Neighbourhood structural and social factors and mental health

Özcan Erdem

NEIGHBOURHOOD STRUCTURAL AND SOCIAL FACTORS AND MENTAL HEALTH

Özcan Erdem

ISBN: 978-94-6361-247-0

Dit proefschrift is tot stand gekomen in het kader van de Academische Werkplaats Publieke Gezondheid CEPHIR (www.cephir.nl), in samenwerking tussen de afdeling Maatschappelijke Gezondheidszorg van het Erasmus MC en de afdeling Onderzoek en BI van de gemeente Rotterdam.

Design and printing: Optima Grafische Communicatie, Rotterdam

NEIGHBOURHOOD STRUCTURAL AND SOCIAL FACTORS AND MENTAL HEALTH

Structurele en sociale buurtfactoren en mentale gezondheid

Thesis

to obtain the degree of Doctor from the
Erasmus University Rotterdam
by command of the
rector magnificus

Prof.dr. R.C.M.E. Engels

and in accordance with the decision of the Doctorate Board.
The public defence shall be held on
Wednesday 10 April 2019 at 15:30 hours
by

Özcan Erdem
born in Taşlık, Kayseri, Turkey

Erasmus University Rotterdam

Doctoral Committee:

Promotor(s):	Prof.dr.ir. A. Burdorf
	Prof.dr. F.J. van Lenthe
Other members:	Prof.dr. S. Denktaş
	Prof.dr. M. Huisman
	Prof.dr. C.L. Mulder

CONTENT

CHAPTER 1

General introduction

BACKGROUND

Depression

Depression is a common health problem among adults in European countries [1, 2]. It was the fourth leading contributor to the global burden of disease in Europe in 2010 [3] and is expected to be the leading contributor in 2030 [4]. Depression almost doubles the risk of premature mortality [5], and seriously affects quality of life of patients [6] and of those in their immediate environment (e.g. children) [7]. Social functioning i.e. the feeling of loneliness, perceived connection with others and perceived difficulties in making new or maintaining friendships, is severely impeded in patients with depression [8]. Hence, preventing the onset is an important strategy to reduce the societal burden of depression [9].

Depression is rather common in the Netherlands compared to other European countries [10, 11]. Eurostat presented that 7.9% of the adult population (15 years and over) in the Netherlands in 2014 reported having depression in the previous 12 months, whereas this was 7.1% in Europe. A Dutch study, in which mental disorders were assessed with the Composite International Diagnostic Interview 3.0 (a comprehensive diagnostic instrument for the assessment of mental disorders according to the definitions and criteria of the Diagnostic and Statistical Manual of Mental Disorders IV), showed that 18.7% of the adult population (18-64 years) ever had depression in their life (i.e. lifetime prevalence) and 5.2% in the previous 12 months (i.e. 12-month prevalence), which equals to more than a half million adults [12, 13].

The risk of depression is not randomly distributed across the populations, but varies by socioeconomic and sociodemographic factors. Women, young people, those living alone or otherwise, low educated, unemployed or disabled and those with low household income are more often depressed than respectively men, older persons, those living with a partner, high educated, those in paid employment and those with high household income [11, 13, 14]. Explanations for these inequalities include poor material circumstances, lack of social support, and unhealthy behaviours [15]. However, these individual factors cannot entirely explain the observed variation in depression in the Netherlands. A rapidly increasing literature points towards the role of social contextual determinants of depression [16, 17].

Neighbourhood

The interest in “neighbourhoods and health” has increased in the field of public health and epidemiology in the past two decades. The underlying reasons for this interest are various [18]. Firstly, a growing sense is witnessed that purely individual-based explanations of the causes of ill-health are insufficient and fail to provide a full insight into risk factors and determinants of diseases or health. Secondly, the revitalized interest in understanding the

causes of social and ethnic inequalities in health aligned with the increasing popularity and availability of methods and data-analysis techniques, such as multilevel analysis, which allow the examination of neighbourhood health effects with individual factors simultaneously. As a result, interest emerged in investigating whether neighbourhood conditions could be relevant contributors to health inequalities. Thirdly, there is a growing perception that policy domains outside public health could affect health through their impact on the contexts in which individuals live, such as housing policy or urban planning policy [18].

Current evidence suggests that the places where people live affect their health and contribute to health inequalities between the individuals [19-21]. Neighbourhood conditions affect people's health over and above individual factors, such as socioeconomic position [18, 22]. Although studies have shown that the role of neighbourhood factors for health is relatively small compared to individual socio-demographic and socioeconomic factors [23], changing them has the potential to influence many people living in a neighbourhood and therefore to contribute to the reduction of social and ethnic inequalities in health. Despite the considerable geographical differences in mental health outcomes, such as common mental disorders, mood and anxiety disorders and depression [13, 24, 25], the impact of neighbourhoods on individual mental health has been understudied. Understanding the role and impact of neighbourhoods on depression might be important for prevention of disease burden of mental health.

