

# Neighborhood characteristics, neighborhood satisfaction, and well-being: The links with neighborhood deprivation



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## ABSTRACT

It has been argued that the residential environment could play a role in the lower health and well-being commonly found in deprived areas. Yet, more knowledge is needed on how residential environmental quality together with neighborhood satisfaction relate to neighborhood socioeconomic deprivation. This paper explores the links between neighborhood deprivation and neighborhood characteristics, neighborhood satisfaction, and well-being, using survey and geospatial data from Oslo. Findings on physical neighborhood characteristics show that deprived neighborhoods are not underprivileged in terms of green space, public transport, and local amenities. However, perceived neighborhood characteristics – evaluated by their residents – were found to be negatively associated with neighborhood deprivation. These results suggest that deprived neighborhoods have higher perceived noise and lower perceived safety, cleanliness, aesthetic quality, reputation, and place attachment. Neighborhood satisfaction and emotional response to neighborhood were found to be lower in deprived neighborhoods. Overall, evidence from this study suggests that even when green space, public transport, and local amenities are evenly distributed, residents of deprived neighborhoods may still experience lower levels of neighborhood satisfaction and lower emotional response to neighborhood due to differences in neighborhood qualities such as perceived safety, noise, and place attachment.

## 1. Introduction

The residential environment could play a role in the lower health and well-being commonly found in deprived neighborhoods. Differences between deprived and non-deprived neighborhoods may exist in terms of both physical neighborhood characteristics such as access to facilities or green space (Nesbitt et al., 2019; Zenk et al., 2005) and perceived neighborhood characteristics such as neighborhood attachment or perceived safety (Poortinga et al., 2008; Steptoe and Feldman, 2001). Since neighborhood characteristics are linked to well-being (Mouratidis, 2018b; Northridge et al., 2003), potential lower environmental quality characterizing poorer neighborhoods could contribute to lower well-being in these areas (Diez Roux and Mair, 2010).

In this paper, the focus is on how neighborhood deprivation relates to neighborhood satisfaction, alongside neighborhood characteristics and well-being. Neighborhood satisfaction is an important life domain able to provide indications about the influence of neighborhood characteristics on well-being (Cao, 2016; Marans and Stimson, 2011). Examining the relationship between neighborhood deprivation and neighborhood satisfaction can shed more light on the role of the residential environment in well-being in deprived areas (Galster, 2012;

van Ham and Manley, 2012). This paper investigates how neighborhood characteristics (both physical and perceived), neighborhood satisfaction, and well-being are linked to neighborhood deprivation. The empirical analysis includes a wide range of both physical and perceived neighborhood characteristics, cognitive and affective evaluations of the neighborhood, and health and subjective well-being measures. It also accounts for urban form in terms of neighborhood density and location, since these factors are often associated with neighborhood deprivation as well as with neighborhood characteristics, neighborhood satisfaction, and well-being (Cao, 2016; Kyttä et al., 2016; Stevenson et al., 2016). Knowledge generated from this paper might give important insights into how to improve the well-being of residents in deprived neighborhoods, by improving neighborhood quality and neighborhood satisfaction.

This paper aims to address the following four research questions. (1) *What is the relationship between neighborhood deprivation and physical neighborhood characteristics?* (2) *What is the relationship between neighborhood deprivation and perceived neighborhood characteristics?* (3) *How is neighborhood deprivation linked to neighborhood satisfaction?* (4) *How is neighborhood deprivation linked to well-being?* The study will draw upon survey and geospatial data collected in Oslo, Norway. Data are analyzed with linear regression and multilevel modeling.

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## 2. Theoretical background

Inequality between neighborhoods and its potential impact on life chances and well-being has been an important subject of academic investigation and debate (e.g. [Cucca, 2020](#); [Diez Roux and Mair, 2010](#); [Kawachi and Subramanian, 2007](#); [Manley et al., 2011](#)). What has been of particular interest is the potential negative effect of neighborhood deprivation – high concentration of poverty and low education in particular neighborhoods – on life chances and well-being. This idea is the so-called “neighborhood effect” which is thought to stem from the book “The Truly Disadvantaged” by William Julius [Wilson \(1987\)](#). To study the implications of neighborhood deprivation, researchers use neighborhood deprivation indices that may include, among others, indicators of neighborhood poverty, income, education, and employment ([Messer et al., 2006](#)).

The qualities of the residential environment may be among the causal pathways behind the possible negative links between neighborhood deprivation and individual outcomes ([Galster, 2012](#)). Neighborhood deprivation might play a negative role in well-being via inequalities in physical and perceived neighborhood characteristics within urban areas ([Diez Roux and Mair, 2010](#); [Drukker and van Os, 2003](#); [Poortinga et al., 2008](#)). It should be noted that neighborhood characteristics may have different value and meaning for different individuals, and naturally people prioritize specific neighborhood characteristics over others. However, since basic physical neighborhood characteristics, such as green space, local amenities, and transport accessibility, and perceived neighborhood characteristics, such as safety and noise, are all linked to well-being ([Kytä et al., 2016](#); [Mouratidis, 2019b](#); [Ulmer et al., 2016](#)), inequalities in such neighborhood characteristics may lead to inequalities in well-being. Neighborhood characteristics are linked to well-being via the life domain of the neighborhood ([Marans and Stimson, 2011](#)), but also via other pathways such as social relationships, daily travel, leisure, and emotional responses ([Mouratidis, 2018b, 2019a, 2019b](#); [Mouratidis et al., 2019](#); [Nordbø et al., 2018](#)).

*Physical neighborhood characteristics* have been found to be less favorable for deprived neighborhoods in certain cases. Some studies find that deprived neighborhoods in some cities have lower green space cover than neighborhoods of higher income and education levels ([Li and Liu, 2016](#); [Nesbitt et al., 2019](#); [Schwarz et al., 2015](#); [Zhou and Kim, 2013](#)). Such inequalities in physical neighborhood characteristics can contribute to inequality in well-being outcomes since access to greenery may have considerable well-being benefits ([Hartig et al., 2014](#); [Ulmer et al., 2016](#)). Access to nature and green space can contribute to well-being via mechanisms such as psychological restoration, stress reduction, and reduction of local air pollution ([Hartig et al., 2014](#)). In other cases, neighborhood deprivation has been linked to transport disadvantage ([Lucas, 2012](#)), lower access to facilities for physical activity ([Estabrooks et al., 2003](#)), and lower access to grocery stores ([Zenk et al., 2005](#)). Such disadvantages may also hamper well-being outcomes ([Finlay et al., 2019](#); [Leyden et al., 2011](#)). However, poorer neighborhoods are not always deprived in terms of physical neighborhood characteristics. This depends on the context, as shown by a study in Glasgow which finds no association between neighborhood deprivation and access to facilities including education, healthcare, sports, and public services ([Macintyre et al., 2008](#)).

*Perceived neighborhood characteristics* including perceived safety, neighborhood attachment, and neighborhood reputation may also be less positive in deprived neighborhoods ([Atkinson and Kintrea, 2001](#); [Poortinga et al., 2008](#)). This lower perceived neighborhood quality could be attributed to the built environment (e.g. urban design, aesthetic aspects, environmental disorder, and litter) as well as the social environment (e.g. stigmatization, social norms, behaviors) in deprived neighborhoods. Differences in perceived neighborhood characteristics could mediate the relationship between neighborhood deprivation and self-reported health ([Poortinga et al., 2008](#); [Stephoe and Feldman,](#)

[2001](#)). Associations between neighborhood perceptions and well-being have been reliably identified by several studies ([Bowling et al., 2006](#); [Mouratidis, 2019b](#); [Toma et al., 2015](#)).

