

# Neighbourhood urban form affecting mental health in Utrecht



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## ABSTRACT

In the recent years there is more attention to mental health of people and during the COVID-19 induced lockdowns people were forced to spend more time in their neighbourhood. During this time people gave their life a lower score and this could be a result of multiple factors. Most of these factors influencing mental health are well-studied. However, there is still limited knowledge on how neighbourhood design influences mental health of people. This research aims to bridge that gap and find out how neighbourhood urban form influences mental health. This will be done using the following research question: *How does different neighbourhood urban form influence the mental health of residents in the municipality of Utrecht?*

This research is conducted by analyzing the available mental health data on the neighbourhoods within the municipality of Utrecht and collecting additional data on the neighbourhood urban form. Results include that mental health is most significantly related to socio-economic variables. Urban form aspects do not seem to consistently influence mental health. Distance to childcare and distance to supermarket are significantly related to some mental health aspects. For a spatial planner these results imply that that in order to improve mental health in a neighbourhood there should be a bigger focus on improving the socio-economic of residents. This could be done according to the Viennese model of urban renewal which aims to do so with public private partnerships.

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# 1. INTRODUCTION

## 1.1 BACKGROUND

Having a high life satisfaction has a positive influence on a person's physical, but also mental health, (Antaramian, 2017). During the COVID-19 crisis, people in the Northern part of the Netherlands reported on giving their life a lower grade than before the crisis. From a 7.4 in March 2020, a 7.7 in the summer of 2020 to a 6.9 in February 2021 and even a 6.0 for adolescents according to research done by Lifelines (NU, 2021). The crisis has also led to an increase in mental health problems especially among adolescents according to the Dutch institute for mental health (GGZ) (Dorlo, 2020). A sharp decrease in social activities to combat COVID-19 is seen as the primary reason for this (NU, 2021). Most of this is out of reach to solve as a spatial planner since the closure of social activities is a concern for politics. However, spatial planning can influence urban form which can in turn influence mental health (Hajrasoulih *et al.* 2018; Renalds *et al.* 2010). It is especially interesting to research out if the mental health of people is affected not only due to less social activities but also because people spend more time in their neighbourhood and therefore, by the characteristics of their neighbourhood. Warren and Skillman (2020) found that the average distance moved during the lockdowns dropped dramatically. According to Renalds *et al.* (2010) and Hajrasoulih *et al.* (2018), it is clear that the urban form influences mental health.

As of 2021, there seem to be enough reasons to include mental health considerations when designing neighbourhoods. And in the Netherlands, a big opportunity has arisen to do this. The country is experiencing a housing shortage, similarly to other developed countries (Lloyd, 2015). Many political parties made it a goal to build 1 million houses before 2030 averaging 111.111 houses per year, this is higher than the average rate of 71.000 houses built in a year (ANP, 2021). This means that fast development like after World War Two is needed. Neighbourhoods from this era in the Netherlands have a distinct urban form due to functionalistic and modernistic influences. Many of these neighbourhoods are known as 'achterstandswijken' (disadvantaged neighbourhoods) (CBS, 2018). Large urban regeneration programs were and are needed to improve the situation also regarding the mental health of residents (Jongeneel-Grimen *et al.* 2016). Nowadays with more knowledge in the effect of urban form on mental health, it is important to prevent making the same mistakes. Building 1 million new houses before also provides a big opportunity to create new neighbourhoods that take the mental health of its residents seriously. It is therefore interesting and important to find out which practices in neighbourhood design have a positive effect on mental health.

## 1.2 RESEARCH PROBLEM

This research aims to understand the relationships between the neighbourhood urban form and mental health of residents. The results from this research could be used in the design of newly built neighbourhoods that take the mental health of residents into account. It can also be used to create points to focus on, to have efficient urban regeneration programs. In this research the choice was made to specifically focus on mental health, because a lot of research about the effect of urban form on physical health is already conducted (Frank and Engelke, 2001). There also is a lot of research done about mental health as well as urban form, however, the link between these two concepts is understudied according to Gruebner *et al.* (2017) and Miles *et al.* (2012). In the same article Gruebner *et al.* (2017) suggests understanding the relationship between urban form and population mental health through a different lens. Interdisciplinary research between architecture, city planning, sociology, geography and neurosciences is needed to solve this problem according to Gruebner *et al.* (2017). The need for interdisciplinary research is also acknowledged by Miles *et al.* (2012). This research will focus on multiple disciplines by including mental health, sociology and spatial features. The case that will be studied is the municipality of Utrecht, located in the center of the Netherlands. This location is used, because it is the only city/municipality in the Netherlands with readily available data on mental health that is divided in on the neighbourhood level, to the best of the researchers knowledge.

The following question is central in this research: *How does different neighbourhood urban form influence the mental health of residents in the municipality of Utrecht?* To answer the question, this research will be shaped by the following sub-questions:

- What are the spatial features of neighbourhoods in the municipality of Utrecht?

- How is the mental health situation in neighbourhoods in the municipality of Utrecht?
- What are the relationships between neighbourhood urban form and the mental health aspects of residents?
- What are the relationships between neighbourhood urban form and the mental health aspects of residents in existing literature?

### 1.3 STRUCTURE OF THE THESIS

First existing theories will be explored using a theoretical framework. These theories will be used to structure the conceptual framework which in turn will structure the data collection and data analysis. In the result section, the most important results will be discussed and the full results from the multiple regression analysis can be found in appendix 1 and 2. After this, conclusions will be drawn from the collected data, recommendations for future research will be made.

## 2. THEORETICAL FRAMEWORK

### 2.1 MENTAL HEALTH

One of the concepts that can be derived from the research questions is mental health. According to the World Health Organization (WHO), "Mental health is defined as a state of well-being in which every individual realizes his or her potential, can cope with the normal stresses of life, can work productively and fruitfully, and can make a contribution to her or his community" (Hoisington *et al.* p2. 2019). A definition by Goldman and Grob (2006) is similar. The main points in the definition of mental health are the ability to function successfully in life, adapt and cope with challenges. Mental disorders on the other hand are indicated by changes in thinking, mood or behavior leading to distress and impaired functioning (Goldman and Grob, 2006). The municipality of Utrecht uses six different variables of mental health in their population studies. In table 1 these variables are shown with the definition that the municipality is using to determine percentage of people in a neighbourhood with a certain disorder.

<b>Variable</b>	<b>Definition in results</b>
Anxiety	Percentage of people (self) diagnosed with anxiety
Burn-out	Percentage of people (self) diagnosed with burn-outs
Depression	Percentage of people (self) diagnosed with depression
High risk of mental illness	Percentage of people at high risk of having a mental illness
Med to high risk of mental illness	Percentage of people at mediocre risk of having a mental illness
≥ Mental illness	Percentage of people with at least one (self) diagnosed mental illness

**Table 1:** Mental health variables used by the municipality of Utrecht

Depression, burn-outs and anxiety are mental health disorders that have some overlap in the effects that they have on a person (Guthrie and Black, 1997). While half of the persons with depressive symptoms are also diagnosed with anxiety there is another half that does not have these overlap and needs different treatment, so it is needed to separate these mental health disorders (Zimmerman, 2016; Guthrie and Black, 1997). Next to the abovementioned disorders there are many more common and less common mental health disorders, which all impact the life of a person in a different but negative way (Guthrie and Black, 1997). Suicidal thoughts are more prevalent among people with mental disorders and these people are more commonly impaired in their social and professional life (Tiller, 2013). Depression is linked to a reduced quality of life and accounts for 8.2% of all the disability adjusted life years lost (DALY's) globally. When multiple disorders are combined the effects are likely to be more severe (Tiller, 2013; Zimmerman, 2016).

