoretical reason explaining why these could influence personal relationships and leisure. Results in Table 5 indicate that when common urban problems are controlled for, the effect of compactness becomes more positive. The significant positive effects of compactness on personal relationships satisfaction and perceived health become even stronger. The emotional response to compact neighborhoods changes from significantly negative to significantly positive. The association between urban form and leisure still remains nonsignificant. Results suggest that particularly perceived safety is very influential in SWB as it exhibits the strongest and most significant effects on relevant SWB determinants. Regarding emotional response to place in

specific, all perceived variables exhibit significant effects. Perceived safety and cleanliness have positive effects, while noise has a negative, and less strong, effect.

**Table 5.** Regression models examining the impact of urban form and common urban problems on SWB determinants.

| Variables | Personal relationships | | Leisure activities | | Health | | Emotional response to neighborhood | |
|---|---|---|---|---|---|---|---|---|
| | A1 | A2 | B1 | B2 | C1 | C2 | D1 | D2 |
| *Urban form attributes* | | | | | | | | |
| Compact | 0.154*** | | 0.005 | | 0.122* | | 0.079* | |
| Distance to city center | | -0.121** | | 0.000 | | -0.060 | | -0.068* |
| Neighborhood density | | 0.017 | | -0.016 | | 0.051 | | -0.017 |
| *Common urban problems* | | | | | | | | |
| Perceived safety | 0.182*** | 0.155*** | 0.148*** | 0.165*** | 0.196*** | 0.165*** | 0.234*** | 0.244*** |
| Perceived noise | | | | | -0.050 | -0.044 | -0.053 | -0.072* |
| Perceived cleanliness | | | | | -0.071 | 0.001 | 0.217*** | 0.199*** |
| *Sociodemographic variables* | | | | | | | | |
| Age | 0.075* | 0.052[a] | 0.130*** | 0.087** | -0.003 | -0.036 | 0.095** | 0.076** |
| Unemployed | -0.141*** | -0.142*** | -0.051 | -0.047 | -0.018 | -0.037 | 0.002 | 0.001 |
| Living with partner/spouse | 0.128*** | 0.127*** | -0.026 | -0.012 | 0.024 | -0.002 | 0.063* | 0.061* |
| Non-Norwegian | 0.006 | -0.010 | 0.049 | 0.033 | 0.096* | 0.064[a] | -0.038 | -0.033 |
| Adjusted household income | 0.097** | 0.086** | 0.070* | 0.055[a] | 0.134** | 0.116** | 0.047 | 0.049[a] |
| Female | 0.137*** | 0.150*** | 0.009 | 0.005 | -0.026 | -0.036 | 0.078** | 0.083** |
| College degree or higher | -0.003 | -0.007 | -0.024 | 0.000 | 0.089* | 0.046 | 0.011 | 0.043 |
| Household with children | -0.012 | -0.044 | -0.080* | -0.122*** | 0.024 | 0.002 | 0.120*** | 0.092** |
| *Summary statistics* | | | | | | | | |
| N | 922 | 1191 | 910 | 1178 | 539 | 712 | 917 | 1181 |
| R-squared | 0.114 | 0.115 | 0.066 | 0.067 | 0.086 | 0.070 | 0.218 | 0.235 |

*Notes*: [a]$p<0.10$, *$p<0.05$, **$p<0.01$, ***$p<0.001$. All coefficients shown are standardized.

Sample for Model C includes solely residents living for 5 or more years in their present dwelling.

### *4.3. Urban form and SWB*

Table 6 examines associations between urban form characteristics and four measures of SWB. Results indicate that urban form compactness is not significantly associated with life satisfaction, eudaimonia, and happiness. Yet, it is associated with higher anxiety (marginally significant $p = 0.101$). This means that residents of compact neighborhoods seem to have higher levels of anxiety.

**Table 6.** Regression models examining the impact of urban form on SWB.

| Variables | Life satisfaction | | Eudaimonia | | Happiness (Hedonic) | | Anxiety (Hedonic) | |
|---|---|---|---|---|---|---|---|---|
| | A1 | A2 | B1 | B2 | C1 | C2 | D1 | D2 |
| *Urban form attributes* | | | | | | | | |
| Compact | 0.009 | | -0.012 | | -0.025 | | 0.062[b] | |
| Distance to city center | | -0.026 | | 0.011 | | 0.018 | | -0.047 |
| Neighborhood density | | -0.027 | | -0.008 | | -0.033 | | 0.020 |
| *Sociodemographic variables* | | | | | | | | |
| Age | -0.851*** | -0.558** | 0.229*** | 0.197*** | -0.726** | -0.665*** | -0.169*** | -0.148*** |
| Age squared | 1.037*** | 0.753*** | | | 0.744*** | 0.626** | | |
| Unemployed | -0.160*** | -0.163*** | -0.140*** | -0.146*** | -0.092** | -0.091** | 0.120*** | 0.132*** |
| Living with partner/spouse | 0.153*** | 0.162*** | 0.082* | 0.093** | 0.118*** | 0.135*** | 0.045 | 0.021 |
| Non-Norwegian | -0.019 | -0.028 | 0.024 | 0.005 | 0.039 | 0.028 | 0.055[a] | 0.071* |
| Adjusted household income | 0.210*** | 0.177*** | 0.113*** | 0.107*** | 0.140*** | 0.112*** | -0.142*** | -0.126*** |
| Female | 0.047 | 0.051[a] | 0.093** | 0.107*** | 0.059[a] | 0.056[a] | 0.010 | 0.013 |
| College degree or higher | 0.055[a] | 0.037 | 0.109*** | 0.115*** | 0.013 | 0.012 | -0.054[a] | -0.048[a] |
| Household with children | 0.039 | 0.014 | 0.060[a] | 0.039 | 0.016 | -0.015 | -0.067[a] | -0.033 |
| *Summary statistics* | | | | | | | | |
| N | 941 | 1218 | 936 | 1211 | 993 | 1203 | 932 | 1207 |
| R-squared | 0.170 | 0.150 | 0.135 | 0.124 | 0.063 | 0.057 | 0.092 | 0.083 |

*Notes*: [a]$p<0.10$, *$p<0.05$, **$p<0.01$, ***$p<0.001$. ([b]$p = 0.101$). All coefficients shown are standardized.