*Well-being* measures such as self-reported health, physical health, mental health, mortality, and subjective well-being are often found to be less positive in deprived neighborhoods ([Diez Roux and Mair, 2010](#); [Halonen et al., 2013](#); [Jokela, 2015](#); [Kawachi and Subramanian, 2007](#); [Kim, 2008](#); [Ludwig et al., 2012](#); [Stafford and Marmot, 2003](#)). Some studies suggest that the negative association between neighborhood deprivation and societal outcomes is mainly due to individual socioeconomic characteristics and not to neighborhood-level conditions ([Jokela, 2015](#); [Manley et al., 2011](#); [Oreopoulos, 2003](#)). It is argued that the tendency to score lower in well-being outcomes by low-income and low-education adults is due more to individual deprivation, linked to unhealthy lifestyles or fewer opportunities for high-quality healthcare, than it is to neighborhood deprivation. According to this argument, poorer people cluster in deprived neighborhoods as they cannot afford to live in affluent ones, and as a consequence of these residents scoring lower in well-being, the average deprived-neighborhood well-being is found to be lower. This self-selection in deprived neighborhoods can be, however, itself considered a form of socio-spatial injustice ([Sampson, 2019](#)). Other studies find that negative associations between neighborhood deprivation and well-being persist even when accounting for individual socioeconomic status ([Ludwig et al., 2012](#); [Poortinga et al., 2008](#); [Xiao et al., 2017](#)). It has been suggested that living in a deprived neighborhood may have an adverse impact particularly on the long-term well-being of children who grow up in these neighborhoods ([Sampson, 2019](#)). Naturally, the context plays an important role in the presence and strength of such possible impacts, as research has shown these to be less strong in more equal societies ([Brattbakk and Wessel, 2013](#)).

*Neighborhood satisfaction* may, at least partially, mediate the relationship between neighborhood characteristics and well-being ([Cao, 2016](#); [Marans and Stimson, 2011](#)), and can therefore be used as an indicator of whether differences in neighborhood characteristics between deprived and non-deprived neighborhoods may contribute to differences in well-being outcomes in these neighborhoods. Neighborhood satisfaction and well-being could be linked in a bidirectional way. Well-being, especially subjective well-being, can also have a “top-down” association with domain satisfaction ([Saris, 2014](#)), in which case a person’s overall life satisfaction affects how he or she evaluates different domains of life, including the neighborhood. Neighborhood satisfaction is largely shaped by neighborhood characteristics which are usually categorized as physical (objective) and perceived (subjective). Physical neighborhood characteristics found to be positively associated with neighborhood satisfaction are the presence of local amenities and access to green space (e.g. [Mouratidis, 2018a](#); [Zhang et al., 2017](#)). Perceived neighborhood characteristics that are associated with neighborhood satisfaction include perceived safety, aesthetic quality, quietness, neighborhood attachment, and neighborhood reputation (e.g. [Cao et al., 2018](#); [Lovejoy et al., 2010](#); [Mouratidis, 2018a](#); [Permentier et al., 2011](#)). The relationship between neighborhood satisfaction and neighborhood deprivation has not been sufficiently explored by previous research, especially together with neighborhood characteristics and well-being. It has been argued that future studies on neighborhood deprivation “should not forget to ask the question whether people are happy where they live” ([van Ham and Manley, 2012](#)). This paper aims to address this gap and provide insight into whether neighborhood quality and neighborhood satisfaction could contribute to possible differences in well-being between deprived and non-deprived areas. This would increase knowledge on potential pathways between neighborhood deprivation and well-being ([van Ham and Manley, 2012](#)).

This paper also addresses a methodological aspect that has been largely missing from relevant studies examining how neighborhood deprivation relates to neighborhood characteristics and well-being. To

get a better understanding of this relationship, there is a need to control for neighborhood density and neighborhood location as these can affect both physical (e.g. access to amenities, public transport, and green space) and perceived neighborhood characteristics (e.g. perceived safety, noise) (Kyttä et al., 2016). For example, denser areas located close to the city center usually offer higher access to facilities and public transport, but they are also perceived to be less safe and have higher noise levels (Mouratidis, 2018a). Neighborhood deprivation is not linked to density and distance to city center since in some cities poorer areas are located in the inner city while in others they are located in the suburbs. In other cases, as in the case of Oslo, there are poorer and richer neighborhoods both in the inner city and the suburbs (Oslo Kommune, 2017). Therefore, since neighborhood location and density are not causally linked to neighborhood deprivation, but can affect physical and perceived neighborhood characteristics, they should be accounted for in order to make generalizations on the relationship between neighborhood deprivation and neighborhood characteristics within specific cases. In analysis on well-being, as with analysis on neighborhood characteristics, accounting for neighborhood location and density, both of which can affect well-being (Cao, 2016; Kyttä et al., 2016; Stevenson et al., 2016), has been largely omitted in relevant studies and should now be considered.

### 3. Data and methods

(Fig. 1)

#### 3.1. Case area

The study is based on data from Oslo, the capital of Norway. In 2019, the population of Oslo Municipality was around 670,000, while the population of the urban area was approximately 1,000,000 and the population of the metropolitan area approximately 1,500,000. Oslo is a good case for this study as it includes diverse neighborhoods with a wide range of neighborhood characteristics as well as variations in neighborhood socioeconomic profiles. Oslo has a high variation in urban form and housing typologies. Compact neighborhoods, low-density suburbs, and medium-density modernist neighborhoods co-exist in Oslo. The inner city of Oslo is mostly characterized by apartment blocks, higher densities, mixed land uses, and frequent public transport, while the suburbs are mostly characterized by single-family housing, lower densities, separate land uses, and higher car dependency. The outer parts of Oslo also include some modernist neighborhoods with medium-density apartment blocks.

Norway is a country employing a welfare state system known as the Nordic model. The country is characterized by high living conditions, low social inequality, and high levels of well-being compared to global as well as European standards. Nevertheless, deprivation levels and well-being outcomes vary across space in Oslo (Ljunggren, 2017; Wessel, 2000). Despite its overall high living conditions and lower inequality compared to other European capitals (Musterd et al., 2017), some neighborhoods in Oslo – and particularly in the eastern part – are characterized by socioeconomic deprivation with lower incomes, higher levels of poverty and unemployment, lower education levels, and higher concentration of overcrowded dwellings (Ljunggren, 2017; Oslo Kommune, 2017; Wessel, 2000). Deprived neighborhoods are