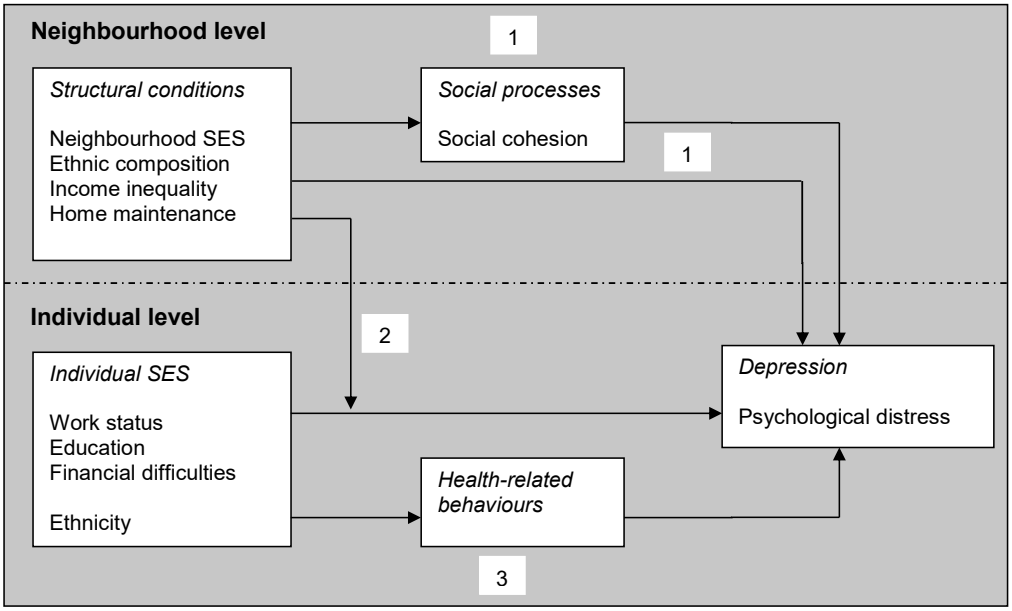
Relevance of neighbourhood characteristics for depression

Neighbourhood inequalities in depression suggest that neighbourhood environmental factors may have an impact on depression. Two types of neighbourhood environmental factors attracted attention from the start of this research theme: structural characteristics and social processes [17]. Structural characteristics include neighbourhood socioeconomic status (SES), income inequality, ethnic composition, urban density, green area and physical conditions (e.g. quality of housing), whereas neighbourhood social cohesion and social capital, neighbourhood disorder, and perceived exposure to crime are examples of indicators reflecting neighbourhood social processes [17]. There is a substantial number of studies on associations between neighbourhood SES and depression. These studies provided some evidence for protective effects for higher neighbourhood SES again depression, above and beyond individual-level sociodemographic and socioeconomic characteristics. Studies that explored the associations between neighbourhood physical conditions, social capital, social cohesion and social disorder, and their role in explaining neighbourhood inequalities in depression are sparse, and show mixed results [16].

Neighbourhood environmental factors may interplay with each other and with individual-level factors in relation to individual mental health. Figure 1 depicts the conceptual

model for this thesis that emphasized the role of the structural and social neighbourhood factors and individual-level factors and their interrelations. In this model that consist of both neighbourhood and individual levels, structural and social factors may be related directly to depression, but social factors are also considered to be intermediates on the pathway through which structural neighbourhood factors are associated with depression. Such direct and indirect pathways from neighbourhood structural and social cohesion to depression have hardly been investigated [16, 26]. This also applies to cross-level interactions between neighbourhood factors and individual level factors in relation to depression [16]. Establishing mediating pathways and effect-modifying factors will vitally advance understanding of neighbourhood effects on depression. Addressing these gaps will help to identify what specific neighbourhood features matter for depression, how, and for whom, and will contribute to curtailing the burden of disease of depression via an area-based/neighbourhood based approach.

Figure 1 Conceptual model for associations between neighbourhood and individual level factors, health-related behaviours, and the outcome measure with research questions (1–3)



An underexposed subject: ethnic inequalities in depression and the potential mediating role of health-related behaviours

There have been consistent reports in the literature of (mental) health inequalities between ethnic minority groups and natives around the world [27-33]. Also in The Netherlands, 45% of Turks, 39% of Moroccan and 29% of Surinamese, experience their health as poor compared to 15% of Dutch natives [34]. A recent study has shown that Turks and Moroccans more often use antidepressants than Dutch natives [35]. Previous studies sought the explanation of these ethnic health inequalities primarily in differences in socioeconomic circumstances, perceived discrimination, forced migration and acculturation process, and less in health-related behaviour [36-38].