Table 7 examines the urban form characteristics along with the three variables related to common urban problems. This analysis attempts to estimate whether the influence of urban form on SWB changes in case these problems are mitigated. Similar to the previous analysis on SWB determinants, the statistical effects of compactness on measures of SWB become more positive when perceived safety, cleanliness, and noise are included in the analysis. Particularly, the nonsignificant positive association between compactness and life satisfaction now becomes significant. And the significant negative association between compactness and anxiety now becomes nonsignificant. In other words, when controlling for urban problems, residents living in compact areas exhibit higher life satisfaction and similar levels of anxiety compared with residents of low-density suburbs. Among the three attributes related to urban problems, perceived safety has the most substantial contribution to life satisfaction and eudaimonia, while perceived safety and noise have important contributions to the hedonic measures of happiness and anxiety.

**Table 7.** Regression models examining the impact of urban form and common urban problems on SWB.

| Variables | Life satisfaction | | Eudaimonia | | Happiness (Hedonic) | | Anxiety (Hedonic) | |
|---|---|---|---|---|---|---|---|---|
| | A1 | A2 | B1 | B2 | C1 | C2 | D1 | D2 |
| *Urban form attributes* | | | | | | | | |
| Compact | 0.082* | | 0.060 | | 0.040 | | 0.015 | |
| Distance to city center | | -0.033 | | 0.002 | | 0.006 | | -0.042 |
| Neighborhood density | | 0.038 | | 0.052 | | 0.014 | | -0.029 |
| *Common urban problems* | | | | | | | | |
| Perceived safety | 0.151*** | 0.133*** | 0.138*** | 0.122*** | 0.091* | 0.082* | -0.137*** | -0.090** |
| Perceived noise | -0.034 | -0.041 | -0.060[a] | -0.058[a] | -0.082* | -0.076* | 0.081* | 0.094** |
| Perceived cleanliness | 0.019 | 0.045 | -0.001 | 0.033 | -0.001 | 0.002 | 0.095* | 0.039 |
| *Sociodemographic variables* | | | | | | | | |
| Age | -0.791*** | -0.538** | 0.224*** | 0.192*** | -0.658** | -0.606** | -0.170*** | -0.150*** |
| Age squared | 0.970*** | 0.695*** | | | 0.668** | 0.563** | | |
| Unemployed | -0.158*** | -0.162*** | -0.137*** | -0.144*** | -0.092** | -0.091** | 0.120*** | 0.131*** |
| Living with partner/spouse | 0.157*** | 0.159*** | 0.088** | 0.091** | 0.122*** | 0.130*** | 0.042 | 0.026 |
| Non-Norwegian | -0.022 | -0.029 | 0.015 | -0.002 | 0.032 | 0.022 | 0.069* | 0.080** |
| Adjusted household income | 0.191*** | 0.162*** | 0.097** | 0.092** | 0.124*** | 0.104*** | -0.130*** | -0.127*** |
| Female | 0.034 | 0.038 | 0.083** | 0.097*** | 0.052 | 0.046 | 0.020 | 0.021 |
| College degree or higher | 0.049 | 0.025 | 0.105*** | 0.105*** | 0.005 | -0.005 | -0.047 | -0.037 |
| Household with children | 0.044 | 0.017 | 0.067* | 0.044 | 0.019 | -0.004 | -0.069 | -0.044 |
| *Summary statistics* | | | | | | | | |
| N | 922 | 1190 | 917 | 1183 | 914 | 1176 | 913 | 1179 |
| R-squared | 0.195 | 0.178 | 0.159 | 0.151 | 0.078 | 0.071 | 0.115 | 0.105 |

*Notes*: [a]$p<0.10$, *$p<0.05$, **$p<0.01$, ***$p<0.001$. All coefficients shown are standardized.

## 5. Discussion

The results of this paper suggest that the compactness of the urban form contributes to SWB determinants in different ways. Compact urban forms seem to positively influence the two most important relevant determinants of SWB: personal relationships and health. Higher levels of personal relationships satisfaction in compact areas have been attributed to a higher concentration of people, easier access to other areas, and more facilities for socializing which altogether enable larger social networks and more active social life (Mouratidis, 2018a). The higher self-reported health found in compact areas is in accordance with some previous studies (Stevenson et al., 2016; Sturm & Cohen, 2004) and could be explained by higher levels of

walking and cycling and reduced usage of private vehicles (Ewing et al., 2003; Stevenson et al., 2016). On the other hand, emotional response to place seems to be negatively influenced by compactness and especially by higher local densities as these may induce higher fear of crime, noise, and litter. An additional explanation of the more negative emotional response to compactness could be the lower connection with nature and stronger feelings of overcrowding, when compared with less compact, suburban settings. Finally, leisure activities do not appear to be significantly influenced by compactness. Residents of different urban forms are similarly satisfied with the time spent on favorite leisure activities.