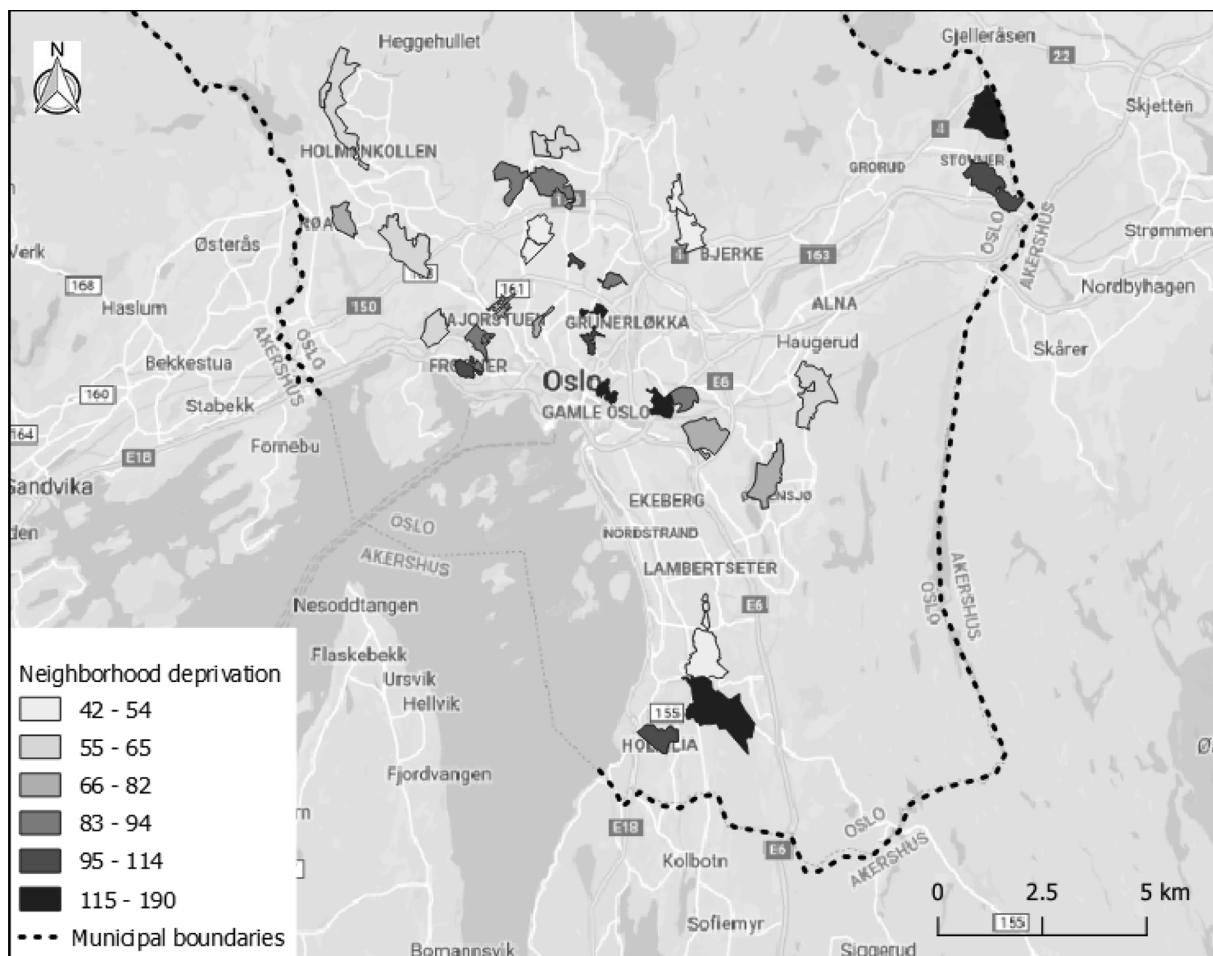


Fig. 1. Map of Oslo showing the case neighborhoods and their deprivation levels.

found in both the inner city and the suburbs (Oslo Kommune, 2017). It has been suggested that neighborhood deprivation in some areas of Oslo could negatively influence individual life chances and well-being (Brattbakk and Wessel, 2013).

### 3.2. Data sources

A population-based survey was conducted in Oslo in May–June 2016. The study's sample consists of 951 individuals aged 19–94, residing in 34 neighborhoods of Oslo Municipality. The survey covered various locations and diverse types of urban form (low, medium and high density). Detailed descriptions of the sample, the neighborhoods, and their characteristics are presented in the Appendix. The target population of the survey for Oslo Municipality was adult residents of all ages living in the 34 neighborhoods. A list of all the residents and their residential addresses within the postal zones corresponding to the selected neighborhoods was obtained from municipal registers. A random sample of residents was selected for each postal zone. The neighborhoods of the study were selected in order to obtain variation in terms of neighborhood density, location, land use mix, as well as neighborhood socioeconomic indicators such as average income and percentage of foreign population. Residents of dense inner-city neighborhoods were oversampled to obtain high numbers of participants for each type of urban form. As only about one third of the population in Oslo Municipality lives in denser, mixed-use neighborhoods, proportionate sampling would have produced an under-representation of such neighborhoods. Oversampling residents of these neighborhoods resulted in greater balance between denser and less dense neighborhoods in the sample (see Appendix). Residents of neighborhoods with higher concentration of foreign population were also oversampled to compensate for the lower response rates in these neighborhoods. The selected residents received an invitation letter to complete an online survey. The invitation letter was sent by post. The invitation letter as well as the online survey were in both Norwegian and English to facilitate the participation of non-Norwegian speaking immigrants. A maximum of one member per household was selected to participate in the study. The response rate in the survey was 13.8 %, therefore non-response bias might be relevant. As seen in Table A1 in the Appendix, most of the survey sample's sociodemographic characteristics do not differ much from the population, but there are some deviations, mainly in terms of immigrant status and level of education. As is often the case in survey research, there is a low response rate of immigrants in the survey which could lead to biased estimates. Statistical analysis in the study has been tested both with and without controlling for non-Norwegian citizenship and produced similar results, suggesting that the under-representation of immigrants in the sample may not materially affect the results. The study has been registered with the Data Protection Official for Research, Norwegian Center for Research Data (NSD).

### 3.3. Variable descriptions

Well-being, neighborhood satisfaction, perceived neighborhood characteristics, and individual sociodemographic variables were measured via the population-based survey. Well-being was measured with life satisfaction, anxiety, and self-reported health following the guidelines of OECD (2013) and the European Social Survey (2012). *Life satisfaction* was assessed 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). *Anxiety* was assessed by asking participants to evaluate the frequency of feelings of anxiety over the past week on a scale from “very rarely or never” (1) to “very often or always” (5). *Health* (self-reported health) was assessed by asking participants to describe their general health on a scale from “extremely poor” (0) to “extremely good” (10). *Neighborhood satisfaction* was assessed by asking survey participants 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. To achieve greater consistency among respondents, neighborhood was defined in the survey as the local area within 15 min walking distance from the respondent's dwelling. In addition to the cognitive evaluation of neighborhood satisfaction, data were obtained on the affective evaluation of the neighborhood by assessing emotional response to neighborhood. *Emotional response to neighborhood* was measured by asking participants to describe their feelings experienced when walking or biking within their neighborhood on a scale from “very negative” (1) to “very positive” (5). Perceived neighborhood characteristics were collected from the survey as follows. Respondents were asked to evaluate neighborhood characteristics *safety*, *noise*, *cleanliness*, *aesthetic quality*, and *neighborhood reputation* on a scale from “very low” (1) to “very high” (5). *Neighborhood attachment* was measured by asking participants how attached they feel to their neighborhood on a scale from “not at all” (1) to “a great deal” (5). Individual *sociodemographic variables* included: age, gender, cohabitation status (living with partner or spouse), citizenship, household income, presence of children in the household, employment status, level of education, and time living in the present dwelling. Time living in the present dwelling was measured on a scale from “less than a year” to “more than ten years”.

Physical neighborhood characteristics were measured using geospatial data. Two urban form features were measured: neighborhood density and neighborhood location in terms of distance to city center. *Density* (neighborhood density) was measured by dividing the population of each neighborhood by the area coverage in hectares. *Distance to city center* was measured from the centroid of each neighborhood in kilometers, along the pedestrian network. The physical neighborhood characteristics that were examined in terms of their relationship to neighborhood deprivation are green space, public transport accessibility, and local amenities including grocery stores and cafés. *Green space* was measured using geographic information systems data from Hansen et al. (2013). Based on these data, mean percentage of green space was measured within a 500 m radius from the centroid of each neighborhood. *Public transport* accessibility was measured with a public transport index, 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. *Grocery stores* were measured as the total number of grocery stores within a 500 m buffer. *Cafés* were measured as the total number of cafés, community centers, restaurants, pubs, and bars within a 1000 m buffer.