To reduce ethnic (mental) health inequalities, it is important to identify factors that contribute to these inequalities. There is a growing body of evidence suggesting that ethnic minorities engage less in health-related behaviour (e.g. less physical activity and a higher prevalence of smoking), with the exception of alcohol consumption [39, 40], and it is well-known that health-related behaviours are associated with enhanced physical and mental health. However, it is not clear whether these health-related behaviours are important mediators of the association between ethnicity and (mental) health. Therefore, exploring the potential mediating of the health-related behaviours can provide more insight into reducing ethnic inequalities in mental health.

OBJECTIVES OF THIS THESIS

This thesis aimed to investigate which and how the neighbourhood factors influence mental health among urban adult residents. The research questions of this thesis are:

1. Are neighbourhood factors associated with depression and does neighbourhood social cohesion mediate these associations?
2. Do neighbourhood factors moderate the associations of neighbourhood and individual socioeconomic factors or individual ethnicity with depression?
3. Do health-related behaviours mediate the association between individual ethnicity and depression?

The overarching objective is to gain insight into the influence of the living environment on the mental health of the residents in order to keep the residents mentally healthy.

Psychological distress as an indicator of depression

This thesis used psychological distress as an indicator of depression [41, 42], measured with the Kessler Psychological Distress Scale (K10). The K10 has been developed as a screening instrument for psychological distress in the general population [43]. The K10 discriminates DSM-IV disorders from non-cases [42] and is strongly associated with the Composite International Diagnostic Interview (CIDI) diagnosis of anxiety and affective disorders [41]. In a recent Dutch study, the K10 proved to be reliable (Cronbach's: 0.94) and valid (area under the curve (*AUC:* 0.87)) in detecting any depressive disorders. At the cut-off of 20 points, sensitivity (0.80) and specificity (0.81) are sufficiently high to appreciate the K10 as appropriate screening instrument [44].

The K10 scale consists of 10 questions that measure a person's level of anxiety and depressive symptoms in the previous four weeks. The items included were: "Did you feel …1) tired out for no good reasons?", 2) nervous?", 3) so nervous that nothing could calm you down?", 4) hopeless?", 5) restless or fidgety?", 6) so restless that you could not sit still?", 7) depressed?", 8) that everything was an effort?", 9) so sad that nothing could cheer you up?" and 10) worthless?". Each item has five response categories "none of the time", "a little of the time", "some of the time", "most of the time" and "all of the time". Cronbach's alpha was 0.92, therefore a sum-score was calculated (range 10-50), with higher scores reflecting more psychological distress.

DATASETS USED

In order to address the research questions of this thesis two datasets were used. In chapters 2-4 data were used from the population health survey *(G4 Gezondheidsenquête 2008)*, conducted in 2008 by the municipal health services of the four largest Dutch cities (Amsterdam, The Hague, Rotterdam and Utrecht). Using a uniform research methodology, information on physical and mental health, social well-being, lifestyle, health care use and demographics of residents were collected. The survey was based on a random sample of 42,686 residents aged 16 years and older from the municipal population registers, stratified by city district and age. Respondents were asked to fill in a written or web-based questionnaire or to take part in a personal interview when having difficulties to complete the questionnaire. Extra effort was made to include vulnerable groups, i.e. older Turks and Moroccans with limited language skills and residents of neighbourhoods with a low response in previous surveys. Non-responders were contacted by telephone or visited at their home and were offered personal help to fill in the questionnaire in the language used by the respondent, e.g. in Turkish or Arabic. In total 20,877 respondents completed the

questionnaire (49% overall response; 54% in Utrecht, 51% in The Hague, 50% in Amsterdam and 47% in Rotterdam) [45]. We limited our analyses to respondents who answered all questions used in the analyses (18,173). These respondents lived in one of 211 neighbourhoods (208 neighbourhoods in chapter 4).

We linked the population health survey with the information at the neighbourhood level. Linkage was based on the four digit postal codes (about 4,000 neighbourhoods) or more refined division of the neighbourhood classification system of Statistics Netherlands (about 12,000 neighbourhoods) whereby neighbourhood boundaries were determined by local authorities themselves within their municipality.

Data on neighbourhood social cohesion were obtained from WoON 2009 Dataset (Ministry of Housing, Spatial Planning and the Environment) [46]. At the individual level, social cohesion was measured with five items, for example: 'the people in my neighbourhood get along well with each other'. All items were measured on a five-point scale. Social cohesion was aggregated on a neighbourhood level by using an ecometrics approach.

Home maintenance was used as an indicator of the quality of housing and was also obtained from the WoON 2009 dataset. It was measured on a five-point scale with the item: 'My house or living area is poorly maintained'. Individual responses were aggregated to the neighbourhood level by taking the mean value of the individual responses.

The scores on neighbourhood deprivation or neighbourhood socioeconomic status (SES) (2010) were obtained from The Netherlands Institute for Social Research (SCP), and were based on the average level of income, employment rate, and average level of education in each four digit postal code [47].

The degree of urbanity of the municipality was retrieved from Statistics Netherlands and was based on the number of addresses per km^2 in 2008: more than 2499 addresses (urban); 1500–2499 addresses (semi-urban); 1000–1499 addresses (intermediate urban-rural); 500–999 addresses (semi-rural); 499 addresses (rural). Data about green areas per neighbourhood were derived from the Dataset Land Use of Statistics Netherlands [48].