### 2.2 URBAN FORM

Urban form is the second concept derived from the research question that needs a definition. According to Renalds *et al.* (2010) it is "the human-made space in which people live, work and recreate on a day-to-day basis. (p. 1)" It does not only contain buildings and parks, but also small green spaces, sidewalks, traffic flow, land use, etc. (Renalds *et al.* 2010) A study done by Kropf (2009) aimed to define the different aspects of urban form which concluded that the most important aspects of urban form can be seen in table 2. These aspects can provide a useful framework for analyzing the different types of neighbourhoods.

	<b>Definition by Kropf</b>	<b>Operationalization</b>
<b>Spatial relations of physical features</b>		
Built physical form	Spatial relations of features built or modified by humans, encompassing both solid and void and including planted vegetation.	Division of space, distance to amenities, types of road
<b>Interrelations between humans and physical features</b>		
Social and economic context/local culture	Collective relations between human activities and between human activities and physical forms.	Vehicle ownership, prevalence of crime, income
Function/use/activity	Relations between humans and physical forms for particular purposes including movement and occupation.	Zoning

Control (e.g. ownership)	Socially acknowledged relations between an individual or group and a physical form conferring powers of action and determination over the form	Housing ownership
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**Table 2:** Relevant aspects of urban form (Kropf, p. 116, 2009)

### 2.2.1 BUILT PHYSICAL FORM

Table 2 provides operationalizations of the urban form principles. Features of the built physical form can be represented by streets, plots and buildings (Kropf, 2014). Type of roads represent the line/network feature of the urban form and the distance to amenities represents the networks as well. Plots and buildings can be represented by green space and building space. Theories about the links between built physical form and mental health mainly focus on the positive mental health effect of green space close to a person's home (Miles *et al.* 2012) Another finding by Miles *et al.* (2012) is that casual social interactions happen more often when walking. These social interactions lead to improved mental health and walking itself also has a relieving effect on depressive symptoms (Miles *et al.* 2012). Therefore, it is important to focus on the walkability of a neighbourhood. It is, however, important to use the correct design for walkways. Coleman (1984) found that overhead (covered) walkways in a neighbourhood are strongly linked to depression. 25% of women in newly built modernistic neighbourhoods of London with overhead walkways had depressive symptoms, six times as many as traditionally built neighbourhoods (Coleman, 1984). These overhead walkways create a shelter for surveillance and increases the confidence of criminals and thus increases criminal activity, which is negatively linked with the mental health situation in a neighbourhood (Barry, 2008; Whitley and Prince, 2005). Coleman (1984) also notes that these overhead walkways make social interactions more difficult, since it is not visible what happens on the inside from the outside. This negative influence of overhead walkways is still in line with the findings of Miles *et al.* (2012).

### 2.2.2 SOCIAL AND ECONOMIC CONTEXT/LOCAL CULTURE

Social and economic context/local culture are not only an important aspect of urban form (Kropf, 2009), it is also a big part of mental health (Stewart-Brown *et al.* 2015). Mental illnesses can be influenced by a poor socio-economic environment, it is however, also possible that a person with mental illnesses creates a poorer socio-economic environment for himself (Stewart-Brown *et al.* 2015). Important indicators for this socioeconomic environment are prevalence of crime, income and vehicle ownership (Barry, 2008; Clark *et al.* 2020; Whitley and Prince, 2005). A neighbourhood with high income the expectation is that mental health of residents is expected to be higher which can negate negative or positive neighbourhood urban form characteristics (Hounkpatin, 2015). Dubey *et al.* (2016) add to that argument by claiming that perceived unsafety and disorderliness of cities has impact on criminal behavior, education, health and mobility. However, Dubey *et al.* (2016) note that the studies where this evidence was found have been limited to a few neighbourhoods or cities. There is also a limitation in data collection, since quantifying data on how cities are perceived is difficult. A spatial planner in the Netherlands does not only have influence over the built physical environment, according to Koresawa, and Konvitz,(2001). They also can influence policies on socio-economic topics in order to create a more pleasant environment, however this influence is limited since politics also have a say here (Koresawa, and Konvitz, 2001).

Urban renewal programs can be initiated to improve socio-economic situations in a neighbourhood. However, these renewal programs can lead to the neighbourhood becoming too expensive for its original residents (Hyra, 2012) This process is called gentrification and it should be avoided if the goal of the urban renewal process is to improve mental health of residents (Hyra, 2012). The Viennese model of gentle urban renewal could be a solution to this problem, or at least be an alleviation against strong gentrification (Hatz, 2021). Here strong public private partnerships are used to ensure that private interests do not take over and the well-being of the original residents is taken into account (Hatz, 2021). In the Netherlands these public private partnerships are a popular tool in planning (Boxmeer and Beckhoven, 2005).

### 2.2.3 FUNCTION/USE/ACTIVITY

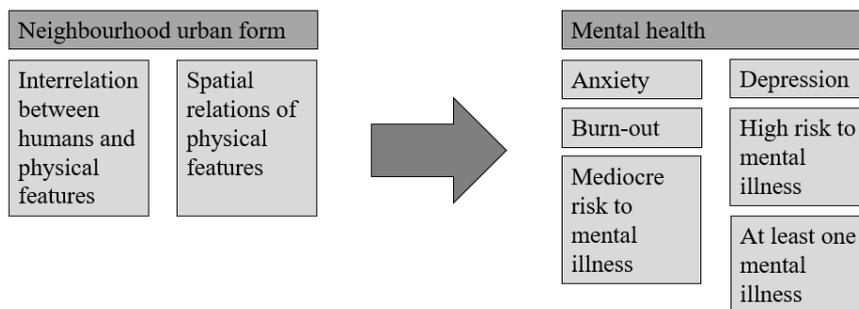
Zoning is a useful tool for a spatial planner to influence the urban form. Zoning determines the purposes of a certain piece of land and thus can be connected with the principle of function in table 2 (Maantay, 2001). With this tool it can be avoided that industrial spaces are too close to residential areas and if used correctly zoning can enhance the quality of an urban area (Maantay, 2001). However strict separate zoning can create urban areas where

there is too much distance and a non-competitive environment between different functions (Hills and Schleicher, 2010). Mixed zoning allows for separation of industrial functions that are not wanted near residential areas, while it allows for shops to be close to residential areas (Maantay, 2001). Since WW2 there was a strong focus on functionalism which entails separation of functions in the Netherlands (Folmer and Risselada, 2013). However, as a result of space constraints this never got as extreme as in North America. Since the 2000s the Dutch government decided in the fifth spatial planning act to focus more on landscapes with mixed functions (Folmer and Risselada, 2013).

### 2.2.4 CONTROL

Related to control is housing ownership, this is an important relationship within a neighborhood. When people own their house they interact with it differently and are more invested in the neighborhood (Mason *et al.* 2013). However, it is disputed whether or not there is an influence of housing ownership on mental health (Baker *et al.* 2013). The common assumption is that it does which relates to the findings of Mason *et al.* (2013). However Baker *et al.* (2013) found no relations during a analysis of an Australian survey of about 10.000 people with different tenures and home-ownership. People with poorer mental health did not see an improvement in their situation when moving to a hypothesized better self-owned home or high quality tenure (Baker *et al.* 2013). This suggest that there are other more important factors influencing their mental health than home ownership.

