Psychological planning

Examining the relation between the neighbourhood and mental health

Bachelor's project

Rijksuniversiteit Groningen, Faculty of spatial sciences

Author: Jildert Dijkstra

Student number: S4080068

Supervisor: Dr. S. Ramezani

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1 Summary

This research project aims to examine the relation between the spatial environment and mental health on a neighbourhood level by answering 'What is the relation between neighbourhood characteristics and mental health in The Netherlands?' This is relevant as the spatial environment is set to play a larger role in our everyday lives. Currently, there is a lack of research on the relation between spatial factors and mental health, especially on a neighbourhood level and in a Dutch context. A quantitative research method is chosen using statistical analysis of two secondary datasets utilising SPSS. The findings suggest that high percentages of neighbourhood housing stock consisting of social housing, large unit housing and housing constructed before 2000 correlate with lower mental health. Findings also suggest that high percentages of inhabitants suffering serious neighbour noise nuisance correlate to lower mental health, while high population density seems to correlate to higher mental health. There is no clear link found between the accessibility of services and mental health. Policy-wise, the findings indicate that reducing noise nuisance should be a top priority for policymakers seeking to improve mental health. Additionally, the findings suggest that planning communities with higher population density might prove beneficial for mental health.

Keywords: Mental health, spatial planning, neighbourhood, Netherlands

2 INTRODUCTION

2.1 BACKGROUND AND MOTIVATION

The covid-19 epidemic worsened the existing mental health crisis in the Netherlands, with more than 1 in 5 of 12-25 year-olds (22%) reporting that they 'seriously considered suicide' during the previous lockdown (RIVM, 2022). Additionally, the negative mental health effects of the covid pandemic have not been limited to the Netherlands alone, with the mental health levels lowering internationally (Findlay et al., 2020, Jones et al., 2021). Besides this, the covid pandemic and the measures along with it have possibly caused a shift in mobility patterns, with working from home becoming more widely adopted (Kellerman, 2022). This increase would mean that people spend even more time in their homes and that the role of the local neighbourhood as a living space for all its citizens becomes even more important. These trends together make it more necessary than ever to study the implications of the neighbourhood on mental health and the implications of this relation on the spatial planning practice in particular.

Currently, there is a lack of research concerning the relation between the living environment and mental health, especially in the Netherlands. There is research suggesting that the living environment has an impact on mental health in the form of urbanity and accessibility (Peterson et al., 2009, Chen et al., 2015, Vella-Brodrick and Stanley, 2013, Liu et al., 2022). Although existing research suggests a relation between the living environment and mental health on the neighbourhood level (Shen, 2022). There is a lack of research done on these relations within a Dutch or European context.

Due to its relatively flat terrain and high population density, The Netherlands is a unique country in a spatial sense (Van Dijk et al., 2019). Therefore, enough research must be done on a local as well as a national level. Although conducting a neighbourhood study using all Dutch neighbourhoods is a large scale study and might lack details, it can help with spotting broad trends across multiple regions and cities in the Netherlands at once. By possibly spotting larger trends, this research can prove an inspiration to conduct more thorough and concrete research on a smaller scale and to establish a basis of results which can serve as comparison material to more local research. Although concrete policy advice is difficult to provide on a large scale, it can serve to formulate loose and broad spatial policy suggestions.

2.2 Research problem

This study aims to examine the link between neighbourhood characteristics and mental health in The Netherlands.

The research question answered in this paper is:

> 'What is the relation between neighbourhood characteristics and mental health in The Netherlands?'

The sub-questions to help define the relation are:

- How is emotional well-being impacted by neighbourhood characteristics?
- How is psychological well-being impacted by neighbourhood characteristics?
- How is social well-being impacted by neighbourhood characteristics?

2.3 Outline

In Chapter 3, a theoretical framework will be drawn to grant a theoretical base to this study, as well as a list of hypotheses. This will be followed up by chapter 4, which discusses the methodology and used datasets behind the study. The results of the analysis will be shown and discussed in chapter 5, and conclusions about those results will be drawn in chapter 6.

3 Theoretical framework

3.1 Defining mental health

The concept of health, including mental health, can be defined in a large variety of ways. The World Health Organization defined mental health as "a state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community" (World Health Organization, 2005). The key aspect of this definition is the concept of well-being which can be split up into a three-factor model consisting of emotional well-being, psychological well-being and social well-being (Keyes, 2006). Emotional well-being can be summarized as well-being derived from perceived happiness and life satisfaction (Keyes, 2006). Psychological well-being is separated into six factors which are self-acceptance, positive relations, autonomy, environmental mastery, purpose in life and personal growth (Ryff, 1989). Lastly, social well-being can roughly be considered as being able to fit into the social fabric and being accepted and integrated (Keyes, 1998).