The study uses a *neighborhood deprivation index* which measures the socioeconomic deprivation levels of each neighborhood. The index was constructed based on data from Oslo Municipality (Oslo Kommune, 2017) for each neighborhood by combining three measures of neighborhood deprivation: percentage of households living in poverty, unemployment rate, and percentage of residents with low education. These measures are strongly correlated for the neighborhoods of Oslo ( $r$ : 0.860, 0.865, and 0.754). Index weights were adjusted according to the weights of the English Index of Multiple Deprivation (IMD), a commonly used deprivation index with high predictive power in urban areas (Niggebrugge et al., 2005). Weights were calculated to correspond to the weights of the three (out of seven) equivalent dimensions of deprivation of IMD: income, employment, and education. The adjusted weights used for the neighborhood deprivation index in this study were: household poverty (38.46 %), unemployment (38.46 %), and low education (23.08 %). Since these three measures are highly correlated in Oslo, a neighborhood deprivation index with alternative weights would produce similar results. Deprivation scores are standardized based on the average ( $= 100$ ) for the whole Oslo Municipality. The deprivation scores of the 34 neighborhoods examined in the study range from 42 to 190 with higher scores indicating higher deprivation.



### 3.4. Statistical analysis

The study uses the software SPSS (version 26) for its statistical analysis. Pairwise correlations between neighborhood deprivation and all the variables of the study are initially presented. To respond to its first research question, the study examines associations between neighborhood deprivation and physical neighborhood characteristics. This provides estimates of whether differences in physical neighborhood characteristics exist between deprived and non-deprived neighborhoods. Neighborhood location and density are accounted for, as explained in the theoretical background presented above. As all variables for this research question are measured at the neighborhood level (level 2), linear regression analysis is conducted for this step. To respond to the second, third, and fourth research questions, the study examines statistical effects of neighborhood deprivation on perceived neighborhood characteristics, neighborhood satisfaction, and well-being respectively. This provides estimates of whether deprivation at the neighborhood level (level 2) is related to differences in perceived neighborhood characteristics, neighborhood satisfaction, and well-being, independently of possible deprivation at the individual level (level 1). For these research questions, multilevel modeling process is followed (Bryk and Raudenbush, 1992). This is done to separate and estimate the effects across neighborhoods (level 2) and across individuals (level 1) (O'Campo et al., 2015; Sampson et al., 2002). For the analysis on well-being, linear regression is eventually used instead of multilevel modeling, since there is no between-cluster variance when level-1 variables are added.

## 4. Results

### 4.1. Descriptive analysis

Table 1 presents descriptive statistics of all variables used in the study along with Pearson's correlations between neighborhood deprivation and all the other variables. The first observation from Table 1 is that physical neighborhood characteristics are not significantly associated with neighborhood deprivation, while perceived neighborhood characteristics yield significant associations. Neighborhood perceptions – safety, noise, cleanliness, aesthetic quality, neighborhood attachment, and neighborhood reputation – are all found to be less positive for deprived neighborhoods. Neighborhood satisfaction is also found to be lower in deprived neighborhoods. Emotional response to neighborhood has a strong negative association with neighborhood deprivation. Among well-being measures, life satisfaction is found to be negatively associated with neighborhood deprivation, suggesting that life satisfaction is lower in deprived neighborhoods. Results on individual sociodemographic variables indicate that living in a deprived neighborhood is associated with younger, male, single, lower-income, and lower-education individuals, as well as with not having children in the household and living in the present dwelling for a shorter time period.

### 4.2. Physical neighborhood characteristics and neighborhood deprivation

Table 2 presents linear regression analysis assessing whether neighborhood deprivation is associated with differences in physical neighborhood characteristics. Results suggest that neighborhood deprivation is not significantly associated with green space and public transport while it is associated with higher presence of local amenities such as grocery stores and cafés. As seen in Table 2, neighborhood location and density are strongly associated with other physical neighborhood characteristics adding greater robustness to the results. As expected, proximity to city center and higher densities are associated with greater access to public transport, grocery stores, and cafés, while green space is significantly lower near the city center.

### 4.3. Perceived neighborhood characteristics and neighborhood deprivation

Table 3 and Table 4 present multilevel models assessing whether neighborhood deprivation is associated with differences in perceived neighborhood characteristics. The first step in multilevel modeling is to examine whether outcome variables vary at the neighborhood level as well as the individual level (Bryk and Raudenbush, 1992). To do this, the first rows of Table 3 and Table 4 present the random effects of the null models for each outcome. Values of between-cluster variance are significant for all outcomes, suggesting that there is significant variation between neighborhoods for each outcome. The next step is to run random intercepts models including only level-1 variables, to determine whether there is between-cluster variance when level-1 variables are added. The final step is to run random intercepts models including both level-1 and level-2 variables (full models).

Fixed effects for full models are presented in Tables 3 and 4. Results suggest that neighborhood deprivation is associated with higher noise and with lower safety, cleanliness, aesthetic quality, neighborhood reputation, and neighborhood attachment. Urban form variables are found to be significantly associated with certain perceived neighborhood characteristics. Therefore, including them in the analysis has provided robustness to the models. Proximity to city center is found to be associated with higher noise, lower aesthetic quality, lower neighborhood reputation, and lower neighborhood attachment. Neighborhood density is associated with higher noise, stronger neighborhood attachment, and lower cleanliness. Perceived safety is found to be similar for different urban forms, when accounting for neighborhood deprivation. According to this result, neighborhood deprivation appears to be the main factor behind the lower perceptions of safety found in dense inner-city neighborhoods in previous studies (Mouratidis, 2019b).

Results in Tables 3 and 4 indicate that the socioeconomic profile of the neighborhood (level 2), measured with neighborhood deprivation index, contributes to a greater extent to most of the perceived neighborhood characteristics (safety, noise, cleanliness, aesthetic quality, and neighborhood reputation) compared to individual socioeconomic characteristics (level 1). As might be expected, individual characteristics play a more important role in neighborhood attachment. Neighborhood attachment is positively associated with age, local citizenship, time living in present dwelling, living with partner or spouse, being female, and having children in the household.

### 4.4. Neighborhood satisfaction and neighborhood deprivation

Table 5 presents models examining how neighborhood deprivation relates to neighborhood satisfaction and emotional response to neighborhood. This analysis follows the same modeling process as the analysis for perceived neighborhood characteristics. The models in Table 5 have been additionally tested replacing the continuous neighborhood deprivation variable with a series of dummy variables representing different levels of neighborhood deprivation. Deprived neighborhoods were considered those where neighborhood deprivation index is equal to or greater than 104, mid-range neighborhoods were considered those where neighborhood deprivation index is greater than 65 and smaller than 104, and affluent neighborhoods were considered those where neighborhood deprivation index is equal to or smaller than 65.

Table 5 shows that neighborhood satisfaction and emotional response to neighborhood are negatively associated with neighborhood deprivation, even after accounting for neighborhood location, neighborhood density, and individual sociodemographic characteristics. The statistical effect of neighborhood deprivation on emotional response to neighborhood is stronger in terms of both effect size and significance level. The results for models that include dummy variables for neighborhood deprivation indicate that neighborhood satisfaction and emotional response to neighborhood are significantly lower for deprived neighborhoods compared to affluent neighborhoods, even after