## 2.3 CONCEPTUAL FRAMEWORK



**Figure 1:** Conceptual framework

In the theoretical framework there are quite a few relations between neighbourhood urban form and mental health. The aim of this research is to find out which urban form characteristics do influence mental health. To do this urban form and mental health need to be defined. Urban form principles that are used are defined by Kropf (2009) and the mental health aspects are used by the municipality of Utrecht. The mental health aspects are portrayed separately, because as found by Tiller (2013) depression is a disorder that is has big effect globally. While having multiple mental health disorders has more severe negative effects on an individual (Tiller, 2013; Zimmerman, 2016). As a result of this the mental health aspects should be looked at separately in order to find out what neighbourhood urban form features influence mental health aspects.

### 3. METHODOLOGY

#### 3.1.1 DATASETS

In this research, there will be a mixture of a quantitative and qualitative approach. Both will be conducted using secondary data since datasets of good quality are available. The quantitative part of the research will be done using several datasets as can be seen in table 3.

Source	Covered area	Purpose for research	Type of data
Municipality of Utrecht	Municipality of Utrecht	Stats on mental health, datasets for GIS	Percentage of presence per neighbourhood
Statistics Netherlands (CBS)	The Netherlands	Stats on neighbourhood characteristics	Percentage of presence per neighbourhood
OpenStreetMap	World	Stats on neighbourhood characteristics	Urban form

**Table 3:** Brief overview of different datasets to be used in the research phase

The prime dataset in this research contains data on mental health aspects (anxiety, burn-out, depression,  $\geq 1$  mental illness, mediocre to high risk of mental illness and high risk of mental illness). It is owned and created for the municipality of Utrecht and only contains data of neighbourhoods under their jurisdiction (Gemeente Utrecht, 2021). Data on prevalence of mental disorders was obtained using various methods, for example through general practitioners, the local department of the GGD and several studies conducted for the municipality. Data on the risk of a person getting a mental disorder is collected using the ‘Kessler Psychological Distress Scale’ (Gemeente Utrecht, 2021).

The datasets on neighbourhood characteristics are created by CBS (CBS, 2016) and by extracting data from OpenStreetMap, to analyze it in GIS. The CBS dataset is an excel document containing various facts about all neighbourhoods in the Netherlands. These neighbourhoods are the same as in the two other datasets meaning that the combination of data is no problem. Characteristics that are included are for example demographics, housing type, income and proximity of services. The OpenStreetMap data analysis can result in data on road types, space division and morphology of a neighbourhood.

#### 3.1.2 DATA LIMITATIONS

The quality of this data is high since it was collected for a governmental organization (municipality of Utrecht) and by the national statistics agency (CBS) (Bhasin, 2020). Because all these variables are readily available it is not needed to collect data using a survey for example. The use of secondary data also simplifies the ethical considerations of this study, since the data comes from highly regarded organizations and is anonymized there is no need for it in this study.

### 3.2 DATA-ANALYSIS

The first step in the data analysis is to conduct the neighbourhood analysis according to the Kropf principles that can be seen in table 2. In table 4 these principles are turned into variables usable for the analysis phase. The first step is to gather data on all these variables using the various datasets and tools like GIS. Type of roads, function and division of space are variables where only raw spatial data is available and thus will be analyzed using GIS. Vehicle ownership, income, distance to amenities, prevalence of crime and housing ownership are variables with complete data provided by the CBS. With all the variables in table 4 below the neighbourhood analysis can be completed.

Variable	Definition
<b>Built physical form</b>	<b>Variable definition and (dataset)</b>
<i>Distance to amenities</i>	(CBS)
Distance supermarket	<i>Average distance to a supermarket in a neighbourhood, measured in meters</i>
Distance GP	<i>Average distance to a doctor in a neighbourhood, measured in meters</i>

Distance school	<i>Average distance to a school in a neighbourhood, measured in meters</i>
Distance childcare	<i>Average distance to childcare in a neighbourhood, measured in meters</i>
<b>Type of roads</b>	<b>(GIS)</b>
Cycle paths	<i>Meters of cycle paths in a neighbourhood per m2 of total neighbourhood area</i>
Pedestrian paths	<i>Meters of paths in a neighbourhood per m2 of total neighbourhood area</i>
Low-speed roads	<i>Meters of 30km/h roads in a neighbourhood per m2 of total neighbourhood area</i>
Mid speed roads	<i>Meters of 50km/h roads in a neighbourhood per m2 of total neighbourhood area</i>
<b>Division of space</b>	<b>(GIS)</b>
Building space	<i>Percentage of the total space per neighbourhood that is used for buildings</i>
Greenspace	<i>Percentage of the total space per neighbourhood that is used for green space</i>
<b>Social and economic context/local culture</b>	
<b>Prevalence of crime</b>	<b>(CBS)</b>
Sexual crimes	<i>Reported cases of sexual crimes in a neighbourhood in 2016</i>
Vandalism	<i>Reported cases of vandalism in a neighbourhood in 2016</i>
Home theft	<i>Reported cases of home theft in a neighbourhood in 2016</i>
<b>Income</b>	<b>(CBS)</b>
Income receiver	<i>Average income of a neighbourhood per receiver of income through work</i>
Income resident	<i>Average income of a neighbourhood per resident of this neighbourhood</i>
<b>Vehicle ownership</b>	<b>(CBS)</b>
Private vehicles	<i>Number of private vehicles in a neighbourhood, measured per household</i>
<b>Function</b>	
<b>Zoning</b>	<b>(GIS)</b>
Commercial space	<i>Space per neighbourhood that is zoned for commercial use, measured in m2</i>
Industrial space	<i>Space per neighbourhood that is zoned for industry use, measured in m2</i>
Office space	<i>Space per neighbourhood that is zoned for office use, measured in m2</i>
<b>Control</b>	
<b>Housing ownership</b>	<b>(CBS)</b>
Rent housing	<i>Percentage of housing in a neighbourhood that is for rent</i>
Bought housing	<i>Percentage of housing in a neighbourhood that is owned by its residents</i>

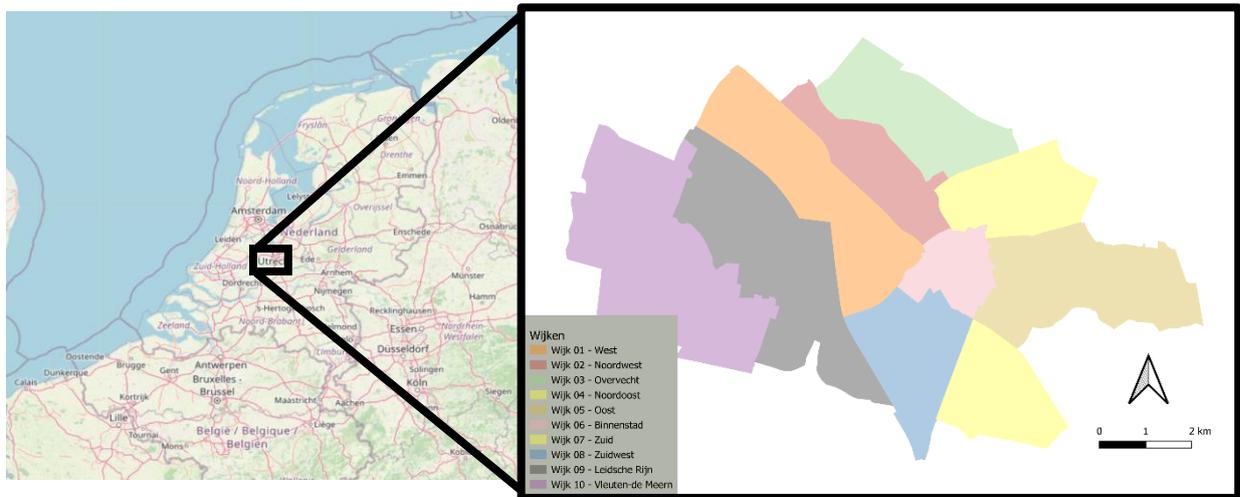
**Table 4:** Variables used in neighbourhood analysis (the spatial level of all variables is neighbourhood)

The next step is to analyze the data on mental health situation per neighbourhood in Utrecht. This will be done in a descriptive way to look if there are any outliers. After this a multiple regression using SPSS will be conducted. This uses mental health as a dependent variable and all the other urban form variables as an independent. The regression needs to be conducted six times with each time a different mental health aspect (table 1) as a dependent variable.