As the aforementioned research is somewhat dated, the perspective on this model has changed somewhat with critics stating that the model is focused heavily on a person's ability to be a productive member of (western) society and therefore fails to apply accordingly to marginalized and discriminated communities (Galderisi et al., 2015). Additionally, the three-factor model by Keyes is argued to be rooted in a western vision of mental health and therefore might fail to accommodate for important cultural

differences in the definition and perception of mental health (Galderisi et al., 2015, Galderisi et al., 2017). Considering these new perspectives, it is stated that "Mental health is a dynamic state of internal equilibrium which enables individuals to use their abilities in harmony with universal values of society" (Galderisi et al., 2015). A dynamic state of internal equilibrium can be seen as the constantly changing nature of the three well-being factors and the interactions between them to form different balances between these well-being factors someone experiences throughout life (Galderisi et al., 2015).

As all three factors together make up the broader concept of mental health, it is key that all are connected to the researched variables. Therefore the dependent variables chosen from the dataset to represent these theories most accurately are the 'moderate or high risk for depression' variable to represent emotional well-being, 'perceived lack of influence over own life' variable to represent psychological well-being and 'loneliness' as a variable to represent social well-being, with lower percentages being better in the context of this research.

3.2 Neighbourhood characteristics

Neighbourhood characteristics is a very broad concept which cannot be defined as a concrete variable in itself similar to mental health. The neighbourhood characteristics can however be split up into more usable groups of variables.

Considering this, the first proposed group of variables are the variables related to the housing stock in neighbourhoods. This is a relevant group of variables since there are multiple negative mental health effects on living in a high-rise apartment complex (Gifford, 2007). Literature also suggests that poor housing conditions cause low mental health which could lead to a slight negative mental health effect from living in pre-2000 housing (Pevalin et al., 2017).

Another important group of variables is the group that signifies the distance to services and mobility. The distance to important services is important as it signifies the walkability of a neighbourhood, walkability in turn has a positive effect on mental health (Wang et al., 2019). Besides this, longer commuting times are related to lower levels of well-being, which could suggest that a high average distance to essential services would correspond to lower levels of mental health (Gan et al., 2018). Additionally, walkability might also relate positively to the number of social interactions, which might in turn be positive for social well-being (Van Den Berg et al., 2017).

Although population density might be related to accessibility, which as aforementioned has a positive impact on mental health, there is evidence that suggests that high density could lead to a negative effect on mental health (Laird, 1973). Important to consider however is that this study is conducted in 1973 in the United States, so the effect could be socio-economic and demographic in nature rather than being directly associated with spatial planning. Low-density suburban areas do not seem to be related to negative effects on mental health (Sturm and Cohen, 2004). Literature also suggests that inhabitants of high-density areas have on average lower levels of social well-being than

inhabitants of low-density areas which makes a negative relation between density and social well-being expected in this research (Fassio et al., 2013).

The final neighbourhood characteristic being considered is noise nuisance. Environmental noise in general is already related to several negative mental and physical health indicators (Stansfeld et al., 2000). Considering this, additional serious noise nuisance from neighbours could be one of the most significant influences causing low mental health, this seems to be supported by literature, with research suggesting that neighbour noise nuisance is related to psychological problems (Grøtvedt, 1990). An important note to add is that low mental health could also make someone more affected by noise nuisance.