As measure for neighbourhood ethnic diversity the formula of the concentration index was used [49]. The index was computed based on information about the percentage of Turkish, Moroccans, Surinamese, other ethnic minority groups, Western and native Dutch residents, that was retrieved from Statistics Netherlands [50].

In chapter 5 a second dataset was used from the national public health survey *(Gezondheidsmonitor Volwassenen GGD-en, CBS en RIVM)* carried out in 2012 by 28 public health services, Statistics Netherlands and National Institute for Public Health and the Environment in the Netherlands. The response was 45-50%. In total, the data include information on 387,195 citizens aged 19 years and older on physical and mental health status, social well-being, health-behaviour, and individual characteristics.

Statistics Netherlands enriched the data at the individual level with information on ethnicity and standardized household income and linked the data with information on the Gini coefficient and mean income at the neighbourhood and municipality level. Mental health information was available for 376,384 respondents as a small number of respondents did not fill in the questions on psychological distress. Due to some loss during linking and missing values on individual level factors, the final study population available for analysis had 336,501 respondents. For more information, we refer to reports that describe the research methodology and response in detail [51, 52].

In chapter 6 the analyses were limited to the four major Dutch cities (Amsterdam, Rotterdam, The Hague and Utrecht) in the national public health survey *(Gezondheidsmonitor Volwassenen GGD-en, CBS en RIVM)* carried out in 2012. In total 28,653 respondents from the four major cities completed the questionnaire resulting in a response of 40%. We focused our analyses to respondents from the three largest ethnic minority groups in the Netherlands: Surinamese (n=1,297), Turks (n=850) and Moroccans (n=779), and native Dutch (n=15,633), because in the four major Dutch cities (Amsterdam, Rotterdam, The Hague and Utrecht), the three largest ethnic minority groups represent a substantial part of the population: 23% of the residents in Rotterdam, Amsterdam and The Hague and 16% in Utrecht. Across the country, they form only 7% of the Dutch population [53].

OUTLINE OF THIS THESIS

Research question 1 is addressed in chapter 2. The associations of structural neighbourhood conditions with individual mental health are examined and the potential mediating role of neighbourhood social cohesion is explored. Research question 2 is addressed in chapters 3-5. In chapter 3, socioeconomic inequalities in individual mental health are investigated and the moderating role of neighbourhood social cohesion. Ethnic inequalities in individual mental health and the moderating role of neighbourhood ethnic diversity are addressed in chapter 4. Whether income inequality at neighbourhood level and individual mental health is associated is investigated in chapter 5. It is also determined whether the association between neighbourhood income inequality and individual mental health differed between low-income and high-income neighbourhoods. The same question is examined at municipality level as well. Chapter 6 focuses on the role of health-related behaviours to explain the ethnic inequalities in individual mental health, and self-rated health (research question 3). In the general discussion, chapter 7, we provided a summary of the main results and a discussion

of the strengths and limits of the studies. The chapter ends with recommendations for policy and stakeholders, and implications for future research.

REFERENCES

1 Kessler R, Aguilar-Gaxiola S, Alonso J*, et al.* Special articles. The global burden of mental disorders: an update from the WHO World Mental Health (WMH) surveys. *Epidemiologia e psichiatria sociale* 2009;18:23.

2 Paykel ES, Brugha T, Fryers T. Size and burden of depressive disorders in Europe. *European neuropsychopharmacology* 2005;15:411-23.

3 Murray CJ, Vos T, Lozano R*, et al.* Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 2012;380:2197-223.

4 Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. *PLoS medicine* 2006;3:e442.

5 Cuijpers P, Smit F. Excess mortality in depression: a meta-analysis of community studies. *Journal of affective disorders* 2002;72:227-36.

6 Kruijshaar ME, Hoeymans N, Bijl RV*, et al.* Levels of disability in major depression: findings from the Netherlands Mental Health Survey and Incidence Study (NEMESIS). *Journal of affective disorders* 2003;77:53-64.

7 Reupert AE, Maybery DJ, Kowalenko NM. Children whose parents have a mental illness: prevalence, need and treatment. *Medical Journal of Australia* 2012;196:7.

8 Saris I, Aghajani M, Werff S*, et al.* Social functioning in patients with depressive and anxiety disorders. *Acta Psychiatrica Scandinavica* 2017;136:352-61.

9 Cuijpers P, van Straten A, Smit F*, et al.* Preventing the onset of depressive disorders: a meta-analytic review of psychological interventions. *American Journal of Psychiatry* 2008;165:1272-80.

10 Eurostat. Persons reporting a chronic disease (% chronic depression). 2014.

11 Bromet E, Andrade LH, Hwang I*, et al.* Cross-national epidemiology of DSM-IV major depressive episode. *BMC medicine* 2011;9:90.