Furthermore, results suggest that compactness is not significantly associated with three SWB measures, life satisfaction, eudaimonia, and happiness, but is associated with higher anxiety. The finding that residents of low-density suburban neighborhoods and residents of high density urban neighborhoods have similar levels of life satisfaction and happiness is in line with results by Feng et al. (2017), although that study focuses only on elderly populations. This finding of the present study contradicts previous suggestions that high density (as typical for the centrally located neighborhoods in this study) is detrimental to livability (Churchman, 1999; Neuman, 2005; Simmel, 1903). It is also in disagreement with regional studies suggesting that high densities may lead to unhappiness (e.g. Morrison, 2011). This claim might be valid when comparing different regions within a country, but is not necessarily applicable to densities within a specific city region. Within a certain city region, higher densities do not seem to lead to lower life satisfaction or to unhappiness, as results from the present study suggest. In certain cases, they are indeed associated with higher life satisfaction (Du et al., 2017). Increased anxiety found in high-density areas is consistent with the findings by Lederbogen et al. (2011) and supports the ideas that higher noise increases stress levels (WHO, 2011) and that lower safety can negatively influence mental health (Won et al., 2016). In addition to higher noise and lower perceived safety, the less natural environment, plethora of stimuli, intense life rhythms, and impersonal local interactions in dense urban areas could increase levels of anxiety and stress. In accordance with these considerations, the higher anxiety in compact areas could be connected to the more negative emotional response to compactness found in the present study. However, the insignificant statistical effect of emotional response to place on anxiety (Table 3) indicates that the higher anxiety in compact areas might also be attributed to the personal characteristics of residents that choose to live in such areas.

There is an evident paradox in the findings of this paper. Although compactness has positive associations with the two most important SWB determinants, personal relationships and health, it does not exhibit significant positive associations with life satisfaction, eudaimonia, and happiness as we would expect, but instead yields insignificant ones. This paradox is also highlighted by the fact that although neighborhood satisfaction, which is a predictor of life satisfaction, has been found to be significantly higher in compact areas of Oslo (Mouratidis, 2017), this is not translated into higher life satisfaction. Therefore, there seem to exist some other indirect negative effects that cancel out the possible positive effects of compactness on SWB through personal relationships and health.

(1) The most evident one is emotional response to place which is lower for compact urban forms. (2) Another indirect negative effect is that of anxiety. Compactness is found to increase anxiety. Anxiety is negatively associated with the other measures of SWB, life satisfaction, eudaimonia, and happiness. Thus, a potential increase in anxiety cancels out some part of the benefits from increased personal relationships satisfaction and health. Nonetheless, the combined negative indirect effects of compactness through emotional response to place and anxiety on life satisfaction, eudaimonia, and happiness are significantly less strong than the positive ones through personal relationships satisfaction and health. For example, personal relationships satisfaction has a much stronger influence on life satisfaction compared with emotional response to place (as seen in Table 3). At the same time, health is more strongly correlated with life satisfaction than anxiety is ($r = 0.45$ versus $r = -0.38$). Therefore, it seems that the impacts of emotional response to place and anxiety alone are not enough to counterbalance the contribution of increased personal relationships satisfaction and health to the three SWB measures (life satisfaction, eudaimonia, and happiness). (3) There might be an additional underlying factor counterbalancing the positive impact of compactness on SWB through personal relationships and health. One hypothesis is that this factor could be related to the characteristics of the people living in denser urban areas. There is evidence suggesting that personality traits and human values differ across geographical locations, thus influencing SWB (Ballas & Tranmer, 2012; Jokela et al., 2015; Morrison & Weckroth, 2017). And if there are certain personality traits or human values that negatively influence SWB and are more prominent in compact areas, then the question is whether the urban form plays any role in that. In other words, there is not enough knowledge on whether a compact urban environment can cultivate certain personality traits and human values or it is people with certain personalities and values who choose to live in compact areas. Another hypothesis is that there might be some

relevant SWB determinant influenced by urban form that is not considered in the conceptual framework applied here or that is not completely captured by the survey questions on the four life domains. One example could be the feelings of connection with nature, which can have a positive impact on SWB (Carrus et al., 2015; MacKerron & Mourato, 2013; Raanaas et al., 2012; White et al., 2013) and might not be completely captured by the question on emotional response to place. All these are just hypotheses however and should be further investigated in future research.

Another issue that arises from the findings of this paper is the relationship between the concepts of anxiety, perceived health, and SWB. First, anxiety can be a measure of both health and the hedonic well-being component of SWB. In this paper, it has been used as a measure of SWB as per OECD's guidelines on SWB measurement (OECD, 2013). It could have been alternatively used as a life domain item related to health, and specifically related to mental health. The evident question that emerges is what aspects of health are covered by the "perceived health" item of the survey. Although the survey item asked residents to evaluate their health in general, the quantitative results of the paper imply that most residents evaluated their physical health when completing this survey item. The finding that perceived health is higher in compact areas while anxiety is also higher in compact areas suggests that the two measures are largely distinct. Their Pearson correlation coefficient is also relatively weak ($r = -0.256$), considering that even the correlation between anxiety and life satisfaction which are certainly distinct measures is stronger ($r = -0.332$). Moreover, it is theoretically justifiable and in line with several previous research studies that physical health, measured here as perceived health, can be enhanced in compact areas due to more active everyday travel (Stevenson et al., 2016; Sturm & Cohen, 2004), while anxiety can also be higher (Lederbogen et al., 2011; Peen et al., 2010) possibly due to environmental stressors and/or residents' personal characteristics (e.g. personality, human values) in denser urban areas.

After statistically controlling for variables relevant to common problems in dense urban areas (safety, cleanliness, and noise), we see that SWB determinants and SWB measures improve for denser areas. Positive associations between compactness and personal relationships satisfaction as well as perceived physical health become even stronger. The significantly negative association between compactness and emotional response to place becomes significantly positive. The significant negative association between compactness and anxiety becomes nonsignificant. Altogether, these lead to a significant positive association between compactness and life satisfaction. In accordance with previous studies (Ettema &

Schekkerman, 2016; WHO, 2011), especially safety and noise seem to be crucial when examining the role of compact urban form in SWB. Thus, to plan for livable compact cities, which could be a strategy towards both environmental and social sustainability, common urban problems such as fear of crime and traffic and high noise levels should be certainly addressed by policymakers.