**Table 1**  
Descriptive statistics and pairwise correlations with neighborhood deprivation.

Variables	N	Min/Max	Mean	s.d.	Correlation with neighborhood deprivation index <sup>a</sup>
<i>Neighborhood deprivation (level 2)</i>					
Neighborhood deprivation index	34	42/190	91.40	(41.18)	
<i>Physical neighborhood characteristics (level 2)</i>					
Population density (persons/ha)	34	24/306	104.74	(80.76)	0.263
Distance to city center (km)	34	1/13.8	5.93	(3.62)	0.219
Green space (% within 500 m)	34	5.07/64.66	24.45	(14.60)	-0.089
Public transport (within 500 m)	34	18/279	105.06	(78.50)	0.180
Grocery stores (within 500 m)	34	0/20	5.35	(5.15)	0.280
Cafés (within 1000 m)	34	0/272	52.97	(70.21)	0.242
<i>Perceived neighborhood characteristics (level 1)</i>					
Safety	940	1/5	4.12	(0.86)	-0.419**
Noise	949	1/5	2.61	(1.14)	0.321**
Cleanliness	938	1/5	3.71	(0.93)	-0.460**
Aesthetic quality	939	1/5	3.88	(0.93)	-0.361**
Neighborhood reputation	934	1/5	3.97	(0.97)	-0.551**
Neighborhood attachment	941	1/5	3.91	(1.02)	-0.175**
Neighbor ties	940	1/5	2.86	(1.19)	-0.138**
<i>Neighborhood satisfaction (level 1)</i>					
Neighborhood satisfaction	948	0/10	8.36	(1.74)	-0.069*
Emotional response to neighborhood	940	1/5	4.08	(0.78)	-0.301**
<i>Well-being (level 1)</i>					
Anxiety	941	1/5	2.07	(1.01)	0.054
Health	945	0/10	7.83	(1.74)	-0.025
Life satisfaction	951	0/10	7.80	(1.71)	-0.078*
<i>Sociodemographic variables (level 1)</i>					
Age	951	19/94	47.61	(15.66)	-0.232**
Female	940	0/1	0.53	(0.50)	-0.089**
Unemployed	948	0/1	0.03	(0.16)	0.039
Non-Norwegian	950	0/1	1.09	(0.29)	0.027
Living with partner/spouse	942	0/1	0.57	(0.50)	-0.165**
Adjusted household income (1000s NOK) <sup>b</sup>	899	35/4330	646.74	(336.89)	-0.156**
Household with children	942	0/1	0.28	(0.45)	-0.140**
College degree or higher	950	0/1	0.82	(0.38)	-0.069*
Time living in dwelling	947	1/5	3.58	(1.34)	-0.206**

Notes: Well-being, neighborhood satisfaction, perceived neighborhood characteristics, and individual sociodemographic variables are measured at the individual level (level 1), while neighborhood deprivation and physical neighborhood characteristics are measured at the neighborhood level (level 2).

<sup>a</sup> Pearson correlation coefficient significant at: \* $p < 0.05$ , \*\* $p < 0.01$ .

<sup>b</sup> Annual household income divided by the square root of household size.

controlling for urban form and individual characteristics. Highly deprived neighborhoods also score lower than mid-range neighborhoods in emotional response to neighborhood ( $p < 0.10$ ). According to results in Table 5, neighborhood proximity to city center is associated with higher neighborhood satisfaction, adding greater robustness to the neighborhood satisfaction models.

#### 4.5. Well-being and neighborhood deprivation

Table 6 presents models examining associations between neighborhood deprivation and well-being measures. Linear regression is used here instead of multilevel modeling, since there is no between-cluster variance when level-1 variables are added. Table 6 shows that

neighborhood deprivation is not associated with anxiety, health, and life satisfaction. Additional analysis – not shown here for simplicity – with dummy variables for neighborhood deprivation (as in Table 5) confirms these results. According to results in Table 6, anxiety is found to be higher in the inner city, even after accounting for neighborhood deprivation, extending previous relevant findings (Lederbogen et al., 2011; Mouratidis, 2019b).

Table 6 shows that well-being measures are significantly associated with individual sociodemographic characteristics but not with the neighborhood socioeconomic profile. This finding supports claims that individual characteristics such as income, unemployment, and education play a more important role in health and well-being compared to neighborhood socioeconomic profile (Manley et al., 2011). Anxiety is

**Table 2**  
Linear regression models presenting associations between neighborhood deprivation and physical neighborhood characteristics.

	Physical neighborhood characteristics			
	Green space	Public transport	Grocery stores	Cafés
Intercept	20.096** (8.198, 31.993)	85.117** (36.360, 133.874)	3.976** (1.125, 6.827)	40.103 (-9.068, 89.274)
<i>Neighborhood deprivation</i>				
Neighborhood deprivation index	-0.054 (-0.154, 0.047)	0.269 (-0.143, 0.682)	0.037** (0.013, 0.061)	0.449* (0.033, 0.865)
<i>Urban form</i>				
Distance to city center	2.359*** (1.042, 3.676)	-9.670*** (-15.066, -4.275)	-0.794*** (-1.109, -0.478)	-10.304*** (-15.745, -4.862)
Density	-0.045 (-0.105, 0.015)	0.503*** (0.259, 0.748)	0.026*** (0.012, 0.040)	0.315* (0.068, 0.562)
<i>Summary statistics</i>				
R-squared	0.568	0.749	0.801	0.681

Notes: <sup>a</sup> $p < 0.10$ , \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ . 95 % confidence intervals are shown in parentheses.

**Table 3**  
Multilevel models presenting associations between neighborhood deprivation and perceived neighborhood characteristics (1/2).

	Perceived neighborhood characteristics		
	Safety	Noise	Cleanliness
<i>Random effects for null model</i>			
Within-cluster variance	0.592***	0.977***	0.641***
Between-cluster variance	0.123***	0.305***	0.231***
Intraclass correlation (ICC)	0.172	0.238	0.265
<i>Fixed effects</i>			
Intercept	4.7538*** (4.2785, 5.2291)	1.9318*** (1.2363, 2.6273)	5.5847*** (5.0373, 6.1321)
<i>Neighborhood deprivation (level 2)</i>			
Neighborhood deprivation index	-0.0082*** (-0.0100, -0.0064)	0.0065*** (0.0031, 0.0099)	-0.0099*** (-0.0126, -0.0073)
<i>Urban form (level 2)</i>			
Distance to city center	0.0105 (-0.0162, 0.0372)	-0.0666** (-0.1140, -0.0193)	-0.0036 (-0.0405, 0.0333)
Density	-0.0007 (-0.0018, 0.0004)	0.0022* (0.0002, 0.0042)	-0.0019* (-0.0035, -0.0003)
<i>Sociodemographic variables (level 1)</i>			
Age	-0.0016 (-0.0053, 0.0020)	-0.0017 (-0.0065, 0.0031)	-0.0066*** (-0.0104, -0.0027)
Female	0.0009 (-0.1023, 0.1041)	-0.022 (-0.1372, 0.1328)	-0.0323 (-0.1401, 0.0754)
Unemployed	-0.0410 (-0.3824, 0.3004)	-0.0840 (-0.5324, 0.3644)	-0.0581 (-0.4143, 0.2980)
Non-Norwegian	0.0948 (-0.0984, 0.2879)	0.1553 (-0.0958, 0.4064)	-0.2017 <sup>a</sup> (-0.4038, 0.0004)
Living with partner/spouse	0.0886 (-0.0232, 0.2004)	0.0858 (-0.0601, 0.2312)	-0.0470 (-0.1640, 0.0700)
Adjusted household income	0.0001 (-0.0001, 0.0003)	-0.0000 (-0.0003, 0.0002)	-0.0000 (-0.0002, 0.0001)
Household with children	-0.1532* (-0.2780, -0.0285)	0.0881 (-0.0748, 0.2509)	-0.1077 (-0.2382, 0.0227)
College degree or higher	0.1746* (0.0369, 0.3123)	-0.1734 <sup>a</sup> (-0.3524, 0.0056)	0.1199 (-0.0237, 0.2635)

Notes: <sup>a</sup>*p* < 0.10, \**p* < 0.05, \*\**p* < 0.01, \*\*\**p* < 0.001. 95 % confidence intervals are shown in parentheses.

**Table 4**  
Multilevel models presenting associations between neighborhood deprivation and perceived neighborhood characteristics (2/2).