12 De Graaf R, Ten Have M, van Dorsselaer S. De psychische gezondheid van de Nederlandse bevolking. *Nemesis-2: Opzet en eerste resultaten, Trimbos-Instituut, Utrecht* 2010.

13 de Graaf R, ten Have M, van Gool C*, et al.* Prevalence of mental disorders and trends from 1996 to 2009. Results from the Netherlands Mental Health Survey and Incidence Study-2. *Social psychiatry and psychiatric epidemiology* 2012;47:203-13.

14 Fryers T, Melzer D, Jenkins R*, et al.* The distribution of the common mental disorders: social inequalities in Europe. *Clinical Practice and Epidemiology in Mental Health* 2005;1:14.

15 Stansfeld S, Head J, Fuhrer R*, et al.* Social inequalities in depressive symptoms and physical functioning in the Whitehall II study: exploring a common cause explanation. *Journal of epidemiology and community health* 2003;57:361-7.

16 Kim D. Blues from the neighborhood? Neighborhood characteristics and depression. *Epidemiologic reviews* 2008;30:101-17.

17 Mair C, Diez Roux AV, Galea S. Are neighbourhood characteristics associated with depressive symptoms? A review of evidence. *Journal of epidemiology and community health* 2008;62:940-6, 8 p following 6.

18 Diez Roux AV, Mair C. Neighborhoods and health. *Annals of the New York Academy of Sciences* 2010;1186:125-45.

19 Marmot MG. Improvement of social environment to improve health. *The lancet* 1998;351:57-60.

20 Pickett KE, Pearl M. Multilevel analyses of neighbourhood socioeconomic context and health outcomes: a critical review. *Journal of Epidemiology & Community Health* 2001;55:111-22.

21 Roux A-VD. Neighborhoods and health: where are we and were do we go from here? *Revue d'epidemiologie et de sante publique* 2007;55:13-21.

22 Kawachi I, Berkman LF. *Neighborhoods and health*: Oxford University Press 2003.

23 Erdem Ö, Van Lenthe FJ, Prins RG*, et al.* Socioeconomic inequalities in psychological distress among urban adults: the moderating role of neighborhood social cohesion. *PloS one* 2016;11:e0157119.

24 RIVM. Neighborhood differences in depression. RIVM 2012.

25 Weich S, Lewis G, Jenkins SP. Income inequality and the prevalence of common mental disorders in Britain. *The British Journal of Psychiatry* 2001;178:222-7.

26 Rios R, Aiken LS, Zautra AJ. Neighborhood contexts and the mediating role of neighborhood social cohesion on health and psychological distress among Hispanic and non-Hispanic residents. *Annals of behavioral medicine : a publication of the Society of Behavioral Medicine* 2012;43:50-61.

27 Kobayashi KM, Prus S, Lin Z. Ethnic differences in self-rated and functional health: does immigrant status matter? *Ethnicity and Health* 2008;13:129-47.

28 Malmusi D, Palència L, Ikram UZ*, et al.* Inequalities by immigrant status in depressive symptoms in Europe: the role of integration policy regimes. *Social psychiatry and psychiatric epidemiology* 2017;52:391-8.

29 Missinne S, Bracke P. Depressive symptoms among immigrants and ethnic minorities: a population based study in 23 European countries. *Social psychiatry and psychiatric epidemiology* 2012;47:97-109.

30 Nielsen SS, Krasnik A. Poorer self-perceived health among migrants and ethnic minorities versus the majority population in Europe: a systematic review. *International journal of public health* 2010;55:357-71.

31 Nazroo JY. The structuring of ethnic inequalities in health: economic position, racial discrimination, and racism. *American journal of public health* 2003;93:277-84.

32 Bas-Sarmiento P, Saucedo-Moreno MJ, Fernández-Gutiérrez M*, et al.* Mental health in immigrants versus native population: a systematic review of the literature. *Archives of psychiatric nursing* 2017;31:111-21.

33 Toselli S, Gualdi-Russo E, Marzouk D*, et al.* Psychosocial health among immigrants in central and southern Europe. *The European Journal of Public Health* 2014;24:26-30.

34 Devillé W, Uiters E, Westert G*, et al.* Perceived health and consultation of GPs among ethnic minorities compared to the general population in the Netherlands. *Morbidity, performance and quality in primary care: Dutch general practice on stage Oxxon: Radcliffe Publishing* 2006;85:96.

35 Wittkampf LC, Smeets HM, Knol MJ*, et al.* Differences in psychotropic drug prescriptions among ethnic groups in the Netherlands. *Social psychiatry and psychiatric epidemiology* 2010;45:819-26.

36 Beck AN, Finch BK, Lin S-F*, et al.* Racial disparities in self-rated health: Trends, explanatory factors, and the changing role of socio-demographics. *Social Science & Medicine* 2014;104:163-77.