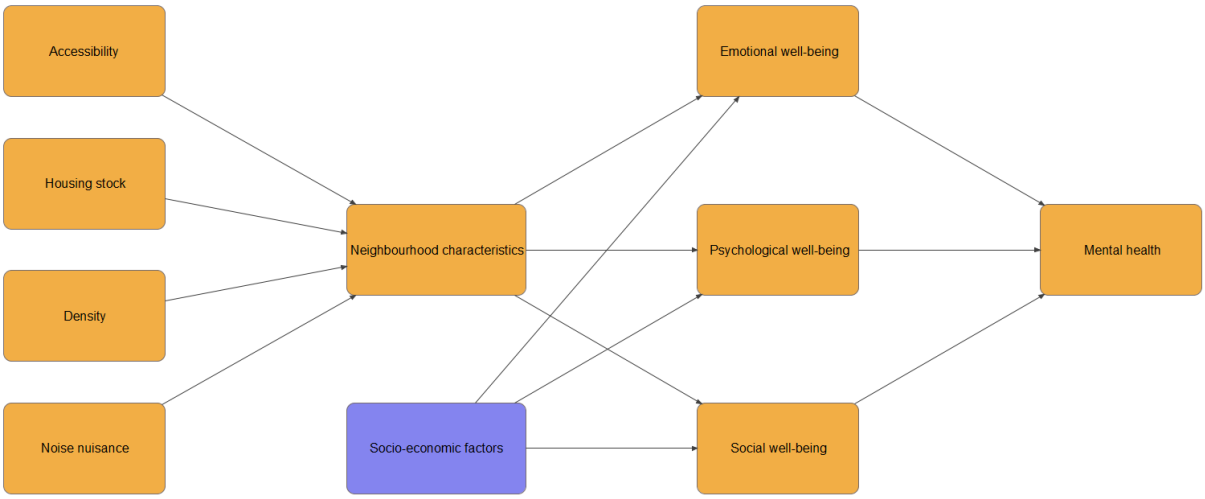

Figure 1 Conceptual model (Socio-economic factors are not researched)

3.3 Hypotheses

Considering the findings in the aforementioned literature, there are a few expectable effects of neighbourhood characteristics on mental health:

- Hypothesis 1: There is a significant relation between neighbourhood characteristics and mental health.
- Hypothesis 2: High amounts of social housing, 'housing units', and housing built before 2000 have a negative influence on emotional and psychological well-being.
- Hypothesis 3: Higher average distance to essential services has a negative impact on emotional, psychological and social well-being.
- Hypothesis 4: Higher population density affects emotional, psychological and social well-being.
- Hypothesis 5: Neighbour noise nuisance has strong negative effects on emotional, psychological and social well-being.

4 Methodology

To answer the posed questions, a quantitative form of research has been used as it can provide more accurate results than qualitative research based on interviewing and looser observations. Using quantitative data makes it possible to spot large-scale patterns across the Netherlands. Considering the scale of the research stretches across the entire country, only secondary data sources have been used. Collecting primary data was considering for personal and financial reasons unfeasible, and there was no clear necessity for primary data collection.

4.1 Datasets

The research uses a dataset that is made up of selected mental health characteristics from the Dutch national health monitor which is a survey conducted every four years by the municipal health services (GGDs), the national institute for health and environment (RIVM) and the central bureau for statistics (CBS). The version of the health monitor used in this research was conducted in 2020 and had 539.902 respondents, which is around 3% of the national population. The survey was conducted by firstly asking respondents to fill in an online survey and following up with a paper and pencil version of the questionnaire if the respondent did not participate in the online version. Considering the resource intensity to collect on a neighbourhood or district level, the RIVM utilizes an estimation method to collect sufficient data on local levels like neighbourhoods and districts. In this model, the health metrics in a neighbourhood are predicted based on population-related data within those neighbourhoods (Van De Kassteele et al., 2017). As the data is an estimate, its precision cannot be deemed completely accurate although the estimates seem to correspond well with reality (Van De Kassteele et al., 2017). The health monitor being used in this research dates from 2020 and is the most recent one to be released.

The other dataset that is utilized in this research is the 'core numbers of districts and neighbourhoods' by the CBS. Although these datasets come out on a year-by-year basis, the 2020 dataset has been chosen to ensure research consistency. The CBS dataset consists of socio-economic, demographic and locational variables. The CBS dataset aims to ensure the comparability of neighbourhoods by mostly providing percentual data. The datasets are merged by joining them together using the neighbourhood codes the RIVM and CBS provided in both datasets.

4.2 VARIABLES

4.2.1 Dependent variables:

- Moderate and high risk for depression

  This variable is obtained by taking the percentage of neighbourhood inhabitants that have scored 16 points or higher on the Kessler-10 test (Appendix 1), and therefore are classified as being of moderate or high risk for depression (RIVM, 2020)

- Perceived lack of influence over own life

  This number is obtained by conducting a 7-question survey on which people could answer in 5 categories ranging from 'completely disagree' to 'completely agree' (RIVM, 2020) (Appendix 2). As the original number in the dataset represented the percentage of people in a neighbourhood who reported to have a perceived sufficient amount of influence over their own life, the given number was subtracted from 100% to create a variable that represents people without perceived influence over their life, which fits more in line with the variables from the other two well-being factors.

- Perceived loneliness

  This variable is based on a Dutch loneliness scale which is based on an 11-question survey and consists of questions that can be answered with yes, no and 'more or less' (RIVM, 2020) (Appendix 3). The percentage of people that scored as either moderately, seriously or severely lonely in a neighbourhood together form the percentage of lonely people in a neighbourhood (RIVM, 2020).