	Perceived neighborhood characteristics		
	Aesthetic quality	Neighborhood reputation	Neighborhood attachment
<i>Random effects for null model</i>			
Within-cluster variance	0.676***	0.544***	1.001***
Between-cluster variance	0.205***	0.420***	0.027 <sup>a</sup>
Intraclass correlation (ICC)	0.233	0.436	0.026
<i>Fixed effects</i>			
Intercept	4.6455*** (4.0409, 5.2500)	4.6040*** (4.0290, 5.1790)	2.9452*** (2.3785, 3.5119)
<i>Neighborhood deprivation (level 2)</i>			
Neighborhood deprivation index	-0.0069*** (-0.0101, -0.0036)	-0.0125*** (-0.0157, -0.0092)	-0.0029** (-0.0048, -0.0010)
<i>Urban form (level 2)</i>			
Distance to city center	-0.0622** (-0.1067, -0.0177)	-0.0563* (-0.1001, -0.0125)	-0.0297* (-0.0586, -0.0007)
Density	-0.0003 (-0.0022, 0.0016)	0.0013 (-0.0006, 0.0032)	0.0011 <sup>a</sup> (-0.0001, 0.0022)
<i>Sociodemographic variables (level 1)</i>			
Age	0.0020 (-0.0020, 0.0059)	0.0041* (0.0004, 0.0077)	0.0100*** (0.0048, 0.0152)
Female	0.0929 <sup>a</sup> (-0.0176, 0.2035)	0.0749 (-0.0270, 0.1767)	0.1966** (0.0700, 0.3232)
Unemployed	-0.3621 <sup>a</sup> (-0.7277, 0.0035)	0.2145 (-0.1293, 0.5583)	-0.0178 (-0.4566, 0.4210)
Non-Norwegian	-0.0955 (-0.3039, 0.1129)	0.0748 (-0.1161, 0.2657)	-0.2228 <sup>a</sup> (-0.4586, 0.0130)
Living with partner/spouse	0.0881 (-0.0312, 0.2073)	0.1184* (0.0085, 0.2283)	0.2412*** (0.1045, 0.3779)
Adjusted household income	-0.0000 (-0.0002, 0.0002)	0.0002* (0.0000, 0.0003)	-0.0002 (-0.0004, 0.0000)
Household with children	-0.0719 (-0.2052, 0.0613)	0.0855 (-0.0370, 0.2081)	0.2738*** (0.1201, 0.4275)
College degree or higher	0.1549* (0.0070, 0.3027)	0.1149 <sup>a</sup> (-0.0209, 0.2507)	0.0952 (-0.0737, 0.2640)
Time living in dwelling			0.1403*** (0.0829, 0.1977)

Notes: <sup>a</sup>*p* < 0.10, \**p* < 0.05, \*\**p* < 0.01, \*\*\**p* < 0.001. 95 % confidence intervals are shown in parentheses.

found to be higher for younger, unemployed, and lower-income individuals. Health is found to be better for younger, higher-income, and higher-education individuals. Life satisfaction is found to be U-shaped with age (lower for middle-aged people), while it is positively associated with income, education level, being employed, and living with partner or spouse, in line with previous studies (Blanchflower and Oswald, 2011).

**5. Discussion**

*5.1. Discussion of the results*

This paper provides new evidence on how neighborhood deprivation relates to neighborhood characteristics, neighborhood satisfaction, and well-being. Findings suggest that while socioeconomically deprived neighborhoods in Oslo are not underprivileged in terms of physical

neighborhood characteristics such as green space, public transport, and local amenities, they are characterized by poorer perceived neighborhood quality which seems to contribute to lower neighborhood satisfaction and lower emotional response to neighborhood. The lower neighborhood satisfaction and lower emotional response to neighborhood suggest that differences in residential environmental quality may contribute to well-being outcomes in deprived neighborhoods.

In contrast with other contexts (Estabrooks et al., 2003; Nesbitt et al., 2019; Zenk et al., 2005), neighborhood deprivation is not found to be linked to differences in physical neighborhood characteristics. In fact, access to local amenities such as grocery stores, cafés, and restaurants is higher in poorer neighborhoods, even after accounting for neighborhood location and density. This finding is in line with similar outcomes from a study in New Zealand (Pearce et al., 2006). The quality of local amenities is relatively similar in poorer and richer neighborhoods of Oslo, contrary to other cities where poorer

**Table 5**  
Multilevel models presenting associations between neighborhood deprivation and neighborhood satisfaction.

	Neighborhood satisfaction			
	Neighborhood satisfaction (1)	Neighborhood satisfaction (2)	Emotional response to neighborhood (1)	Emotional response to neighborhood (2)
<i>Random effects for null model</i>				
Within-cluster variance	2.943***	2.943***	0.536***	0.536***
Between-cluster variance	0.089	0.089	0.062**	0.062**
Intraclass correlation (ICC)	0.029	0.029	0.103	0.103
<i>Fixed effects</i>				
Intercept	7.8649*** (6.8292, 8.9005)	7.3724*** (6.4030, 8.3418)	3.9879*** (3.5570, 4.4189)	3.4167*** (2.9643, 3.8693)
Neighborhood deprivation (level 2)				
Neighborhood deprivation index	-0.0030 <sup>b</sup> (-0.0067, 0.0007)		-0.0044*** (-0.0056, -0.0031)	
Deprived neighborhood		Reference		Reference
Mid-range neighborhood		0.2185 (-0.0963, 0.5332)		0.1466 <sup>a</sup> (-0.0204, 0.3135)
Affluent neighborhood		0.4228* (0.0230, 0.8226)		0.4577*** (0.2589, 0.6565)
<i>Urban form (level 2)</i>				
Distance to city center	-0.0925** (-0.1484, -0.0365)	-0.0988*** (-0.1535, -0.0441)	0.0175 (-0.0040, 0.0391)	0.0056 (-0.0213, 0.0325)
Density	0.0003 (-0.0020, 0.0025)	0.0005 (-0.0019, 0.0029)	-0.0004 (-0.0012, 0.0004)	-0.0001 (-0.0014, 0.0011)
<i>Sociodemographic variables (level 1)</i>				
Age	0.0114** (0.0033, 0.0194)	0.0116** (0.0036, 0.0195)	0.0047* (0.0007, 0.0086)	0.0053** (0.0013, 0.0094)
Female	0.0925 (-0.1355, 0.3205)	0.0937 (-0.1338, 0.3212)	0.0892 <sup>a</sup> (-0.0076, 0.1860)	0.0853 <sup>a</sup> (-0.0120, 0.1827)
Unemployed	-0.6520 <sup>a</sup> (-1.4093, 0.1053)	-0.6528 <sup>a</sup> (-1.4108, 0.1052)	0.0381 (-0.2881, 0.3642)	0.0291 (-0.2992, 0.3574)
Non-Norwegian	-0.0520 (-0.4777, 0.3737)	-0.0630 (-0.4890, 0.3630)	-0.0681 (-0.2490, 0.1128)	-0.0887 (-0.2701, 0.0926)
Living with partner/spouse	0.2781* (0.0307, 0.5255)	0.2859* (0.0391, 0.5328)	0.1484** (0.0436, 0.2532)	0.1616** (0.0566, 0.2665)
Adjusted household income	0.0003 (-0.0001, 0.0006)	0.0003 (-0.0001, 0.0006)	0.0002* (0.0000, 0.0003)	0.0002* (0.0000, 0.0003)
Household with children	-0.0248 (-0.3013, 0.2517)	-0.0262 (-0.3024, 0.2500)	0.0652 (-0.0521, 0.1825)	0.0673 (-0.0501, 0.1846)
College degree or higher	0.2895 <sup>a</sup> (-0.0147, 0.5938)	0.2894 <sup>a</sup> (-0.0147, 0.5934)	0.2329*** (0.1033, 0.3624)	0.2315*** (0.1021, 0.3610)
Time living in dwelling			-0.0461* (-0.0900, -0.0022)	-0.0483* (-0.0925, -0.0041)

Notes: *ap* < 0.10, \**p* < 0.05, \*\**p* < 0.01, \*\*\**p* < 0.001. *bp* = 0.103. 95 % confidence intervals are shown in parentheses.

neighborhoods tend to have stores of lower quality (Cummins and Macintyre, 2002; Pearce et al., 2007). The higher access to local amenities in poorer neighborhoods can be considered positive for their social sustainability. Local amenities positively contribute to neighborhood satisfaction in Oslo (Mouratidis, 2018a), and, therefore, it is important that poorer households, which may have fewer mobility options, can access them easily. Another important finding from this study is that public transport accessibility is similar in deprived and non-deprived neighborhoods in Oslo. This suggests that, contrary to other contexts (Lucas, 2012), transport disadvantage is not present for

poorer neighborhoods in Oslo.