37 Bhugra D, Becker MA. Migration, cultural bereavement and cultural identity. *World Psychiatry* 2005;4:18.

38 Ikram UZ, Snijder MB, Fassaert TJ*, et al.* The contribution of perceived ethnic discrimination to the prevalence of depression. *The European Journal of Public Health* 2015;25:243-8.

39 Hildebrandt VH, Bernaards C, Stubbe J. Trendrapport bewegen en gezondheid 2010/2011. 2013.

40 Van Lindert H, Droomers M, Westert G. Een kwestie van verschil: verschillen in zelf-gerapporteerde leefstijl, gezondheid en zorggebruik. *Utrecht/Bilthoven: NIVEL, RIVM* 2004.

41 Andrews G, Slade T. Interpreting scores on the Kessler Psychological Distress Scale (K10). *Australian and New Zealand journal of public health* 2001;25:494-7.

42 Kessler RC, Andrews G, Colpe LJ*, et al.* Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychological medicine* 2002;32:959-76.

43 Kessler R, Mroczek D. Final versions of our non-specific psychological distress scale. *Memo dated March* 1994;10:1994.

44 Donker T, Comijs H, Cuijpers P*, et al.* The validity of the Dutch K10 and extended K10 screening scales for depressive and anxiety disorders. *Psychiatry Research* 2010;176:45-50.

45 Veelen Jv, van Dijk A, Ariëns G*, et al.* De G4 op gezondheid uitgemeten. *Over gezondheid en gezondheidsverschillen in de vier grote steden Den Haag: Gemeente Den Haag, dienst OCW* 2009.

46 Bleije B, Hooimeijer P, van Hulle R*, et al.* Wonen overwogen. *De resultaten van het Woononderzoek Nederland* 2009.

47 Bijl R, Boelhouwer J, Pommer E*, et al. The social state of the Netherlands 2009*: Netherlands Institute for Social Research/SCP 2010.

48 CBS. Bestand Bodemgebruik: Productbeschrijving. CBS 2008.

49 Budescu DV, Budescu M. How to measure diversity when you must. *Psychological methods* 2012;17:215.

50 CBS. Core statistics neighborhoods 2004-2008. Statistics Netherlands 2008.

51 Statistics Netherlands. Opbouw en instructie totaalbestand Gezondheidsmonitor Volwassenen 2012. 2015.

52 Houben-van Herten M. Evaluatie Gezondheidsmonitor 2012. Den Haag/Heerlen: CBS 2015.
53 CBS. Regional core statistics the Netherlands. Statistics Netherlands 2013.

CHAPTER 2

Structural neighbourhood conditions, social cohesion and psychological distress in the Netherlands

Erdem, Ö., Prins, R.G., Voorham, T.A., Van Lenthe, F.J., & Burdorf, A.

European Journal of Public Health. 2015;25:995-1001.

ABSTRACT

Background

Neighbourhood inequalities in psychological distress are well reported but underlying mechanisms remain poorly understood. The main purposes of this study were to investigate associations between structural neighbourhood conditions and psychological distress, and to explore the potential mediating role of neighbourhood social cohesion.

Methods

Cross-sectional questionnaire study on a random sample of 18,173 residents aged ≥ 16 years (response 49%) from the four largest cities in the Netherlands. Psychological distress was measured with the Kessler Psychological Distress Scale (K10). Structural environmental factors under study were neighbourhood socioeconomic status, neighbourhood green, urbanity and home maintenance. Neighbourhood social cohesion was measured by five statements and aggregated to the neighbourhood level by using ecometrics methodology. Multilevel linear regression analysis was used to investigate associations of neighbourhood characteristics with psychological distress, adjusted for individual level characteristics.

Results

High neighbourhood socioeconomic status and neighbourhood social cohesion were associated with decreased psychological distress. Adjusted for individual level characteristics and neighbourhood socioeconomic status, only neighbourhood social cohesion remained significantly associated with psychological distress. Neighbourhood social cohesion accounted for 38% of the differences in the association between neighbourhood socioeconomic status and psychological distress.

Conclusion

High neighbourhood social cohesion is significantly associated with decreased psychological distress among residents of the four largest cities in the Netherlands. Reducing neighbourhood inequalities in psychological distress may require increasing social interactions among neighbourhood residents.