4.2.2 Independent variables:

- Housing stock
  - % part of large housing unit

    This variable examines the percentage of the neighbourhood housing stock comprising houses within large housing units. These can roughly be described as houses which form a larger whole such as a flat, gallery home or staircase-access home. Constructions like duplexes and rowhouses do not count however (CBS, 2020).

  - % housing built before 2000

This variable examines the percentage of the neighbourhood housing stock comprising housing built before 2000.

- % social market housing

  This variable examines the percentage of the neighbourhood housing stock comprising housing that is rented out by social housing corporations

- Accessibility
  - Average distance in km to doctor

    Average distance in kilometres by road from the neighbourhood to a doctor's practice

  - Average distance in km to supermarket

    Average distance in kilometres by road from the neighbourhood to a supermarket

  - Average distance in km to a daycare

    Average distance in kilometres by road from the neighbourhood to a daycare

  - Average distance in km to elementary school

    Average distance in kilometres by road from the neighbourhood to an elementary school

- Population density

  Amount of inhabitants per square kilometre of neighbourhood

- Neighbour noise nuisance

  Percentage of neighbourhood inhabitants who experience serious noise nuisance from neighbours (RIVM, 2020).

VARIABLE	DATASET
Moderate & high risk for depression	RIVM health monitor
Lack of influence over own life	RIVM health monitor
Loneliness	RIVM health monitor
Housing stock	CBS core numbers neighbourhoods
Average distance	CBS core numbers neighbourhoods
Population density	CBS core numbers neighbourhoods
Noise nuisance	CBS core numbers neighbourhoods

Table 1 Variables by dataset

5 RESULTS

To study the effects of neighbourhood characteristics on mental health, several multiple regression analyses have been used to determine the nature of the relation between the two. A multiple regression analysis has been chosen as the used data is all quantitative and based on percentages, which makes it suitable for tests comparing ratio variables. Additionally, multiple regression analyses allow the assessment of the strength of the relation between the predictor variables and the dependent variable.

5.1 EMOTIONAL WELL-BEING

The emotional well-being at the neighbourhood level was researched by conducting a multiple regression analysis. The analysis will analyse the effect of neighbourhood characteristics on the percentage of neighbourhood inhabitants being at medium or high risk for depression. The test was significant with (p=,000)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	31,595	,208		151,927	,000		
	W_HousingUnit	,035	,002	,138	18,048	,000	,468	2,139
	W_SocialHousing	,083	,002	,254	34,483	,000	,504	1,983
	W_Pre2000	,000	,002	-,001	-,230	,818	,967	1,034
	A_Doctor	,199	,047	,041	4,199	,000	,292	3,426
	A_Supermarket	,017	,051	,003	,340	,734	,286	3,494
	A_Daycare	,140	,080	,020	1,759	,079	,222	4,510
	A_School	-,191	,078	-,025	-2,434	,015	,255	3,924
	O_PopDensity	-6,618E-5	,000	-,038	-4,753	,000	,416	2,405
	O_Noise	1,567	,031	,568	49,772	,000	,209	4,784

a. Dependent Variable: D_MedHighriskDepression

Table 2 Multiple linear regression results emotional well-being

The first thing to discuss from these findings is that the tolerance levels are > 0,1 for all variables and the VIF is < 10 for all variables, this proves that there are acceptable levels of multicollinearity for all variables.

As can be seen in Table 2, the percentage of housings stock consisting of both social housing and large housing units has a significant positive relation with the percentage of neighbourhood inhabitants being at medium or high risk for depression, considering that the relation is relatively strong for both the social housing (p=,000; β=,254) and large housing units (p=,000; β=,138), this finding aligns well with the existing theory that high-rises are damaging to mental health (Gifford, 2007). The expectation that a higher percentage of neighbourhood housing stock being built before 2000 is correlated to high percentages of medium and high risk for depression in neighbourhoods was however inaccurate as there is no significant relation between these two factors (p=,818), this might be for the reason that if a house is old it does not immediately mean that it is in a poor condition.

Of the accessibility-related variables, the average neighbourhood distance to doctors (p=,000; β=,041), schools (p=,015; β=-,025) and day-cares (p=,079; β=,020) had a significant effect on high percentages of medium and high risk for depression in neighbourhoods, with the average neighbourhood distance to a doctor being somewhat negatively related to emotional well-being while the average neighbourhood distance to an elementary school being somewhat positively related to emotional well-being. Literature would suggest that longer distances are negative for mental health (Wang et al., 2019, Gan et al., 2018). This difference between theory and actual findings could be explained by the fact that the Netherlands as a whole is a relatively small and dense country and therefore has fewer cases of amenities being so far away that it causes a very large effect on mental health.