To expand the relevance of this paper's findings to a wider set of contexts, we should consider the characteristics of the built environment in Oslo as well as the socioeconomic characteristics of its population. Both Oslo's inner city as well as its suburbs are of relatively high quality. There is an extensive multimodal public transport system, which allows car restrictions within the city, resulting in limited traffic and noise even in the denser areas. There is also easy access to green spaces – which have been found to promote SWB (Carrus et al., 2015; Dong & Qin, 2017) – with parks in every neighborhood and close proximity to the forest. Although the inner city is characterized by high density (average density of the study's compact areas is 211 persons per hectare), this density is not extremely high by world standards. Therefore, even central compact areas are not too overcrowded, which could lead to higher stress levels and discomfort (Churchman, 1999). Crime records are also low in Oslo. In addition, due to the country's welfare system, social equity, which plays an important role in happiness in cities (Ballas, 2013), is high both between as well as within neighborhoods. There are no significant cases of highly degraded urban or suburban areas. Specifically for the study's case neighborhoods, median incomes are almost identical in the inner city and the suburbs. Therefore, overall, Oslo is a relatively well-functioning, peaceful, green, and prosperous city of high social equity. Along the lines of the present study's findings, we could expect urban form to influence SWB in similar ways in major metropolitan areas of other Nordic countries and perhaps even in cities with similar physical form and socioeconomic attributes in other geographical contexts. In contrast, compact areas of cities that face major urban problems such as overcrowding due to extremely high densities, extreme traffic and noise, poverty, high crime, litter, and lack of green space might produce different results. In such cases for example, health might be negatively influenced because of high pollution and stress, certain leisure activities might be restricted due to lack of green space, and emotional response to place might be more negative. Similarly, cases of degraded suburbs that face problems such as very low access to facilities, poor connection to other areas by public transport, poverty, and high crime might also negatively influence SWB determinants and eventually SWB. As other cities may differ from Oslo in terms of physical form or socioeconomic characteristics, future studies

should continue to explore the relationship between urban form and SWB in different cities in order to provide insights from a wider set of contexts.

There are a few limitations in this study. First, although the conceptual framework used has been successfully applied, since the four SWB determinants employed as mediators are indeed found to be associated with both built environment characteristics as well as SWB measures, there might be additional latent SWB determinants that are relevant to the built environment and are not considered here. Second, personal characteristics such as human values and personality traits that could perhaps offer further explanations of the study's findings are not included in the analysis. Third, although the study presents to a certain degree evidence on causality due to its conceptual framework and the inclusion of intermediate variables, regression results are cross-sectional and should be interpreted with caution since they indicate associations and not necessarily causal relationships. Future research could explore this topic further by addressing the aforementioned issues while using longitudinal data.

## 6. Conclusions

This paper provides new empirical insights into the impact of compact (high density, mixed land uses, and high public transport accessibility) versus lower-density (lower densities, separate land uses, and higher car reliance) urban forms on SWB. Although compact cities have been often considered as having adverse social effects (Churchman, 1999; Morrison, 2011; Simmel, 1903; Wirth, 1938), previous literature has not adequately examined the relationships between diverse urban forms and SWB within the same city region. The paper's findings suggest that compact development is not necessarily detrimental to SWB when high densities are accompanied by mixed land uses, public transport, limited car traffic, access to green spaces, and social equity. Moreover, it seems that if urban problems related to fear of crime, litter, and noise are mitigated, the compact city has the potential to promote SWB.

Another contribution of this paper is that in addition to trying to assess possible impacts of the urban form on SWB, it additionally sheds light on how these impacts are shaped. Empirical investigations explaining how causal relationships between the built environment and SWB are shaped are scarce. And there has been a call for new conceptual approaches on studying the links between environmental attributes and life quality (Van Kamp et al., 2003). This study has applied a new conceptual and methodological framework (Mouratidis, 2018b)

that includes SWB determinants – personal relationships, health, leisure activities, and emotional response to place – as mediating variables that help explain causal mechanisms. Thereby, this study moves beyond dominant research approaches that focus solely on correlations between environmental attributes and SWB or use neighborhood/community satisfaction as an intermediate variable between environmental attributes and SWB (see e.g. Marans, 2003). The approach followed here could provide a new paradigm for future relevant research.

The study's findings indicate positive signs for urban sustainability. Important synergies between environmental and social sustainability have been identified. It is of particular significance that environmentally friendly urban forms can be beneficial for personal relationships and physical health. These are not only among the most crucial domains for quality of life at a certain point in time, but are very important for human flourishing across the lifespan (e.g. Vaillant, 2012). On the other hand, special attention should be paid to perceived safety and noise. Fear of crime and noise appear to be concerns even in relatively peaceful and quiet compact cities and may lead to unpleasant emotions and increased anxiety. Researchers, practitioners, and policymakers should carefully look into ways to counter these implications in order to achieve the goal of livable compact cities.

**Acknowledgements**

This study is part of a research project on "Compact city or sprawl? The role of urban form in subjective well-being" supported by the Norwegian University of Life Sciences. I am grateful to Petter Næss and Jin Xue for their valuable input.

## Appendix

**Table A1.** Compact neighborhoods of the study.

| Neighborhood name | Neighborhood type | Population density (persons/ha) | Distance to city center (km) | Main building type | Land uses | Sample size (persons) |
|---|---|---|---|---|---|---|
| St. Hanshaugen | Compact | 203 | 2.3 | Apartment block | Mixed | 62 |
| Grønland | Compact | 205 | 1.0 | Apartment block | Mixed | 100 |
| Frogner A | Compact | 135 | 2.8 | Apartment block | Mixed | 8 |
| Frogner B | Compact | 306 | 2.6 | Apartment block | Mixed | 20 |
| Majorstuen A | Compact | 221 | 3.1 | Apartment block | Mixed | 57 |
| Majorstuen B | Compact | 247 | 2.9 | Apartment block | Mixed | 35 |
| Sagene | Compact | 267 | 3.5 | Apartment block | Mixed | 57 |
| Torshov | Compact | 135 | 3.3 | Apartment block | Mixed | 71 |
| Grünerløkka A | Compact | 171 | 1.5 | Apartment block | Mixed | 53 |
| Grünerløkka B | Compact | 244 | 2.3 | Apartment block | Mixed | 72 |

*Note*: Total sample size for compact neighborhoods N = 535.