This results in an overview of the variables that have a significant influence on mental health aspects. It also gives the direction and strength of this relationship. This regression can only be conducted when the independent variables are not correlated with each other. So, that means that a correlation test needs to be conducted and only variables that are not significantly correlated can be in the regression at the same time. After the correlating variables are found the regression with the same dependent variable needs to be conducted multiple times. This is to make sure no correlating variables are used in the same regression. After the regression is complete, the next step is to look at in which neighbourhoods and at what scale these variables are present. With help of the literature in the theoretical framework, an attempt will be made to conclude the effect of urban form principles on mental health.

### 3.3 CASE STUDY OF UTRECHT

The municipality of Utrecht is the area of study, and it is divided into ten different neighbourhoods, as shown in figure 2. Each neighbourhood has both a name and a number (see legend), because the neighbourhood names are in Dutch further references to neighbourhoods will be made using the neighbourhood number as shown in figure 2.



**Figure 2:** Neighbourhoods in Utrecht (Municipality of Utrecht, 2021)

The municipality of Utrecht is dominated by the city of Utrecht, which used to be the most important city in the Netherlands in the middle ages (Ontdek Utrecht, 2021). The former important medieval city, is now only a small part of the municipality and can be found in wijk 06. Because the city used to be walled there was not a lot of space and a dense neighbourhood was created (Arbury, 2005). During the industrial revolution there was no space left for the booming city and new neighbourhoods were built (Arbury, 2005). These neighbourhoods continued in the same traditional characteristic until 1900 (Kluck *et al.* 2016). From 1900 onwards there was a growing awareness of housing quality and hygiene, this resulted in more spacious housing with gardens inspired by Ebenezer Howards garden city (Kluck *et al.* 2016). As a result of the post war housing shortage wijk 03 and wijk 08 were built in a modernistic style, meaning high rise apartment buildings with a lot of green space surrounding it. Wijk 10 mainly consists of sub-urban developments from the 1990s onwards, but this was built around an existing village core. Because the majority of housing in wijk 10 is sub-urban development it is defined as such in table 5. In this table neighbourhoods are defined according to divisions made by Boogerd *et al.* (2016). Differences between sub-urban neighbourhoods and 70s sub urban neighbourhoods can mainly be found in the morphology, the 70s suburbs are so-called cauliflower neighbourhoods which means a maze of residential roads lead to houses, while newer suburbs have a more straightforward street pattern.

Neighbourhood	Neighbourhood type (Boogerd)	Category
Wijk 01	Pre-war building blocks	Industrial city extensions
Wijk 02	Pre-war working-class neighbourhood	Industrial city extensions
Wijk 03	Post-war high rise garden city	Modernistic
Wijk 04	Garden city	Early 20 <sup>th</sup> century
Wijk 05	Pre-war building blocks	Early 20 <sup>th</sup> century
Wijk 06	Historic city centre	Traditional
Wijk 07	Cauliflower/living streets	70s low density suburbs
Wijk 08	Post war high rise garden city	Modernistic
Wijk 09	VINEX	Sub-urban
Wijk 10	VINEX – old village core	Sub-urban

**Table 5:** Neighbourhood data (Boogaard *et al.* 2016)

## 4. RESULTS

### 4.1 DESCRIPTIVE STATISTICS

#### 4.1.1 SPATIAL RELATIONS OF PHYSICAL FEATURES

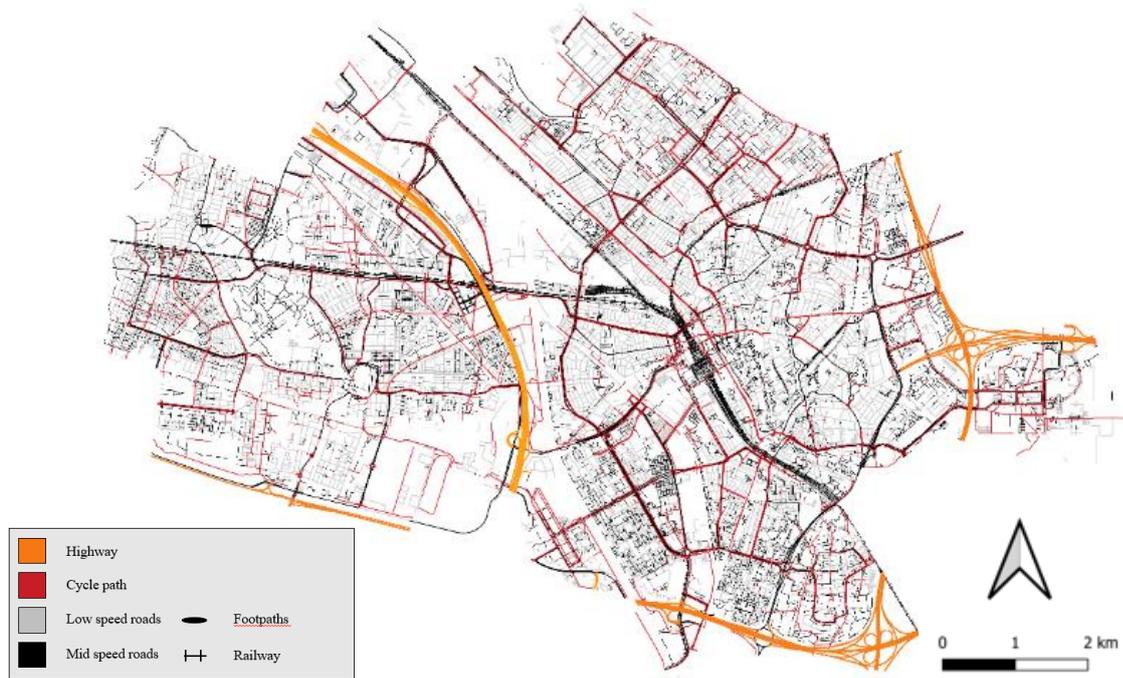
There are some interesting differences in the built physical form of the 10 neighbourhoods. Notable differences in space division can be seen between traditional and sub-urban neighbourhoods, with the latter having more green space at 38,9% against 12,4% on average for traditional neighbourhoods (appendix 1). Traditional neighbourhoods all have a low area allocated for green space, but this number grows the more recent the neighbourhood is. This is not the case for suburban or modernistic neighbourhoods, where differences can be seen within the modernistic neighbourhoods. Wijk 03 having 42,9% allocated as green space while wijk 08 only has 16%, the same goes for wijk 09 and wijk 10 with 22,90% and 56,30% green space respectively (appendix 1).