Another unexpected result is that population density does not have a negative effect on emotional well-being, as population density significantly affects the percentage of neighbourhood inhabitants being at medium or high risk for depression in a slightly negative way (p=,000; β=,038). This is against the literature that suggests that higher density results in lower mental health (Laird, 1973). This may also prove the suspicions about the accuracy of this source considering its age and location.

As predicted in hypothesis 5, the percentage of neighbourhood inhabitants experiencing neighbour noise nuisance turned out to have a strong and significant positive relation with the percentage of neighbourhood inhabitants being at medium or high risk for depression (p=,000; β=,568). This fits in line with the research, which suggested that exposure to neighbour noise nuisance correlates with psychological problems (Grøtvedt, 1990).

Looking at the beta (β) values, it is visible that the percentage of people in a neighbourhood experiencing noise nuisance from neighbours is the largest positive impact on the percentage of neighbourhood inhabitants being at medium or high risk for depression. This fits in line with hypothesis 5 in which it was expected that noise pollution would impact all three mental health factors strongly.

5.2 PSYCHOLOGICAL WELL-BEING

Psychological well-being will be analysed using a multiple linear regression analysis as well to determine the effects of neighbourhood characteristics on the percentage of neighbourhood inhabitants that have a perceived lack of control over their own life. The multiple linear regression test is significant (p=,000).

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	4,189	,089		46,976	,000		
	W_HousingUnit	,014	,001	,140	17,118	,000	,468	2,139
	W_SocialHousing	,078	,001	,594	75,383	,000	,504	1,983
	W_Pre2000	,022	,001	,182	31,913	,000	,967	1,034
	A_Doctor	,034	,020	,017	1,669	,095	,292	3,426
	A_Supermarket	-,087	,022	-,042	-4,026	,000	,286	3,494
	A_Daycare	,116	,034	,040	3,384	,001	,222	4,510
	A_School	-,022	,034	-,007	-,642	,521	,255	3,924
	O_PopDensity	,000	,000	-,261	-30,050	,000	,416	2,405
	O_Noise	,315	,013	,286	23,337	,000	,209	4,784

a. Dependent Variable: D_LackofInfluence

Table 3 Multiple linear regression results psychological well-being

The first thing to discuss from these findings is that the tolerance levels are > 0,1 for all variables and the VIF is < 10 for all variables, this proves that there are acceptable levels of multicollinearity for all variables.

As visible in table 3, the effect of the percentage of neighbourhood housing stock consisting of large housing units is significantly positively related to the percentage of neighbourhood inhabitants that have a perceived lack of control over their own life (p=,000; β=,140). Comparably, the effect of the percentage of neighbourhood housing stock consisting of social housing on the percentage of neighbourhood inhabitants that have a perceived lack of control over their own life is positive and significant as well (p=,000; β=,594). Considering that these numbers are comparable to those seen in the multiple regression analysis for emotional health, this test also supports the claims made in the literature (Gifford, 2007). These results also prove hypothesis 2, as high amounts of social housing and 'housing units' indeed have a proven negative influence on emotional and psychological well-being. Hypothesis 2 is in this case also supported by the fact that the percentage of neighbourhood housing stock built before 2000 positively and significantly affects the percentage of neighbourhood inhabitants that have a perceived lack of control over their own life (p=,000; β=,182). The fact that the percentage of neighbourhood housing stock built before 2000 is significant in this analysis while it was not significant in the emotional well-being analysis is puzzling. A possible explanation could be that poor housing conditions are in the case of rental homes beyond the control of the homeowner (Kemp, 2011). This could explain why in this case it can cause a feeling of a lack of control.

Contrary to the multiple regression analysis for emotional well-being, the significant accessibility variables are this time the neighbourhood average distance to a supermarket (p=,000; β=-,042) and the neighbourhood average distance to a daycare (p=,001; β=,040). Similar to the emotional well-being analysis however is the fact that the findings do not correspond with the literature as the relation between the neighbourhood's average distance to a supermarket is slightly negatively related to the percentage of neighbourhood inhabitants that have a perceived lack of control over their own life. Considering that the beta (β) values are quite close to zero, and the fact that the value of beta (β) of accessibility variables is mixed between positive and negative values makes it concludable that hypothesis 3 is incorrect. This is in direct contrast to the literature mentioned in the theoretical framework (Wang et al., 2019, Gan et al., 2018). A possible explanation for this is the fact that the Netherlands is a country notorious for its bicycling infrastructure and number of cyclists, considering that the literature sources both used car traffic to examine the mental health effects of commuting (Wang et al., 2019, Gan et al., 2018). Considering that cycling is beneficial for mental health and an attractive mode of travel in the Netherlands, it is not unthinkable that this mostly mitigates effects from the distance to services on mental health (Rashad, 2007). This is supported by the fact that the mean neighbourhood distance to all researched amenities is between 1 and 2 kilometres, which is a walkable or bikeable distance in a flat country like the Netherlands.