**Table A2.** Low-density suburban neighborhoods of the study.

| Neighborhood name | Neighborhood type | Population density (persons/ha) | Distance to city center (km) | Main building type | Land uses | Sample size (persons) |
|---|---|---|---|---|---|---|
| Holmen | Low-density suburban | 30 | 6.0 | Detached house | Separate | 13 |
| Lofthus | Low-density suburban | 50 | 5.6 | Detached house | Separate | 17 |
| Hellerud | Low-density suburban | 44 | 7.7 | Detached house | Separate | 33 |
| Holmenkollen A | Low-density suburban | 24 | 10.5 | Detached house | Separate | 19 |
| Korsvoll | Low-density suburban | 31 | 6.5 | Detached house | Separate | 11 |
| Nordberg | Low-density suburban | 26 | 5.8 | Detached house | Separate | 13 |
| Stovner | Low-density suburban | 36 | 13.1 | Detached house | Separate | 7 |
| Nordstrand | Low-density suburban | 38 | 8.4 | Detached house | Separate | 14 |
| Hauketo | Low-density suburban | 32 | 10.1 | Detached house | Separate | 12 |
| Rykkinn | Low-density suburban | 26 | 19.2 | Detached house | Separate | 44 |
| Bærums Verk | Low-density suburban | 42 | 17.7 | Detached house | Separate | 38 |
| Stabekk | Low-density suburban | 26 | 8.6 | Detached house | Separate | 11 |
| Asker | Low-density suburban | 23 | 25.0 | Detached house | Separate | 41 |
| Nesøya | Low-density suburban | 14 | 21.6 | Detached house | Separate | 45 |
| Ski | Low-density suburban | 22 | 26.4 | Detached house | Separate | 42 |
| Oppegård | Low-density suburban | 27 | 17.6 | Detached house | Separate | 51 |
| Drøbakk | Low-density suburban | 38 | 36.0 | Detached house | Separate | 26 |
| Bjørnemyr | Low-density suburban | 26 | 46.0 | Detached house | Separate | 35 |
| Ytre Enebakk | Low-density suburban | 22 | 32.6 | Detached house | Separate | 32 |

*Note*: Total sample size for low-density suburban neighborhoods N = 504.

**Table A3.** Other neighborhoods of the study.

| Neighborhood name | Neighborhood type | Population density (persons/ ha) | Distance to city center (km) | Main building type | Land uses | Sample size (persons) |
|---|---|---|---|---|---|---|
| Frogner C | Inner-city mixed | 94 | 2.8 | Mixed | Mostly separate | 17 |
| Skøyen | Inner-city low density | 46 | 4.2 | Mixed | Separate | 16 |
| Grefsen | Suburban mixed | 97 | 7.6 | Mixed | Separate | 26 |
| Vålerenga | Inner-city mixed | 130 | 2.5 | Mixed | Mostly separate | 52 |
| Etterstad | Inner-city medium density | 72 | 3.2 | Apartment block | Separate | 14 |
| Høyenhall | Inner-city low density | 52 | 4.4 | Detached house | Separate | 13 |
| Østenjø | Suburban mixed | 55 | 6.4 | Mixed | Separate | 16 |
| Holmenkollen B | Suburban mixed | 60 | 10.6 | Mixed | Separate | 20 |
| Hovseter | Suburban mixed | 76 | 7.4 | Mixed | Separate | 22 |
| Ullevål | Inner-city mixed | 57 | 4.0 | Mixed | Separate | 22 |
| Berg | Inner-city low density | 35 | 4.6 | Detached house | Separate | 20 |
| Kringsjå | Suburban mixed | 73 | 6.8 | Mixed | Separate | 12 |
| Vestli | Suburban medium density | 126 | 13.6 | Apartment block | Separate | 3 |
| Tokerud | Suburban mixed | 81 | 13.8 | Mixed | Separate | 16 |
| Holmlia | Suburban mixed | 62 | 10.8 | Mixed | Separate | 13 |
| Blystadlia | Suburban mixed | 88 | 20.0 | Mixed | Separate | 23 |

*Note*: Total sample size for other types of neighborhoods N = 305.

**Table A4.** Comparison of sociodemographic characteristics.

| Sociodemographic variables | Survey respondents (N=1344) | Population |
|---|---|---|
| | Mean | Mean |
| Age (for aged 18 or older)[1] | 50.16 | 46.30 |
| Unemployed[2] | 2.50% | 3.50% |
| Living with partner/spouse[1] | 61% | 48% |
| Non-Norwegian[1] | 9% | 21% |
| Adjusted household income (1000s NOK)[1] | 642.2 | 582.98 |
| Household size (persons)[1] | 2.22 | 1.94 |
| Number of children in household[1] | 0.54 | 0.46 |
| Household with children[1] | 32% | 26% |
| Respondent is female[1] | 53.40% | 50.30% |
| Respondent has college degree or higher[2] | 79% | 47% |

*Notes*:

[1]Population mean refers to the counties of Oslo and Akershus.

[2]Population mean refers to Oslo municipality.

*Sources*: Statistics Norway (2017) and European Commission (2016).