**Figure 3:** Space division in Utrecht

For building space there are less surprising results, wijk 06 has by far the most space used by buildings 47.82% (appendix 1) as expected in a dense former medieval city and the lowest building space can be found in the sub-urban developments. The distance to the different amenities is fairly equally distributed, in sub-urban neighbourhoods the distances are higher than the other neighbourhood types. Between the other neighbourhood types there are no big differences, with the exception of distance to childcare in wijk 03. There the average distance to childcare is 1100 meter, which is way higher than the average of 460 meters, wijk 08, the other modernistic neighbourhood also has an above average distance to childcare (appendix 1). For other services there are no big differences for modernistic neighbourhoods.

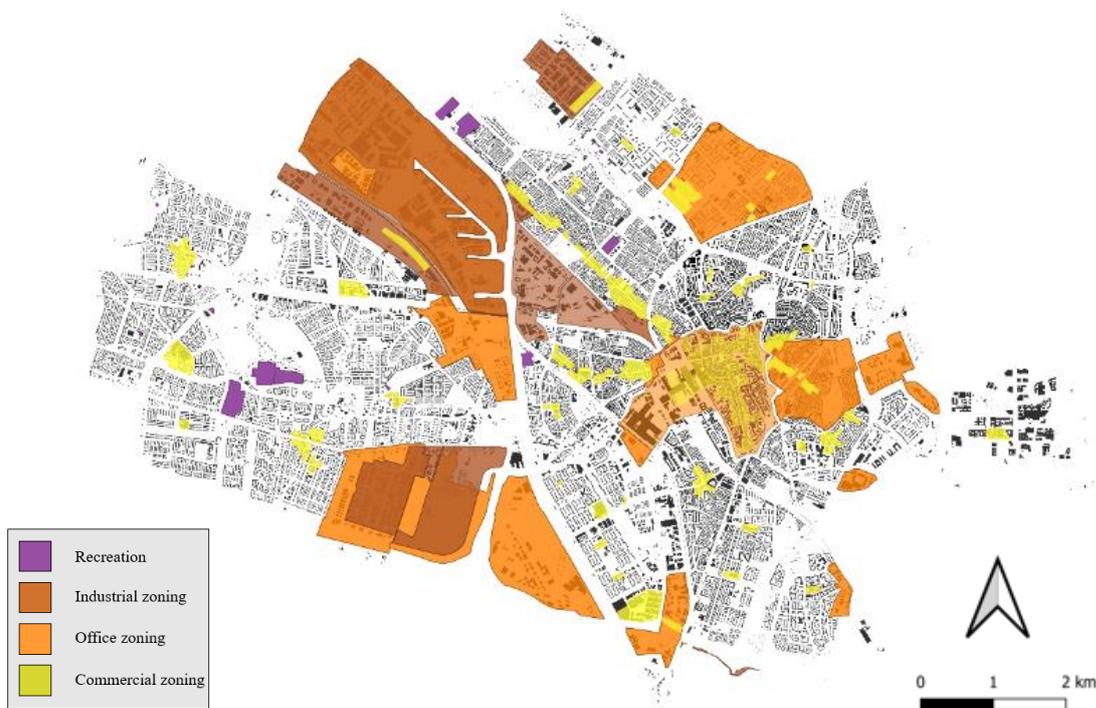
Neighbourhoods with a high rate of walkability can be found across all different types. Wijk 06 logically has the highest rate of walkability, as a result of the building age, when there were no large amounts of vehicles to take into account. What is striking is that for other neighbourhoods there are no large differences except for wijk 07 and wijk 08. A sub-urban and a modernistic neighbourhood respectively, these neighbourhoods have much higher rates of walkability, also compared to the same neighbourhood category (appendix 1).



**Figure 4:** Road types in Utrecht

#### 4.1.2 INTERRELATIONS BETWEEN HUMANS AND PHYSICAL FEATURES

Industrial zoning is more prevalent in neighbourhoods that have space at the edge of the municipality, office space like commercial space is more prevalent in the core of the city. However, office, space is more prevalent at the edges of the city. This is the result of offices that are located along the motorway as can be seen in figure 5 and appendix 1.



**Figure 5:** Zoning in Utrecht

Socio-economic variables differ greatly between neighborhoods. Income is noticeably lower in wijk 03, wijk 02 and wijk 08 (appendix 1). Two out of three are modernistic neighborhoods. Also notably is that the newest sub-urban developments do not have the highest income residents. These can be found in wijk 06, wijk 04 and wijk 05, in these neighborhoods there is traditional housing or early 20<sup>th</sup> century housing. Lowest incomes can be found in the modernistic neighborhoods, also where the highest percentages of rent housing can be found. The opposite is not entirely true, the highest percentage of bought housing can be found in sub-urban developments and not in the neighborhoods with the highest incomes. Private vehicles are the most prevalent in suburban neighborhoods and wijk 08 also has a high share of them. The most striking result in prevalence of crime is that in wijk 06 the rates of vandalism are double and for sexual crimes quadruple the number of the other neighborhoods.

4.1.3 MENTAL HEALTH

In figure 6 the mental health situation in each neighbourhood can be observed. There are no big differences between most neighbourhoods and there also seems to be a high correlation between all the mental health aspects. If one variable is high all of them are relatively high.. Of the neighbourhoods, only wijk 03 shows higher numbers and wijk 09 and 10 show a clear lower prevalence of mental health issues. However, when looking, the difference is only significant in wijk 03 in the aspects of depression and high risk to mental illness (appendix 1). This can be attributed to a number of variables and is likely a combination of them. Wijk 03 is a modernistic neighbourhood which scores low on all variables of the neighbourhood analysis except green space in the neighbourhood. The other modernistic neighbourhood of wijk 08 only has a slightly higher than average mental health scores, implying that this could be a result of socio-economic factors like income and housing ownership.