The effect of population density on the percentage of neighbourhood inhabitants that have a perceived lack of control over their own life is significant (p=,000; β=-,261). Again, the value for beta (β) confirms that there is a negative relation between population density and the percentage of neighbourhood inhabitants that have a perceived lack of control over their own life, this proves that density is not a negative predictor of mental health but a positive predictor. These findings directly contrast the expectations, as it was hypothesised that population density would negatively impact emotional and psychological well-being. This can be explained by the fact that the literature the hypothesis was based on comes from the United States, a country which has in general cities with much lower density than in Europe (Laird, 1973). A possibility could be that the differences in low and high density are much less distinct than in the US, causing an unexpected effect or a general difference in culture.

As expected, the relation between the percentage of people in a neighbourhood experiencing noise nuisance from neighbours and the percentage of neighbourhood inhabitants that have a perceived lack of control over their own life is both significant and positive (p=,000; β=,286). This also is in line with the research as it states that high amounts of neighbour noise can lead to psychological problems, which is negative for psychological well-being (Grøtvedt, 1990).

5.3 SOCIAL WELL-BEING

In the literature and hypotheses, it was expected that the impact of neighbourhood characteristics on social well-being would be of a different nature than the impact of these characteristics on emotional and psychological well-being (Van Den Berg et al., 2017). Consequently, a multiple linear regression analysis conducted on the impact of neighbourhood statistics on the percentage of neighbourhood inhabitants suffering from loneliness might show a different set of results. The multiple linear regression test was significant with p=,000.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	29,241	,155		189,241	,000		
	W_HousingUnit	,056	,001	,236	39,030	,000	,468	2,139
	W_SocialHousing	,094	,002	,304	52,335	,000	,504	1,983
	W_Pre2000	,030	,001	,107	25,564	,000	,967	1,034
	A_Doctor	,294	,035	,064	8,320	,000	,292	3,426
	A_Supermarket	,003	,038	,001	,082	,934	,286	3,494
	A_Daycare	,117	,059	,017	1,978	,048	,222	4,510
	A_School	,254	,058	,036	4,373	,000	,255	3,924
	O_PopDensity	,000	,000	-,165	-25,742	,000	,416	2,405
	O_Noise	1,667	,023	,644	71,275	,000	,209	4,784

a. Dependent Variable: D_Loneliness

Table 4 Multiple linear regression results social well-being

The first things to discuss from these results are that the tolerance levels are > 0,1 for all variables and the VIF is < 10 for all variables, this shows that there are acceptable levels of multicollinearity for all variables.

The effects of the percentage of neighbourhood housing stock consisting of large housing units on the percentage of neighbourhood inhabitants suffering from loneliness are both significant and positive (p=,000; β=,236). The same is true for both the impact of the percentage of neighbourhood housing stock consisting of social housing (p=,000; β=,304) and the percentage of neighbourhood housing stock built before 2000 (p=,000; β=,107). Although it was hypothesised that the main effects of the housing variables would be on the emotional and psychological well-being levels and not on social well-being, the values in table 4 would suggest that they have a negative impact on social well-being as well.

Of the accessibility variables, there is a significant positive relation between the neighbourhood's average distance to a doctor (p=,000; β=,064), a daycare (p=,048; β=,017) and an elementary school (p=,000; β=,036) and the percentage of neighbourhood inhabitants suffering from loneliness. This would suggest that a high average distance to services has a negative effect on social well-being, which fits in line with the findings in the literature (Van Den Berg et al., 2017). The fact that the neighbourhood's distance adversely impacts social well-being also proves part of hypothesis 3.

There is a significant negative impact of population density on the percentage of neighbourhood inhabitants suffering from loneliness (p=,000; β=-,165). Again, these findings surrounding population density stand in contrast with the hypothesis. This is because it was suggested that inhabitants of higher-density areas have lower well-being than those in low-density areas.