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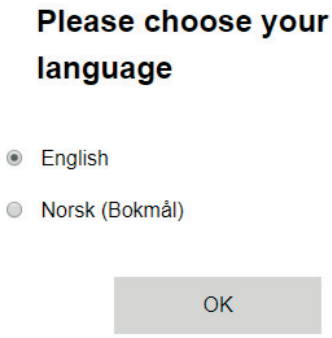
# Appendices

# Appendix A. Survey questionnaire

# Appendix A. Survey questionnaire




Welcome! Thank you for agreeing to take part in this survey.

Your participation is very important for the success of this research project. Please answer as carefully and honestly as possible.

This survey should take 10-15 minutes to complete. Be assured that all responses you provide will remain strictly anonymous and confidential.

**1) * Here you enter the ID-number shown in the letter:**

**2) In which type of residence do you live?**

- Apartment building
- Detached single-family house
- Duplex house
- Row house
- Other
- I don't know

If other, please specify. If you don’t know, click ‘Next’ to continue.

**3) Type of residence:**

**4) For how long have you been living in your present dwelling?**

- Less than one year
- 1 - 2 years
- 2 - 5 years
- 5 - 10 years
- More than 10 years
- I don't know

**5) For how long have you lived in the greater Oslo region in total?**

- Less than one year
- 1 - 2 years
- 2 - 5 years
- 5 - 10 years
- More than 10 years
- I don't know

Please write the address of your present dwelling.

**6) Address:**

**7) Postal code:**

**8) City:**

Please write the address of your **previous** dwelling.

**9) Address of previous dwelling:**

**10) Postal code of previous dwelling:**

**11) City of previous dwelling:**

**12) All things considered, how satisfied are you with your life as a whole nowadays?**

| Extremely dissatisfied | | | | | | | | | | Extremely satisfied | I don't know |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**13) Overall, to what extent do you feel that the things you do in your life are worthwhile?**

| Not at all worthwhile | | | | | | | | | | Extremely worthwhile | I don't know |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**14) Please tell us how much of the time during the past week:**

| | Very rarely or never | Rarely | Sometimes | Often | Very often or always | I don't know |
|---|---|---|---|---|---|---|
| Your sleep was restless | ○ | ○ | ○ | ○ | ○ | ○ |
| You felt happy | ○ | ○ | ○ | ○ | ○ | ○ |
| You felt lonely | ○ | ○ | ○ | ○ | ○ | ○ |
| You felt sad | ○ | ○ | ○ | ○ | ○ | ○ |
| You had a lot of energy | ○ | ○ | ○ | ○ | ○ | ○ |

| | Very rarely or never | Rarely | Sometimes | Often | Very often or always | I don't know |
|---|---|---|---|---|---|---|
| You felt anxious | ○ | ○ | ○ | ○ | ○ | ○ |
| You felt calm and peaceful | ○ | ○ | ○ | ○ | ○ | ○ |
| You felt bored | ○ | ○ | ○ | ○ | ○ | ○ |

We will now ask you some questions about your local area.

As your **'local area'** please consider the area that is within 15 minutes walking distance from your dwelling.

**15) How well do you think your local area meets your current needs? Consider your local area's internal characteristics (physical and social) as well as the accessibility to other areas.**

| Extremely poorly 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Extremely well 10 | I don't know |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**16) What about your previous local area?**

| Extremely poorly 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Extremely well 10 | I don't know |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**17) How important is the role of the local area you live in for your life in general? Consider your local area's internal characteristics (physical and social) as well as the accessibility to other areas.**

- (1) Not at all
- (2) Little
- (3) Somewhat
- (4) Much
- (5) A great deal
- I don't know

**18) Please rate the following features within your local area:**

| | Nonexistent | Very low | Low | Medium | High | Very high | I don't know |
|---|---|---|---|---|---|---|---|
| Shops | | | | | | | |
| Socializing places (e.g. cafés, restaurants, bars, local social clubs) | | | | | | | |
| Facilities and services (e.g. education, healthcare, public services) | | | | | | | |
| Open public spaces (e.g. green spaces, squares) | | | | | | | |
| Public transport | | | | | | | |

**19) Please rate your local area's following features:**

| | Very low | Low | Medium | High | Very high | I don't know |
|---|---|---|---|---|---|---|
| Overall aesthetic quality | | | | | | |
| Cleanliness | | | | | | |

| | Very low | Low | Medium | High | Very high | I don't know |
|---|---|---|---|---|---|---|
| Encourages walking | ○ | ○ | ○ | ○ | ○ | ○ |
| Encourages biking | ○ | ○ | ○ | ○ | ○ | ○ |
| Safety | ○ | ○ | ○ | ○ | ○ | ○ |

**20) ...please rate your local area's following features:**

| | Very low | Low | Medium | High | Very high | I don't know |
|---|---|---|---|---|---|---|
| Opportunities to meet new people | ○ | ○ | ○ | ○ | ○ | ○ |
| Opportunities for entertainment | ○ | ○ | ○ | ○ | ○ | ○ |
| Interesting things happening | ○ | ○ | ○ | ○ | ○ | ○ |
| Opportunities for physical activities | ○ | ○ | ○ | ○ | ○ | ○ |
| Liveliness | ○ | ○ | ○ | ○ | ○ | ○ |
| Accessibility to Oslo city center | ○ | ○ | ○ | ○ | ○ | ○ |
| Accessibility to nature | ○ | ○ | ○ | ○ | ○ | ○ |
| Proximity to friends and relatives | ○ | ○ | ○ | ○ | ○ | ○ |

**21) What do you think of your local area’s following features?**

| | Very low | Low | Medium | High | Very high | I don't know |
|---|---|---|---|---|---|---|
| Noise | ○ | ○ | ○ | ○ | ○ | ○ |
| Traffic | ○ | ○ | ○ | ○ | ○ | ○ |
| Air pollution | ○ | ○ | ○ | ○ | ○ | ○ |