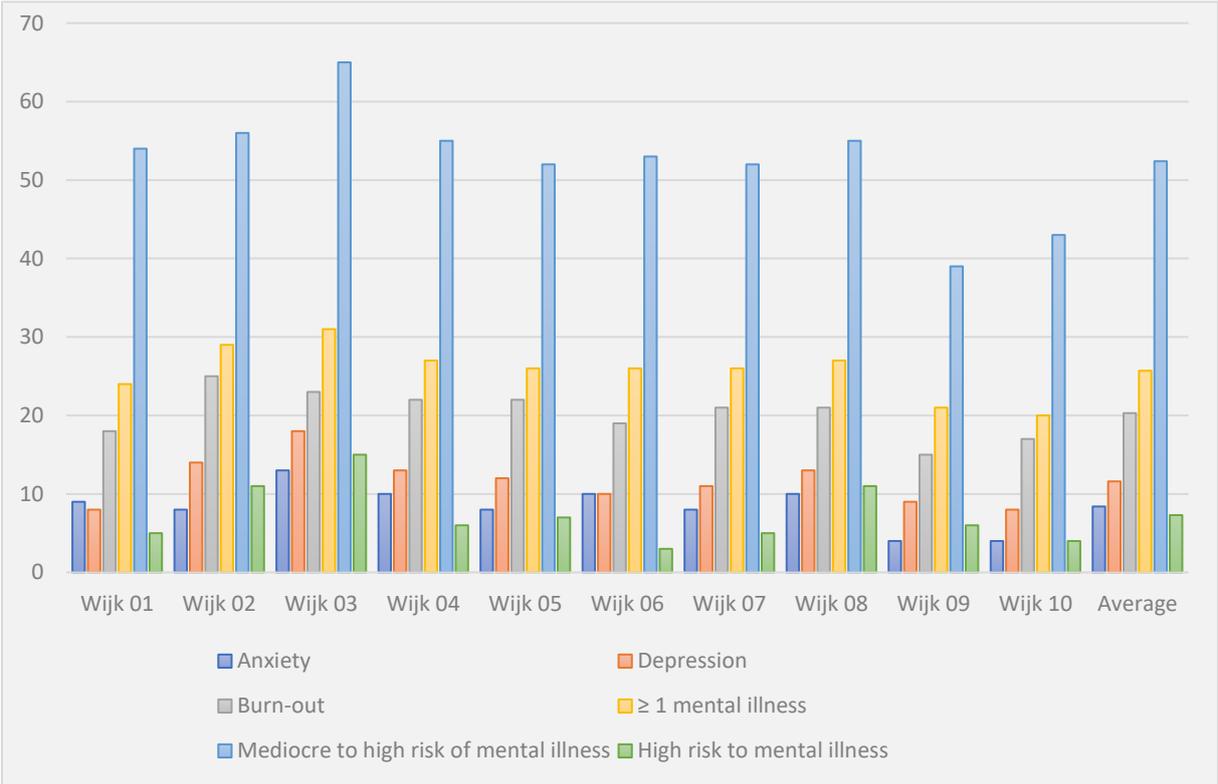


Figure 6: Mental health aspects divided per neighbourhood

### 4.3 REGRESSION

In table 6 the results of the multiple regression are shown. Green cells represent variables that have a significant influence on the corresponding mental health aspect. The variable that is connected to the most aspects of mental health is the percentage of bought housing in a neighbourhood. This is followed by the presence of home theft, average income per receiver and the number of private vehicles per household. Prevalence of depression is the aspect of mental health that is connected to the most variables, followed by the prevalence of burn-outs and the percentage of people in a neighbourhood with medium to high risk of mental illnesses. All these significant variables are socio-economic, however, there are some significant built physical environment variables. Distance to amenities is the category that is most often significantly related to mental health variables. Prevalence of people with at least one mental illness in a neighbourhood is the only mental health aspect that is not significantly related to any neighbourhood urban form variables.

Variable	Anxiety	Burn-out	Depression	High risk to mental illness	Med to High risk of mental illness	≥ 1 Mental illness
Distance supermarket						
Distance GP						
Distance school						
Distance childcare						
Sexual crimes						
Vandalism						
Home theft						
Rent housing						
Bought housing						
Income receiver						
Income resident						
Cycle paths						
Pedestrian paths						
Low-speed roads						
Mid speed roads						
Building space						
Greenspace						
Commercial space						
Industrial space						
Office space						
Private vehicles						

Table 6: Significant variables from the multiple regression (green cell represents a significant combination)

## 5. CONCLUSION

The goal of this research was to find out if neighbourhood urban form influences the mental health of its residents by answering the following research question: *How do different types of neighbourhoods influence the mental health of residents in the municipality of Utrecht?*

Within the municipality of Utrecht there is only one neighbourhood with a statistically significant different mental health situation. The modernistic neighbourhood of wijk 03 has a higher prevalence of depression and a high risk of mental illness than the other neighbourhoods. As claimed by Coleman (1984) a modernistic building style has negative effects on the mental health of residents and this could be the case here. However, looking at the results of the regression it is more likely that socio-economic factors have negatively influenced mental health in wijk 03. Wijk 03 has the lowest scores on income, home theft and the lowest share of bought housing. These are variables that Hounkpatin (2015) and Dubey *et al.* (2016) theorized to overshadow the neighbourhood urban form in its influence on mental health. The main of these built physical environment features is distance to amenities. Furthermore higher prevalence of burn-out and depressive issues are related to a lower amount of office space and a higher amount of cycle paths. A lower amount of mid-speed roads (50km/per hour) can also be related to a higher prevalence of burnout symptoms. Using existing literature it is hard to find an explanation for these outcomes, it could be that these variables correlate to other factors not taken into account in this study. Noteworthy is the fact that pedestrian paths do not have a significant influence on mental health while this was an influence that is present in existing literature Miles *et al.* (2012).

The main significant variables are the percentage of bought housing in the neighbourhood (more bought housing, better mental health). Wijk 03 has the lowest amount of buy houses with only 19% and also has the worst mental health situation. While wijk 09 and 10 have the highest number of bought housing with 57% and 69% respectively. Further important variables are income per receiver (higher income, better mental health), the prevalence of home theft (more home theft, worse mental health) and the number of private vehicles per household (more vehicles, better mental health) (table 6). Also interesting is the influence of distance to child care in a neighbourhood. Higher distance to a child care facility has a negative influence on mental health, which is the case in both the modernistic neighbourhoods of wijk 03 and 08. This could be a result of zoning which is separated meaning that childcare is often not close to residential buildings. However, it can also be a result of the lower socio-economic status in the neighbourhoods meaning that people have less money to spend on childcare.

These results imply that there should be a focus on socio-economic issues if the desire is to improve mental health of people. However it is important to keep in mind that it could be the result of the type of housing that people can afford. Neighbourhood types of lower socio-economic status attract people of lower socioeconomic status. These people generally have more stress about their daily life which results in lower mental health or their mental health causes their lower socio-economic status (Hatz, 2021). These policies could then start a gentrification process which pushes the people at whom the policies were focused out of the neighbourhood Hyda, 2012). The Viennese model of gentle Urban renewal with public private partnerships could be a solution to this problem. Especially in the Netherlands which is already knowledgeable with public private partnerships.

For further research into the effect of neighbourhood urban form it could be interesting to take the quality of space and roads into account. The lack of this can be seen as a serious limitation of this research. Furthermore this research looked at mental illness at the neighbourhood level as a result of limited data that is provided. This can still give interesting results as can be seen from this research, but neighbourhoods in Utrecht are quite big and differences are expected to occur within them.

## 7.1 APPENDIX 1 – RESULTS IN TABLES

	Greenspace	Building space	Industrial space	Office space	Commercial space
	<i>Actual</i>	<i>Actual</i>	<i>Zoning</i>	<i>Zoning</i>	<i>Zoning</i>
Wijk 01	10,80%	23,32%	59,74%	48,79%	2,43%
Wijk 02	18,40%	24,99%	4,66%	0,31%	8,45%
Wijk 03	42,90%	16,04%	8,60%	29,86%	3,64%
Wijk 04	33,80%	19,60%	0%	0%	1,90%
Wijk 05	35,10%	16,32%	0%	20,15%	2,58%
Wijk 06	8,20%	47,82%	0%	82,73%	30,07%
Wijk 07	37,70%	14,11%	0,37%	2,68%	1,02%
Wijk 08	16,00%	21,83%	0%	9,99%	5,73%
Wijk 09	22,90%	15,22%	17,90%	31,93%	1,40%
Wijk 10	56,30%	14,41%	5,52%	10,35%	2,45%

**Table 1:** Division of space between different neighborhoods (note: there is overlap between the zoned space)

	Distance to supermarket	to	Distance to childcare	Distance to GP	Distance to school
	<i>In meters</i>		<i>In meters</i>	<i>In meters</i>	<i>In meters</i>
Wijk 01	400		400	500	400
Wijk 02	400		400	500	400
Wijk 03	500		1100	600	500
Wijk 04	600		400	400	400
Wijk 05	500		400	500	600
Wijk 06	400		300	400	400
Wijk 07	500		400	600	500
Wijk 08	400		800	600	400
Wijk 09	800		500	800	600
Wijk 10	900		500	900	700