Similarly to emotional and psychological well-being, noise has a negative effect on social well-being. The effect of the percentage of people in a neighbourhood experiencing noise nuisance from neighbours on the percentage of neighbourhood inhabitants suffering from loneliness is significant and positive (p=,000; β=,644). The one surprising finding from these results is that noise plays a relatively large role in predicting higher percentages of neighbourhood inhabitants as the beta (β) is relatively high at 0,644, which, is a high number considering the cited literature mostly considers emotional and psychological well-being, which made the social well-being effects of noise harder to predict than the other two types of well-being (Grøtvedt, 1990).

6 Conclusion

6.1 Findings

This research aimed to examine if there is a relation between neighbourhood characteristics and mental health in the Netherlands. The findings will be discussed by analysing the hypotheses. The hypotheses will either be briefly proven or rejected based on the aforementioned results.

Hypothesis 1: *'There is a significant relation between neighbourhood characteristics and mental health'* has been proven as all multiple regression tests have returned significantly and all neighbourhood variables have had a proven significant impact on at least one factor of broader well-being.

Hypothesis 2: *'High amounts of social housing, 'housing units', and housing built before 2000 have a negative influence on emotional and psychological well-being'* has been proven true by the multiple regression analyses. Besides the expected effect on emotional and psychological well-being, the findings also support that the aforementioned housing stock factors negatively affect social well-being. Social housing stock and large housing unit stock have been proven to have a significant negative impact on all three mental well-being factors while the percentage of neighbourhood housing stock being built before 2000 has a negative relation with psychological and social well-being.

Hypothesis 3: *'Higher average distance to essential services has a negative impact on emotional, psychological and social well-being'* can be rejected. The neighbourhood's average distance to amenities does not have a conclusive positive or negative effect on the three well-being factors. A possible explanation for this is the comparatively small size of the Netherlands and the cycling culture, which means that almost everywhere, essential amenities are already accessible by slow modes of transport.

Hypothesis 4: *'Higher population density has a negative effect on emotional, psychological and social well-being'* can also be rejected. The multiple linear regression analyses show that higher numbers of population density are positively related to all three mental health factors, particularly psychological and social well-being. These findings conflict clearly with the cited literature, which states that high density is disadvantageous to mental health. A possible explanation for this is that the literature sources use the United States and Italy, which are both much larger and less dense countries than the Netherlands, the differences between low and high density in the Netherlands could also be less abrupt than in both other countries.

Hypothesis 5: *'Neighbour noise nuisance has strong negative effects on emotional, psychological and social well-being'* has been proven true as all multiple linear regression analyses showed a negative relation between neighbour noise nuisance and all mental well-being factors. Additionally, the beta (β) values corresponding to neighbour noise nuisance in the multiple linear regression analyses are all among the highest values for beta (β), suggesting that neighbour noise nuisance also has a comparatively strong negative effect on all three mental well-being factors.

Considering these findings, it is clear that mental health, in general, is affected by neighbourhood characteristics. Emotional well-being seems to be influenced most strongly by the percentage of people in a neighbourhood experiencing serious noise nuisance from neighbours in a negative way. Furthermore, higher percentages of neighbourhood housing stock consisting of large housing units and percentages of neighbourhood housing stock consisting of social housing are also related to lower emotional well-being levels.

Contrary to emotional well-being, psychological well-being is influenced most strongly by housing stock, with high percentages of neighbourhood housing stock consisting of social housing, large housing units and housing built before 2000 serving as the strongest predictors for worse psychological well-being in a neighbourhood. A high percentage of people in a neighbourhood experiencing noise nuisance from neighbours is a predictor of lower levels of psychological well-being. Density on the other hand seems to be positively related to psychological well-being.

Social well-being is most negatively impacted by neighbour noise nuisance according to the multiple regression analysis. High percentages of neighbourhood housing stock consisting of social housing, large housing units and housing built before 2000 also are predictors for worse social well-being in a neighbourhood. Comparably to psychological well-being, social well-being is also impacted positively by population density.

6.2 Policy suggestions

Although the scope of the research is too large to confidently provide policy advice, the findings of this research can help with informing policy decisions to allow planners to design better and healthier cities. The largest possibility for planners to improve mental health on the neighbourhood level is to mitigate neighbour noise nuisance, which is one of the biggest predictors of low mental well-being. Another important takeaway message is that mental health should not be seen as a barrier to densification, as the findings suggest a slight positive effect of density on mental health. Although densification is positive for mental health, it seems that individuality has to be somewhat ensured as large housing units are negatively correlated with mental health. Therefore it is important to plan with density but to utilise a human scale. Although the strength of its effects seemed small, the accessibility of services, especially day-cares and schools are generally somewhat beneficial for mental well-being. Therefore, it is key to plan with accessibility in mind and to make sure that essential services are always acceptably nearby.