The study’s findings indicate that neighborhood deprivation is strongly linked to lower perceived neighborhood quality. Perceived neighborhood characteristics such as safety, neighborhood attachment, and neighborhood reputation are found to be less positive in deprived neighborhoods, in line with previous studies (Atkinson and Kintrea, 2001; Poortinga et al., 2008). The present study has examined a series of perceived neighborhood characteristics all of which are less positively evaluated by residents of deprived neighborhoods. These differences in perceived neighborhood characteristics seem to be responsible

**Table 6**  
Linear regression models presenting associations between neighborhood deprivation and well-being measures.

	Well-being measures		
	Anxiety	Health	Life satisfaction
Intercept	2.7497*** (2.1720, 3.3273)	6.9808*** (5.9600, 8.0016)	7.6098*** (6.3320, 8.8876)
Neighborhood deprivation (level 2)			
Neighborhood deprivation index	-0.0008 (-0.0025, 0.0009)	-0.0003 (-0.0033, 0.0027)	0.0007 (-0.0020, 0.0035)
Urban form (level 2)			
Distance to city center	-0.0317* (-0.0608, -0.0026)	0.0270 (-0.0242, 0.0783)	0.0062 (-0.0401, 0.0526)
Density	-0.0005 (-0.0016, 0.0007)	0.0008 (-0.0011, 0.0028)	0.0002 (-0.0016, 0.0020)
<i>Sociodemographic variables (level 1)</i>			
Age	-0.0094*** (-0.0140, -0.0048)	-0.0116** (-0.0197, -0.0035)	-0.0551* (-0.0989, -0.0114)
Age squared			0.0007** (0.0003, 0.0011)
Female	0.0074 (-0.1235, 0.1382)	0.0713 (-0.1588, 0.3013)	0.1500 (-0.0578, 0.3579)
Unemployed	0.8334*** (0.4000, 1.2667)	-0.6336 (-1.3970, 0.1297)	-2.0125*** (-2.7068, -1.3181)
Non-Norwegian	0.3033* (0.0578, 0.5488)	0.3361 (-0.0933, 0.7656)	-0.3071 (-0.6964, 0.0821)
Living with partner/spouse	0.0547 (-0.0874, 0.1967)	0.0649 (-0.1862, 0.3159)	0.5921*** (0.3654, 0.8187)
Adjusted household income	-0.0004*** (-0.0006, -0.0002)	0.0008*** (0.0004, 0.0011)	0.0009*** (0.0006, 0.0012)
Household with children	-0.0562 (-0.2145, 0.1021)	0.0737 (-0.2060, 0.3535)	0.0711 (-0.1936, 0.3359)
College degree or higher	-0.07933 (-0.2541, 0.0954)	0.2635 <sup>a</sup> (-0.0453, 0.5722)	0.2651 <sup>a</sup> (-0.0136, 0.5438)
<i>Summary statistics</i>			
R-squared	0.083	0.048	0.161

Notes: <sup>a</sup>*p* < 0.10, \**p* < 0.05, \*\**p* < 0.01, \*\*\**p* < 0.001. 95 % confidence intervals are shown in parentheses. The life satisfaction model includes age squared since life satisfaction is U-shaped with age (Blanchflower and Oswald, 2011). Linear regression is used instead of multilevel modeling, since there is no between-cluster variance when level-1 variables are added.



for the lower neighborhood satisfaction and lower emotional response to neighborhood found in deprived neighborhoods of the study, since perceived neighborhood characteristics are the strongest predictors of neighborhood satisfaction (Cao et al., 2018; Lovejoy et al., 2010; Mouratidis, 2019b; Permentier et al., 2011).

Contrasting with a wide range of studies from various contexts (Diez Roux and Mair, 2010) which find associations between neighborhood deprivation and well-being even after controlling for individual characteristics (e.g. Xiao et al., 2017) or through longitudinal research designs (e.g. Ludwig et al., 2012), this study finds that neighborhood deprivation is not associated with life satisfaction, self-reported health, or anxiety. This finding is in line with certain studies that find no causal link between neighborhood deprivation and well-being (e.g. Jokela, 2015). Findings may be explained by taking into consideration the context of the case of Oslo. Social inequalities are lower in Oslo compared to most cities in other studies. This means that differences in individual socioeconomic characteristics are also smaller and that differences in neighborhood deprivation are smaller. Immigrant groups in Oslo are also relatively well-integrated into the local society compared with other European cities (Andersen and Biseth, 2013). In addition, the relatively even distribution of physical neighborhood characteristics found in Oslo may contribute to the nonsignificant associations found between neighborhood deprivation and well-being since physical neighborhood characteristics are recognized as potential pathways between neighborhood deprivation and well-being (Galster, 2012).

The present study's findings do not, however, imply that well-being is not influenced by neighborhood deprivation in Oslo. On the contrary, findings suggest that neighborhood deprivation may negatively contribute to well-being via lower perceived neighborhood quality, lower emotional response to neighborhood, and lower neighborhood satisfaction, but that these potential contributors might be counterbalanced by other factors or might simply be relatively small for the case of Oslo. In other contexts, these pathways can be stronger, potentially translating into differences in well-being measures. Although it is not within the scope of this study to empirically test these possible pathways, the outcomes of the study provide some reliable indications for their existence.

## 5.2. Policy implications

The study's findings have important implications for policymakers aiming to improve living conditions and well-being in urban areas. It should be again noted that well-being mostly depends on individual-level factors, so urban policies can only complement policies targeting individual-level socioeconomic conditions (Poortinga et al., 2008). The lower perceived neighborhood quality, neighborhood satisfaction, and emotional response to neighborhood found in deprived areas should be considered and addressed by urban policymakers. In addition, extra support for residents of deprived areas could be provided targeting at improving well-being measures such as health and life satisfaction which are hampered by individual deprivation. Policy recommendations should thus be considered even in a context where social inequalities are lower and inequalities in physical neighborhood characteristics may not be present. Housing policies could provide support for vulnerable groups in order to improve their life chances and well-being outcomes (Andersen and Røe, 2017; Bolt et al., 2010; Bricocoli and Cucca, 2016; Fainstein, 2010). Measures for preventing displacement, regulations for minimum sizes of dwellings, and provisions for affordable housing are some ideas for more equitable housing. Additional support in terms of public transport availability, accessibility, and affordability can improve life chances of vulnerable groups. Increasing green space in deprived areas not only has important environmental benefits (Yiannakou and Salata, 2017), but can also improve perceptions of safety and stability and provide health and subjective well-being benefits (Harvey et al., 2015; Haybatollahi et al., 2015; Mouratidis, 2019c; Szulcowska et al., 2014; Ulmer et al., 2016).