**22) How would you rate your local area's reputation in comparison with others in Oslo region?**

- (1) Very low
- (2) Low
- (3) Medium
- (4) High
- (5) Very high
- I don't know

**23) How attached do you feel to your local area?**

- (1) Not at all
- (2) Little
- (3) Somewhat
- (4) Much
- (5) A great deal
- I don't know

**24) To what extent do you...**

| | Not at all | Little | Somewhat | Much | A great deal | I don't know |
|---|---|---|---|---|---|---|
| feel that your neighbors help one another? | | | | | | |
| feel close to your neighbors? | | | | | | |

**25) How satisfied are you with your personal relationships?**

| Extremely dissatisfied | | | | | | | | | | Extremely satisfied | I don't know |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| | | | | | | | | | | | |

**26) How many people, if any, are there with whom you can discuss intimate and personal matters?**

- None
- 1
- 2
- 3
- 4-6
- 7-9
- 10 or more
- I don't know

**27) To what extent do you receive support from people you are close to when you need it?**

- (1) Not at all
- (2) Little
- (3) Somewhat
- (4) Much
- (5) A great deal
- I don't know

**28) To what extent do you provide support to people you are close to when they need it?**

- (1) Not at all
- (2) Little
- (3) Somewhat
- (4) Much
- (5) A great deal
- I don't know

**29) How often do you meet friends and relatives for social activities? Do not consider friends/relatives that live within your household.**

- Never
- Less than once a month
- Once a month
- Several times a month
- Once a week
- Several times a week
- Every day
- I don't know

**30) How is your social life influenced by your local area? Consider your local area's internal characteristics (physical and social) as well as the accessibility to other areas.**

- (1) Very negatively
- (2) Negatively
- (3) No particular influence
- (4) Positively
- (5) Very positively
- I don't know

**31) How satisfied are you with the time you spend on your favorite leisure activities?**

| Extremely dissatisfied | | | | | | | | | | Extremely satisfied | I don't know |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**32) How many of the last 7 days were you physically active continuously for 20 minutes or longer? Consider all kinds of physical activity: e.g. exercise, manual work, brisk walking, biking, housework.**

- None
- 1 day
- 2 days
- 3 days
- 4 days
- 5 days
- 6 days
- 7 days
- I don't know

**33) How often do you walk or bike for more than 10 minutes starting from your home's doorsteps?**

- Never
- Less than once a month
- 1-3 days a month
- Once a week
- 2-3 days a week
- 4 or more days a week
- I don't know

**34) How does your local area influence how much time you spend on your favorite leisure activities? Consider leisure opportunities in your local area as well as the accessibility to other areas.**

- (1) Very negatively
- (2) Negatively
- (3) No particular influence
- (4) Positively
- (5) Very positively
- I don't know

**35) How would you describe your feelings created when walking/biking in your local area?**

- (1) Very negative
- (2) Negative
- (3) Neutral
- (4) Positive
- (5) Very positive
- I don't know

**36) What is your current employment status?**

- Paid work
- Student
- Out of work
- Retired
- Other
- I don't know

**37) How satisfied are you overall with your work/studies?**

- (1) Very dissatisfied
- (2) Dissatisfied
- (3) Neutral
- (4) Satisfied
- (5) Very satisfied
- I don't know

How much time do you typically spend to arrive at your main occupation (door to door)?

**38) Minutes:**

**39) What is the main transport mode you typically use to travel to your main occupation?**

- None (work from home)
- Walking
- Bicycle
- Automobile
- Subway, tram or bus
- Train
- Boat/ferry
- Other
- I don't know

**40) What are your general feelings about your travel to your main occupation? Consider the time spent and mode(s) of travel.**

- (1) Very negative
- (2) Negative
- (3) Neutral
- (4) Positive
- (5) Very positive
- I don't know

**41) What are your general feelings about your travel for purposes other than work/education? Consider the time spent and mode(s) of travel.**

- (1) Very negative
- (2) Negative
- (3) Neutral
- (4) Positive
- (5) Very positive
- I don't know

**42) How satisfied are you with your dwelling? Consider only the interior of your dwelling.**

- (1) Very dissatisfied
- (2) Dissatisfied
- (3) Neutral
- (4) Satisfied
- (5) Very satisfied
- I don't know

**43) How would you describe your health in general?**

| Extremely poor 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Extremely good 10 | I don't know |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**44) Gender:**

- Male
- Female

In which year were you born?

**45) Year of birth:**

YYYY

**46) What passport do you hold?**

- Norwegian
- Other
- I don't know

Please indicate the country that issued your passport. (If other)

**47) Country:**

**48) What kind of education do you have?**

- Elementary school
- High-school or professional secondary school
- Education as skilled worker or craftsman/-woman
- Bachelor’s degree or similar
- Master’s degree or higher
- I don't know

**49) Do you live with a spouse/partner?**

- Yes
- No
- I don't know

**50) How many children live within your household?**

- 0
- 1
- 2
- 3
- 4 or more
- I don't know

**51) Including yourself, how many people live regularly within your household in total?**

- 1
- 2
- 3
- 4
- 5
- 6
- 7 or more
- I don't know

If 7 or more, what is the exact number?

In case you don't know, please click 'Next' to continue.

**52) Number of household members:**

**53) What is the total annual income of your household from all sources (gross income before taxation)? If you don't know the exact figure, please give an estimate.**

- Below 200 000 NOK
- 200 000 - 399 999 NOK
- 400 000 - 599 999 NOK
- 600 000 - 799 999 NOK
- 800 000 - 999 999 NOK
- 1 000 000 - 1 199 999 NOK
- 1 200 000 - 1 399 999 NOK
- 1 400 000 NOK or above
- I don't know / Do not wish to answer

If 1400000 NOK or more, please give an estimate.

In case you do not know/do not wish to answer, click 'Next'.