6.3 Limitations and opportunities

Several limitations and opportunities have been spotted during research, the first one being that the dependent variables from the dataset are only narrow indications of the three factors of mental well-being as emotional well-being comprises a broader definition than only ‘the absence of depression’. Although the three selected dependent variables are all somewhat representative of the mental well-being factors, they do not

fit perfectly, which is a negative consequence of working with secondary datasets. Another data-related problem is the fact that the effects of social housing on a neighbourhood level are more socio-economically relevant than directly relevant to the practice of spatial planning. Additionally, as the data was collected in 2020, during the start of the covid-19 pandemic, the mental well-being of people was likely different than during more normal times, there is a possibility that the results are therefore not entirely representative during non-pandemic times.

Although it was theoretically possible to use GIS in this research, the scale and timeframe made the implementation difficult in reality. Using GIS in future research on a more local level can however help with the visualisation of data, as well as a more thorough analysis of building stock and the built environment. Another possibility is the exploration of the degree that access to public green spaces has on mental well-being as there is evidence that suggests that green space has a positive effect on mental health (James et al., 2015). More local research of a municipality or a group of municipalities can also uncover common locational patterns in GIS visualisation which could prove valuable for spatial policy.

A limitation encountered during the research was the generally small impact of the accessibility variables on the well-being variables. Possible research comprising more accessibility variables could give a clearer picture of the relation between accessibility and mental health specifically. Additionally, the accessibility could more clearly be studied by using GIS analysis or studying the rural-urban difference between these variables.

The methodology of this research can also be applied to analyse the results from the health monitor surveys from 2012 and 2016 as well as future iterations of the health monitor. A comparison between those results could be analysed to establish trends in the relation between the neighbourhood and mental health over a longer time.

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8 APPENDICES

8.1 APPENDIX 1 – KESSLER-10 TEST

	None of the time	A little of the time	Some of the time	Most of the time	All of the time
During the last 30 days, about how often did you feel tired out for no good reason?	1	2	3	4	5
During the last 30 days, about how often did you feel nervous?	1	2	3	4	5
During the last 30 days, about how often did you feel so nervous that nothing could calm you down?	1	2	3	4	5
During the last 30 days, about how often did you feel hopeless?	1	2	3	4	5
During the last 30 days, about how often did you feel restless or fidgety?	1	2	3	4	5
During the last 30 days, about how often did you feel so restless you could not sit still?	1	2	3	4	5
During the last 30 days, about how often did you feel depressed?	1	2	3	4	5
During the last 30 days, about how often did you feel that everything was an effort?	1	2	3	4	5
During the last 30 days, about how often did you feel so sad that nothing could cheer you up?	1	2	3	4	5
During the last 30 days, about how often did you feel worthless?	1	2	3	4	5

Scores above 25 were counted as moderately to highly depressed

(Kessler et al., 2002)

8.2 APPENDIX 2 – INFLUENCE OVER OWN LIFE QUESTIONNAIRE

	Completely agree	**Agree**	**Neither agree or disagree**	**Disagree**	**Completely disagree**
I have little control over the things that happen to me	1	2	3	4	5
I have no way to solve some of my problems	1	2	3	4	5
There is little I can do to change important things in my life	1	2	3	4	5
I often feel hopeless in dealing with life's problems.	1	2	3	4	5
Sometimes I feel that I am a puppet of life.	1	2	3	4	5
What happens to me in the future depends largely on myself	5	4	3	2	1
I can do just about anything if I set my mind to it.	5	4	3	2	1

Scores below 20 are considered as a lack of influence

(RIVM, 2020)

8.3 Appendix 3 – Loneliness questionnaire

	No	Somewhat	Yes
There is always someone around me I can go to with my daily problems.	1	1	0
I miss a really good friend.	0	1	1
I experience an emptiness around me.	0	1	1
There are enough people I can fall back on in case of trouble.	1	1	0
I miss cosiness (gezelligheid) around me.	0	1	1
I think my circle of acquaintances is too limited.	0	1	1
I have many people on whom I can fully rely.	1	1	0
There are enough people with whom I feel closely connected.	1	1	0
I miss people around me.	0	1	1
I often feel abandoned.	0	1	1
When I need it, I can always turn to my friends.	1	1	0

Scores above 3 are considered as lonely

(de Jong-Gierveld and van Tilburg, 1999)