**Table 2:** Average distance to services per neighbourhood

	Income	Housing rent	Housing buy	Private vehicles
	<i>*1000</i>	<i>%</i>	<i>%</i>	<i>Per household</i>
Wijk 01	27,9	46	52	0,6
Wijk 02	22,9	60	39	0,5
Wijk 03	17,5	80	19	0,6
Wijk 04	31,7	41	53	0,5
Wijk 05	29,5	56	40	0,4
Wijk 06	33,8	61	36	0,8
Wijk 07	24,8	57	42	0,6
Wijk 08	22,4	64	36	1,1
Wijk 09	28,4	40	57	1,6
Wijk 10	28,3	31	69	1,1

**Table 3:** socio-economic indicators of a neighbourhood

	Home theft	Vandalism	Sexual crimes
Wijk 01	6	5	5
Wijk 02	7	6	4
Wijk 03	7	8	7
Wijk 04	6	4	3
Wijk 05	6	4	4
Wijk 06	7	13	29
Wijk 07	6	6	5
Wijk 08	8	6	6
Wijk 09	3	8	4
Wijk 10	4	4	3

**Table 4:** prevalence of crime per neighbourhood

Neighbourhood	Cycle paths	Footpaths	Low-speed roads	Mid speed roads
	<i>Meter per</i>	<i>M2 of area</i>	<i>Meter per</i>	<i>M2 of area</i>
Wijk 01	3,25	2,66	9,10	3,30
Wijk 02	5,86	6,56	14,87	4,37
Wijk 03	5,66	6,20	12,28	3,12
Wijk 04	3,84	7,25	11,62	3,40
Wijk 05	3,66	7,89	10,36	2,82
Wijk 06	4,83	15,79	15,86	1,75
Wijk 07	3,80	12,13	10,21	3,21
Wijk 08	6,20	10,87	14,07	4,46
Wijk 09	5,06	6,65	11,62	3,47
Wijk 10	3,00	6,96	10,26	2,45

**Table 5:** Road type distribution per neighbourhood

	Median	95% median – (std.dev *2)	95% median + (std.dev *2)	Min	Max
Anxiety	8,400	2,886	13,914	4	13
Depression	11,600	5,404	17,796	8	18
Burn-out	20,300	14,260	26,340	15	25
Mental illness	25,700	19,030	32,370	20	31
Mediocre to high risk of mental illness	52,400	38,158	66,642	39	65
High risk of mental illness	7,300	-0,304	14,904	3	15

**Table 6:** significance of differences in mental health aspects between neighbourhoods

## 7.2 APPENDIX 2 – REGRESSION RESULTS

Variable	Variable	B and (Constant)	Influence direction
			<i>Higher mental illness prevalence when</i>
<b>Anxiety</b>	Distance supermarket	-11,335 (11,873)	Lower distance
	Distance childcare	5,092 (11,873)	Higher distance
	Home theft	1,550 (-0,900)	Higher home theft rate
<b>Burn-out</b>	Bought housing	-0,164 (15,652)	Lower rate of bought housing
	Income receiver	-0,362 (32,449)	Lower income
	Cycle-paths	1,727 (21,266)	More cycle paths
	Mid speed roads	-0,735 (21,266)	Less mid speed roads
	Office space	-0,049 (21,266)	Less office space
<b>Depression</b>	Private vehicles	-6,695 (21,266)	Less private vehicles
	Bought housing	-0,197 (21,605)	Lower rate of bought housing
	Income resident	-0,429 (23,059)	Lower income
	Income receiver	-0,405 (25,193)	Lower income
	Cycle-paths	1,299 (6,257)	More cycle paths
	Office space	-0,054 (21,605)	Less office space
<b>High risk of- mental illness</b>	Private vehicles	-4,885 (6,257)	Less private vehicles
	Distance childcare	12,761 (0,664)	Higher distance
<b>Med to high risk- of mental illness</b>	Income resident	-0,684 (25,579)	Lower income
	Home theft	4,050 (28,100)	Higher home theft rate
	Bought housing	-0,323 (73,347)	Lower rate of bought housing
	Income receiver	-0,836 (93,314)	Lower income
	Private vehicles	-8,487 (73,347)	Less private vehicles
<b>Mental illness</b>	Distance GP	-22,209 (93,314)	Lower distance
	Home theft	1,850 (14,600)	Higher rate of home theft
	Bought housing	-0,213 (35,118)	Lower rate of bought housing

Table 1: Regression output

## 8. BIBLIOGRAPHY

- ANP. 2021. *Organisaties willen komende 10 jaar 1 miljoen betaalbare huizen*. [online] Available at: <<https://www.nd.nl/nieuws/varia/1020452/organisaties-willen-komende-10-jaar-1-miljoen-betaalbare-huizen>> [Accessed 26 February 2021].
- Antaramian, S., 2017. The importance of very high life satisfaction for students' academic success. *Cogent Education*, 4(1), p.1307622.
- Araya, R., Dunstan, F., Playle, R., Thomas, H., Palmer, S. and Lewis, G., 2006. Perceptions of social capital and the built environment and mental health. *Social science & medicine*, 62(12), pp.3072-3083. *Useful since it looks at quality of questionnaires*
- Arbury, J. (2005), *From urban sprawl to compact city: an analysis of urban growth management in Auckland, thesis*, University of Auckland.
- BAGLEY, C. (1973) The built environment as an influence on personality and social behaviour: a spatial study. In *Psychology and the Built Environment* (eds D. Canter & T. R. Lee). Tonbridge: Architectural Press.
- Baker, E., Bentley, R., & Mason, K. (2013). The mental health effects of housing tenure: causal or compositional?. *Urban Studies*, 50(2), 426-442.
- Barry, M.M., 2008. The influence of social, demographic and physical factors on positive mental health in children, adults and older people.
- Bhasin, H., (2020) *Sources of Secondary Data and its Advantages and Disadvantages* [online] Available at <<https://www.marketing91.com/sources-of-secondary-data/>> [Accessed 10 June 2021]
- Birtchnell, J., Masters, N., & Deahl, M. (1988). Depression and the physical environment: a study of young married women on a London housing estate. *The British Journal of Psychiatry*, 153(1), 56-64.
- Boogaard, F., Kluck, J., Bakker, W., Kleerekoper, L., Rouvoet, M., Wentink, R., ... & Loeve, R. (2016). Voor hetzelfde geld klimaatbestendig: voorbeelden klimaatbestendige inrichting voor veelvoorkomende karakteristieke straten.
- Boxmeer, B. V., & BECKHOVEN, E. V. (2005). Public-private partnership in urban regeneration: a comparison of Dutch and Spanish PPPs. *European Journal of Housing Policy*, 5(1), 1-16.
- CBS. 2021. *Niet alle naoorlogse stadswijken kennen achterstand*. [online] Available at: <<https://www.cbs.nl/nl-nl/achtergrond/2018/09/niet-alle-naoorlogse-stadswijken-kennen-achterstand>> [Accessed 26 February 2021].
- CBS, 2016. *Kerncijfers wijken en buurten 2016*. [online] CBS. Available at: <<https://www.cbs.nl/nl-nl/maatwerk/2020/29/kerncijfers-wijken-en-buurten-2020>> [Accessed 12 March 2021].
- Clark, B., Chatterjee, K., Martin, A. and Davis, A., 2020. How commuting affects subjective wellbeing. *Transportation*, 47(6), pp.2777-2805.
- Coleman, A. (1984). Urban housing and social malaise. *Land Use Policy*, 1(1), 14-24.
- Dorlo, C., 2021. *Ggz: mentale gezondheid in gevaar door corona, jongeren kunnen 'door ijs zakken'*. [online] NOS. Available at: <<https://nos.nl/artikel/2352807-ggz-mentale-gezondheid-in-gevaar-door-corona-jongeren-kunnen-door-ijs-zakken.html>> [Accessed 26 February 2021].
- Dubey, A., Naik, N., Parikh, D., Raskar, R., & Hidalgo, C. A. (2016, October). Deep learning the city: Quantifying urban perception at a global scale. In *European conference on computer vision* (pp. 196-212). Springer, Cham.