Development of pedestrian areas and limiting traffic can have noise-reducing benefits in deprived neighborhoods in addition to environmental benefits (Soni and Soni, 2016). Finally, policymakers could employ empowerment strategies that promote public participation and the inclusion of vulnerable groups in the planning process. Such strategies can have positive well-being impacts (Baba et al., 2017; Wallerstein, 2006) both as means to reduce well-being disparities by reducing exclusion and as end goal by improving social cohesion.

## 5.3. Limitations and future research

This study has some limitations that could be explored by future research. First, the analysis is based on cross-sectional data, and, therefore, the results should be interpreted with caution since they indicate associations and not causal relationships (van Ham and Manley, 2012). Second, it should be acknowledged that the study's cross-sectional design may not capture possible long-term well-being effects of growing up in deprived neighborhoods (Miltenburg and van der Meer, 2018; Musterd et al., 2012). Third, although the study uses established measures of well-being (European Social Survey, 2012; OECD, 2013), data are based on single-item indicators. Latent constructs may provide even greater accuracy to the estimates. Fourth, the study does not control for neighborhood choice or self-selection. Variables explaining neighborhood choice could contribute to some degree to the variation in the outcome variables (van Ham and Manley, 2012). For example, as people tend to prefer neighborhoods with a certain level of homogeneity (Semyonov et al., 2007), they may choose to cluster in neighborhoods with similar sociocultural backgrounds. This clustering could bias the results at the neighborhood level, since people of different backgrounds might have different expectations when evaluating neighborhood quality or well-being aspects. Although analysis in the present study is expected to at least partially capture such influences as it accounts for a series of individual-level sociodemographic variables, future studies could limit potential biases even further by including neighborhood self-selection variables and/or by employing longitudinal research designs. Fifth, it is outside the scope of this study to statistically test whether lower neighborhood satisfaction and lower emotional response to neighborhood mediate the relationship between neighborhood deprivation and well-being. Future studies could test these potential pathways. Sixth, the associations between neighborhood deprivation and physical neighborhood characteristics might be influenced by the conceptualization and operationalization of neighborhood deprivation. In the present study, neighborhood deprivation combines measures of household poverty, unemployment rate, and low education. Using other deprivation indices, such as the IMD that additionally includes measures related to housing, services, and the living environment, might have produced different results. Seventh, since the focus in this paper is on how neighborhood deprivation relates to neighborhood qualities and neighborhood satisfaction, the variables examined here revolve around the neighborhood dimension. However, neighborhood deprivation might be linked to inequalities in housing characteristics that could in turn have an impact on residential satisfaction and well-being. Future studies could explore such possible links.

## 6. Conclusions

This paper has provided new insights into how residential environmental quality and neighborhood satisfaction are linked to neighborhood deprivation. Four research questions have been addressed. (1) Findings on physical neighborhood characteristics show no substantial differences in green space and public transport accessibility between deprived and non-deprived neighborhoods, while access to local amenities such as grocery stores and cafés is higher in deprived neighborhoods. (2) Perceived neighborhood characteristics are found to be negatively associated with neighborhood deprivation. Deprived neighborhoods were found to have higher perceived noise and lower

perceived safety, cleanliness, aesthetic quality, reputation, and place attachment. (3) Neighborhood satisfaction and emotional response to neighborhood were found to be lower in deprived neighborhoods, even after accounting for individual sociodemographic characteristics as well as neighborhood location and density. (4) Well-being measures – anxiety, self-reported health, and life satisfaction – are found to be non-significantly linked to neighborhood deprivation, when accounting for individual sociodemographic characteristics.

Overall, evidence from this study suggests that even when green space, public transport, and local amenities are relatively evenly distributed, residents of deprived neighborhoods may still experience lower levels of neighborhood satisfaction and emotional response to neighborhood due to differences in neighborhood qualities such as perceived safety, noise, and place attachment. This knowledge has shed more light on the role of the residential environment in well-being in deprived areas. It has also provided a platform for future research that could assess neighborhood satisfaction and emotional response to

neighborhood as possible pathways between neighborhood deprivation and well-being.

#### CRediT authorship contribution statement

**Kostas Mouratidis:** Conceptualization, Methodology, Formal analysis, Investigation, Visualization, Writing - original draft, Writing - review & editing.

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## Appendix A

### Table A1, Table A2, and Table A3

**Table A1**  
Comparison of sociodemographic characteristics.

	Survey respondents (N = 951) Mean	Population Mean
Age (for aged 18 or older) <sup>a</sup>	47.61	46.30
Unemployed <sup>b</sup>	3.00 %	2.50 %
Living with partner/spouse <sup>a</sup>	57 %	48 %
Non-Norwegian citizenship <sup>b</sup>	9%	25 %
Adjusted household income (1000s NOK) <sup>a</sup>	646.74	582.98
Household size (persons) <sup>a</sup>	2.12	1.94
Number of children in household <sup>a</sup>	0.47	0.46
Household with children <sup>a</sup>	28 %	26 %
Respondent is female <sup>a</sup>	53 %	50.30 %
Respondent has college degree or higher <sup>b</sup>	82 %	50 %
Neighborhood deprivation index <sup>b</sup>	91.40 %	100 %

<sup>a</sup> Population mean refers to the counties of Oslo and Akershus, which include Oslo metropolitan area.

<sup>b</sup> Population mean refers to Oslo municipality.

**Table A2**  
Case neighborhoods of West Oslo.

Neighborhood name	Deprivation index	Population density (persons/ha)	Distance to city center (km)	Green space (%) 500 m	Public transport 500 m	Grocery stores 500 m	Cafés 1000 m	Sample size (persons)
Frogner C	111	94	2.8	17	120	9	91	15
Nordberg	91	26	5.8	29	24	1	9	13
Frogner B	91	306	2.6	13	184	10	92	20
Frogner A	89	135	2.8	12	152	8	121	8
Majorstuen B	82	247	2.9	7	174	13	117	35
Majorstuen A	82	221	3.1	5	162	10	104	57
Hovseter	82	76	7.4	26	26	4	9	22
St. Hanshaugen	76	203	2.3	14	203	9	171	62
Holmenkollen B	65	60	10.6	65	18	0	0	20
Holmenkollen A	65	24	10.5	33	36	0	1	19
Kringsjå	57	73	6.8	41	44	3	3	12
Korsvoll	57	31	6.5	48	20	2	4	11
Holmen	57	30	6.0	25	88	2	3	13
Skøyen	56	46	4.2	39	50	3	44	16
Grefsen	54	97	7.6	36	66	1	12	26
Ullevål	52	57	4.0	18	64	3	29	22
Berg	52	35	4.6	23	40	4	18	20
Lofthus	42	50	5.6	18	164	3	10	17

**Table A3**  
Case neighborhoods of East Oslo.

Neighborhood name	Deprivation index	Population density (persons/ha)	Distance to city center (km)	Green space (%) 500 m	Public transport 500 m	Grocery stores 500 m	Cafés 1000 m	Sample size (persons)
Grønland	190	205	1.0	6	256	20	186	99
Vestli	188	126	13.6	41	24	1	3	3
Tokerud	188	81	13.8	37	24	1	7	16
Hauketo	182	32	10.1	44	55	2	4	12
Grünerløkka upper	122	244	2.3	7	244	14	214	72
Vålerenga	115	130	2.5	10	160	4	37	52
Grünerløkka lower	111	171	1.5	12	187	18	272	52
Stovner	105	36	13.1	16	75	1	5	7
Holmlia	104	62	10.8	37	73	4	12	13
Sagene	95	267	3.5	17	279	10	62	57
Etterstad	93	72	3.2	8	191	4	22	14
Torshov	88	135	3.3	12	178	9	92	71
Østenjø	81	55	6.4	23	50	2	9	16
Høyenhall	77	52	4.4	22	24	3	17	13
Hellerud	57	44	7.7	41	73	2	8	32
Nordstrand	53	38	8.4	31	44	2	13	14

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