INTRODUCTION

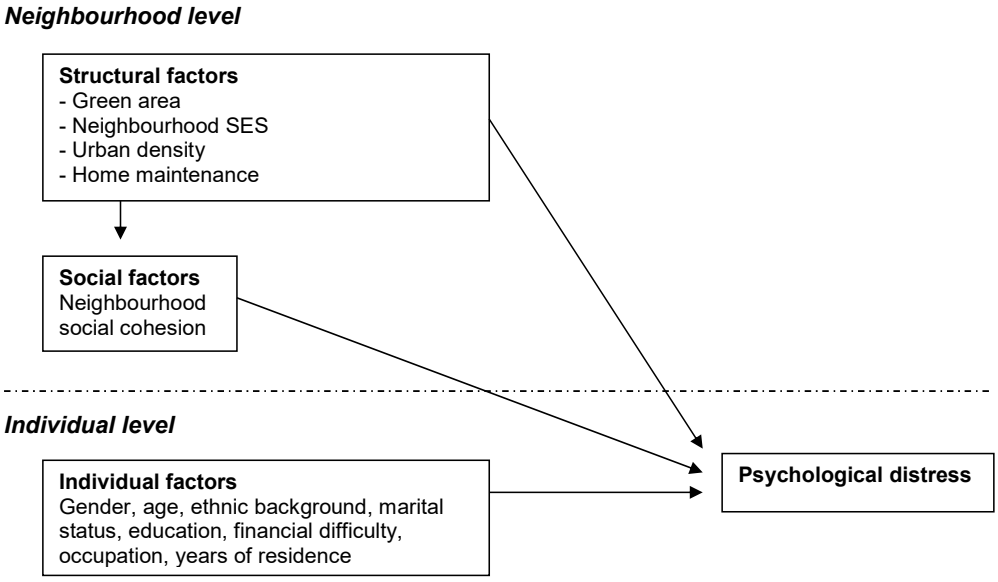
Major depressive disorders are among the leading causes of disability-adjusted life years worldwide [1]. The prevalence of depressive disorders among adults is 7% in the US [2] and 5% in the Netherlands [3] and is expected to increase [1]. Major depressive disorders may have negative consequences for individuals' quality of life [4], and for the mental health of persons in their social environment [5]. Approximately 20% of the Dutch national healthcare budget is spent on mental disorders, with a substantial contribution of depressive disorders [6]. Given the impact of depressive disorders on individuals and society, better insight in its determinants is required.

Depressive disorders are not randomly distributed across populations. Neighbourhood differences suggest that structural and social environmental factors may have an impact on depressive disorders [7, 8], even over and above residents' individual socioeconomic status (SES). Structural factors may include neighbourhood economic deprivation [9-13], neighbourhood racial/ethnic composition [14, 15] or quality of housing [16]. Social environmental factors include neighbourhood disorder, violence, perceived exposure to crime, social interactions between neighbours, and neighbourhood cohesion [8]. A review on the influence of social capital and social cohesion on mental health showed no strong evidence for a protective role of social cohesion on mental health [17]. Another review presented less consistent results. Whereas there is strong evidence for a protective role of individual-level social capital on mental health, there is no evidence for such role of neighbourhood level social capital [18]. In the past few years, some studies have found evidence for the inverse relationship of higher neighbourhood level social capital with higher prevalence of mental health [19-21].

Neighbourhood environmental factors may interplay with each other and with individual level factors in relation to mental health. Carpiano proposed a conceptual model on the relationship between social cohesion and social capital with individual health outcomes [22]. Besides separating social cohesion of social capital, he highlighted to structural neighbourhood factors and individual level factors and their interrelations. In this model that consist of both neighbourhood and individual levels, structural and social factors may be related directly or indirectly to individual health [22].However, for mental health a broader range of social environmental factors is important. McNeillet et al., identified five dimensions of the social environment: social support and networks, socioeconomic position and income inequality, racial discrimination, neighbourhood deprivation, and social cohesion and social capital [23]. Figure 1 depicts the conceptual model for this study, which draws heavily on the previously mentioned work by Carpiono and MCNeillet. In this model, social and structural factors are directly related to mental health, but social factors are also considered to be

intermediates on the pathway through which structural neighbourhood factors are associated with individual health. Such direct and indirect pathways from neighbourhood structural and social cohesion to depressive disorders have hardly been investigated [21]. In this study, it was therefore explored whether structural and social environmental factors are directly and indirectly related to psychological distress (an indicator of depressive disorders in urban adults). It was hypothesized that a) higher neighbourhood SES, more green in neighbourhoods, high-quality housing, more social cohesion, and lower urbanity are associated with less psychological distress among inhabitants of the four largest cities in the Netherlands and that b) these associations of structural factors with psychological distress are mediated partly by social cohesion.

Figure 1 Conceptual model for associations between individual and neighbourhood level factors and psychological distress



METHODS

Study design

Data for the present study were used from the health survey conducted in 2008 by the municipal health services of the four largest Dutch cities (Amsterdam, The Hague, Rotterdam and Utrecht). Using a uniform research methodology, information on physical and mental health, social well-being, lifestyle, health care use, and demographics of residents were collected. The survey was based on a random sample of 42,686 residents aged 16 years and older from the municipal population registers, stratified by city district and age.

Although no formal power calculation was conducted, this sample size was considered sufficiently large to have at least 100 respondents per neighbourhood. Respondents were asked to fill in a written or web-based questionnaire or to take part in a personal interview when having difficulties to complete the questionnaire. Extra effort was made to target vulnerable groups, i.e. older Turks and Moroccans with limited language skills and residents of neighbourhoods with a low response in previous surveys. Non-responders were contacted by telephone or visited at their home and were offered personal help to fill in the questionnaire in the language used by the respondent e.g. in Turkish or Arabic.