- Ettema, D. and Schekkerman, M., 2016. How do spatial characteristics influence well-being and mental health? Comparing the effect of objective and subjective characteristics at different spatial scales. *Travel behaviour and society*, 5, pp.56-67.
- Folmer, E., & Risselada, A. (2013). Planning the neighbourhood economy: Land-use plans and the economic potential of urban residential neighbourhoods in the Netherlands. *European planning studies*, 21(12), 1873-1894.
- Frank, L. D., & Engelke, P. O. (2001). The built environment and human activity patterns: exploring the impacts of urban form on public health. *Journal of planning literature*, 16(2), 202-218.
- FREEDMAN, J. L. (1975) *Crowding and Behaviour*. San Francisco: W. H. Freeman.
- Gago, E.J., Roldan, J., Pacheco-Torres, R. and Ordóñez, J., 2013. The city and urban heat islands: A review of strategies to mitigate adverse effects. *Renewable and Sustainable Energy Reviews*, 25, pp.749-758.
- Gemeente Utrecht, 2021. *Psychische gezondheid | Utrecht*. [online] Volksgezondheidsmonitor.nl. Available at: <<https://www.volksgezondheidsmonitor.nl/psychische-gezondheid-utrecht/page70.html>> [Accessed 12 March 2021].
- Goldman, H.H. and Grob, G.N., 2006. Defining 'mental illness' in mental health policy. *Health Affairs*, 25(3), pp.737-749.
- Gruebner, O., Rapp, M.A., Adli, M., Kluge, U., Galea, S. and Heinz, A., 2017. Cities and mental health. *Deutsches Ärzteblatt International*, 114(8), p.121.
- Guthrie, E., & Black, D. (1997). Psychiatric disorder, stress and burn-out. *Advances in psychiatric treatment*, 3(5), 275-281.
- Hatz, G. (2021). Can public subsidized urban renewal solve the gentrification issue? Dissecting the Viennese example. *Cities*, 115, 103218.
- Heaviside, C., Macintyre, H. and Vardoulakis, S., 2017. The urban heat island: implications for health in a changing environment. *Current environmental health reports*, 4(3), pp.296-305.
- Hills Jr, R. M., & Schleicher, D. (2010). The steep costs of using noncumulative zoning to preserve land for urban manufacturing. *The University of Chicago Law Review*, 249-273.
- Hoisington, A.J., Stearns-Yoder, K.A., Schuldt, S.J., Beemer, C.J., Maestre, J.P., Kinney, K.A., Postolache, T.T., Lowry, C.A. and Brenner, L.A., 2019. Ten questions concerning the built environment and mental health. *Building and environment*, 155, pp.58-69.
- Houkpatin, H.O., Wood, A.M., Brown, G.D. and Dunn, G., 2015. Why does income relate to depressive symptoms? Testing the income rank hypothesis longitudinally. *Social Indicators Research*, 124(2), pp.637-655.
- Hyra, D. S. (2012). Conceptualizing the new urban renewal: Comparing the past to the present. *Urban Affairs Review*, 48(4), 498-527.
- Kluck, J., Bakker, W., Kleerekoper, L., Rouvoet, M., Wentink, R., Klok, L., & Loeve, R. (2016). Voor hetzelfde geld klimaatbestendig. Hogeschool van Amsterdam.
- Knottnerus, J.A. and Tugwell, P., 2016. Promoting transparency of research and data needs much more attention. *Journal of clinical epidemiology*, 70, pp.1-3.

- Koresawa, A., & Konvitz, J. (2001). Towards a new role for spatial planning. Towards a new role for spatial planning, 737, 11.
- Kropf, K., 2009. Aspects of urban form. *Urban morphology*, 13(2), p.105.
- Kropf, K. (2014). Ambiguity in the definition of built form. *Urban morphology*, 18(1), 41-57.
- Lifelines.nl. 2021. *Lifelines maakt onderzoek naar gezonder oud worden mogelijk*. [online] Available at: <<https://www.lifelines.nl/>> [Accessed 26 February 2021].
- Lloyd, M.G., Peel, D. and Janssen-Jansen, L.B., 2015. Self-build in the UK and Netherlands: mainstreaming self-development to address housing shortages?. *Urban, planning and transport research*, 3(1), pp.19-31.
- Maantay, J. (2001). Zoning, equity, and public health. *American journal of public health*, 91(7), 1033.
- Mason, K. E., Baker, E., Blakely, T., & Bentley, R. J. (2013). Housing affordability and mental health: does the relationship differ for renters and home purchasers?. *Social science & medicine*, 94, 91-97.
- McCombes, S., 2021. *How to write a research methodology*. [online] Scribbr. Available at: <<https://www.scribbr.com/dissertation/methodology/>> [Accessed 12 March 2021].
- Miles, R., Coutts, C. and Mohamadi, A., 2012. Neighborhood urban form, social environment, and depression. *Journal of Urban Health*, 89(1), pp.1-18.
- Mumford, L. (1954). The Neighborhood and the Neighborhood Unit. *Town Planning Review* 24:256–270
- NU.nl. 2021. *Levenskwaliteit Noord-Nederlanders op dieptepunt sinds begin coronacrisis*. [online] Available at: <<https://www.nu.nl/groningen/6114106/levenskwaliteit-noord-nederlanders-op-dieptepunt-sinds-begin-coronacrisis.html>> [Accessed 26 February 2021].
- Ontdek Utrecht, 2021, *Utrecht 900 jaar in 2022* [Online] Available at: <<https://www.ontdek-utrecht.nl/900jaar/>> [Accessed 10 June 2021]
- Renalds, A., Smith, T.H. and Hale, P.J., 2010. A systematic review of built environment and health. *Family & community health*, 33(1), pp.68-78.
- RIVM, 2021. *Gezondheid per buurt, wijk en gemeente*. [online] RIVM. Available at: <<https://www.rivm.nl/media/smap/index.html>> [Accessed 12 March 2021].
- Statline, 2021. *Bevolkingsontwikkeling; maand en jaar*. [online] CBS-Statline. Available at: <<https://opendata.cbs.nl/statline/?dl=2C8D4#/CBS/nl/dataset/83474NED/table>> [Accessed 12 March 2021].
- Stewart-Brown, S., Samaraweera, P. C., Taggart, F., Kandala, N. B., & Stranges, S. (2015). Socioeconomic gradients and mental health: implications for public health. *The British Journal of Psychiatry*, 206(6), 461-465.
- Tiller, J. W. (2013). Depression and anxiety. *The Medical Journal of Australia*, 199(6), S28-S31.
- Whitley, R. and Prince, M., 2005. Fear of crime, mobility and mental health in inner-city London, UK. *Social science & medicine*, 61(8), pp.1678-1688.
- Zimmerman, M., Kerr, S., Kiefer, R., Balling, C., & Dalrymple, K. (2019). What is anxious depression? Overlap and agreement between different definitions. *Journal of psychiatric research*, 109, 133-138.