**54) Total household income (NOK):**

**55) Our research project also includes face-to-face interviews with a number of persons/households in order to gain deeper insight into the research questions of the study. Would you be willing to participate in such an interview?**

- Yes
- No

You have responded positively to participating in a possible interview. What is your email address that we can use to contact you?

**56) Email:**

**57) Is there anything else you would like to tell us regarding your local area and how it influences your life? If so, you are welcome to provide comments below. Otherwise, you may click 'Send' to conclude the survey.**

[Send]

100 % completed

# Appendix B. Interview guide

## Appendix B. Interview guide

Firstly, the purpose of the project is reintroduced to the participant. The interviewee has already been informed about it earlier when introduced to the questionnaire and again when being contacted with the request for an interview. Before the interview begins, the following aspects are explained to the interviewee:

1. Anonymity / confidentiality / answer sincerely / no right or wrong / if do not wish to answer of course we can skip the question

2. Take time to respond / think before if necessary / no pressure

3. Questions similar to the questionnaire but here more detailed

*Focus question*

How might living in this local area influence your life? (The interviewee speaks freely for some time (15-20 minutes or so) about her/his thoughts concerning any influences of local area characteristics on her/his life.)

*General questions about local area*

For how long have you been living in your present dwelling?

Why did you move to your present dwelling? How satisfied are you with your present dwelling?

(Are you renting or owning this dwelling? How do you feel about this?)

Why did you choose this area? How satisfied are you with this local area?

In which local areas/cities have you lived before (if appropriate)? What differences could you think of between these local areas? Do these differences affect you in any way? If so, how? Did your previous local area /city influence your life differently? If so, how?

What do you like about your local area? Please elaborate.

What do you dislike about your local area? Please elaborate.

What improvements could be made in your local area?

How important is it for you to live in a local area that you like?

What do you associate with a good place to live?

And which characteristics do you associate with an unattractive local area?

Are there any areas in the city or the Oslo region in general where you would not at all have liked to live? Why?

Would you consider changing local area/city? Why?

If so, which local areas/towns/cities would you consider moving to? Why?

What are your favorite spots in your local area? Why? How about in other parts of the city?

What are your least favorite spots in your local area? Why? How about in other parts of the city?

Have you noticed any changes in your local area during the years? What do you think about them?

*Three SWB perspectives*

What are important factors of a good life for you? Would living in this residential area be related to any of those factors? Please explain. How important is the influence of your local area on those factors? How about your previous local area? (life satisfaction)

Is there any influence of this local area on your mood or emotions? Please elaborate. How important is this influence on your overall emotional status and mood? Which parts of your local area create positive feelings for you? Which negative? And why? How about your previous local area? (hedonic well-being)

What is a meaningful life for you? Does the local area you live in influence this? Please elaborate. How important is this influence? How about your previous local area? (eudaimonia)

*Accessibility in general*

What do you think of the location of your local area within the city? How might it influence your life?

Is it important for you to access other areas? Please elaborate.

How satisfied are you with the quality and variety of facilities and services in your area or in the surrounding areas? What could be improved?

How do you feel about the time you spent traveling for everyday activities? How important is it for you? What would you change ideally?

Which means of transport do you use for different types of trips (work, education, picking up children, access to facilities, leisure activities)?

Does living in this local area affect your choice on modes of transport? If so how?

How do you feel when traveling by _____ for your activities? (used transport modes)

How would you prefer to travel for each type of activity? How could this be achieved?

How much do you walk in your local area? Would you prefer to walk more/less?

How much do you use your bike in your local area? Would you prefer to bike more/less?

*Personal relationships*

How important are your personal relationships for you?

Do you think your local area might have an impact on your social, marital or family life compared to living in another area of the region? If so, what?

Do you think the physical arrangement of the local area promotes or hinders socializing in any way? If so, how?

How often do you meet friends, relatives or other people?

Would you prefer to meet them more often? In case yes, what barriers exist (e.g. time limitations, economic limitations, distances, raising children)

Do any of them live in this local area? Where do you usually meet?

Do you visit open spaces in your local area to meet friends or relatives or other people? If no, why?

Do you visit cafes, restaurants or other socializing facilities in your local area? If no, why?

How satisfied are you with the variety and quality of these facilities in close proximity? What could be improved?

*Leisure activities*

What kind of interests (e.g. sports, hobbies, cultural activities, nature visits) do you have (except for your work)? How important are they for you?

Do you practice these interests? Where do you practice them?

Do you think your residential area might have any impact on what kinds of interests you have? If so what? On how often you practice them?

Do you have any leisure interests on which you must for several reasons renounce? In case, which interests? Why must you renounce on these activities? (e.g. time limitations, economy, distances, raising children)

How satisfied are you with sports, cultural or other recreational facilities in your area or nearby? What would you improve?

*Urban design*

How beautiful do you consider your local area? Is this important for you?

What do you think about the buildings in your area?

What do you think about the streets in your area?

What do you think about the public parks and squares in your area?

*Other perceived characteristics*

What do you think about safety in your local area? How do you feel about this? If safe, what do you think makes it safe? How could safety be improved in local areas?

Is there a sense of community in this local area? How do you feel about this? How could a community feeling be developed in local areas?

How close do you feel with your neighbors? Do you socialize with them? How do you feel about this?

What do you think about the reputation/social status of your local area? Does it matter to you? How do you feel about it?

Would you say that this residential area consists of people who are quite similar to yourself or very different kinds of people? How do you feel about it? What about this local area compared to others?

*Health*

In what way / to what extent, if so ever, is your choice of residential location related to your or family members' health?

Do you think that your residential environment has any influence (positive or negative) on your physical health? In which ways? On your mental health? What about your previous residential local area?

*Other*

Are there any factors among those we already discussed that are more important for your overall wellbeing/quality of life? If so, which ones?

Are there any relevant issues that we have not been talking about, which you would like to add?

ISBN: 978-82-575-1523-2
ISSN: 1894-6402

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