Response

In total 20,877 respondents completed the questionnaire (49% overall response; 54% in Utrecht, 51% in The Hague, 50% in Amsterdam, and 47% in Rotterdam). Response was higher among women than among men and increased with age. The response was highest among the Dutch (57%) and lowest among Moroccans (30%) [24].

We limited our analyses to respondents who answered all questions used in the analyses (18,173). These respondents lived in one of 211 neighbourhoods (on average 86 respondents (SD: 63) per neighbourhood). Dutch neighbourhoods comprise on average of approximately 4,000 residents.

By participating in this survey respondents gave permission to use their answers for scientific purposes. The dataset is anonymous and the Dutch Code of Conduct for Medical Research allows the use of anonymous data for research purposes, without an explicit informed consent [25].

Measures

Psychological Distress

Psychological distress was measured with the Kessler Psychological Distress Scale (K10). The K10 is able to discriminate DSM-IV disorders from non-cases [26] and has a good agreement with the Composite International Diagnostic Interview (CIDI) diagnosis of anxiety

and affective disorders [27]. The K10 scale consists of 10 questions on anxiety and depressive symptoms in the previous four weeks: “Did you feel …1) tired out for no good reasons?”, 2) nervous?”, 3) so nervous that nothing could calm you down?”, 4) hopeless?”, 5) restless or fidgety?”, 6) so restless that you could not sit still?”, 7) depressed?”, 8) that everything was an effort?”, 9) so sad that nothing could cheer you up?” and 10) worthless?”. Response categories were "none of the time" (1), "a little of the time" (2), "some of the time" (3), "most of the time" (4) and "all of the time" (5). Cronbach’s alpha was 0.92, therefore a sum-score was calculated (10-50; higher scores reflecting higher levels of psychological distress).

Individual level factors

Gender, age, ethnic background, marital status and years of residence in the current city were derived from the questionnaire. Ethnic background was defined by respondent or one of the parents being born in a foreign country [28]. Years of residence in the city was included to adjust for exposure to the environment. Education, occupation and having financial difficulties were included as measures of individual SES. Educational level was categorised into: “primary school” (1), “lower general secondary education” (2), “higher general secondary education” (3) and “college, university” (4). Occupation status was categorised into four categories: “housewife, houseman, student” (1), “unemployed, recipient of disability benefits or social assistance benefits” (2), “(early) pensioner” (3) and “(self-)employed” (4). Financial difficulties were measured with the question "Have you had difficulty in the past year to make ends meet with the household income?" with a 4-point answering scale ranging from “great difficulty” (1) to “no difficulty” (4). Financial difficulties was defined by some and great difficulties (scores 1 and 2).

Neighbourhood structural factors

Composite scores on neighbourhood SES were obtained from the Netherlands Institute for Social Research (SCP). For each 6-digit zip-code area (on average 17 addresses), the SCP conducted a telephone interview among a randomly selected person. The responses of the 6-digit zip code areas were aggregated to a higher level 4-digit zip code area. Neighbourhood SES was composed by three characteristics of individuals within the 4-digit zip code area: income, work, and level of education. Composite scores were created by conducting a factor analysis on these three variables [29].

Home maintenance was used as an indicator of the quality of housing and was obtained from the WoON 2009 dataset (Ministry of Housing, Spatial Planning and the Environment), a national survey among 78,000 (response = 59%) randomly selected Dutch inhabitants (age ≥ 18 years) [30]. Home maintenance was measured with the item: "My

house or living area is poorly maintained" ("totally agree" (1) to "totally disagree" (5)). Individual responses were aggregated to the neighbourhood level by taking the mean value of the individual responses.

The degree of urbanity of the municipality was retrieved from Statistics Netherlands and was based on the number of addresses per km^2 in 2008: more than 2499 addresses (urban); 1500-2499 addresses (semi-urban); 1000-1499 addresses (intermediate urban-rural); 500-999 addresses (semi-rural); 499 addresses (rural).

Data about green areas per neighbourhood were derived from the Dataset Land Use of Statistics Netherlands. In this geographical database, land use was defined in polygons. Each polygon had a land use typology (e.g. business, parks) and an area. For each neighbourhood we calculated the proportion surface area that could be classified as green (i.e. the typologies of parks, plantations, green belts and forests) relative to total land area excluding surface area consisting of water.

Social environmental factors

Data on neighbourhood social cohesion were obtained from WoON 2009 Dataset. At the individual level, social cohesion was measured with five items: "the people in my neighbourhood get along well with each other", "I live in a close-knit neighbourhood with a lot of solidarity", "I have a lot of contact with my direct neighbours", "I have a lot of contact with other neighbours", "In this neighbourhood, the people hardly know each other". All items were measured on a 5-point scale ("totally disagree" (1) - "totally agree" (5)). The last item was reverse-coded.

Social cohesion was aggregated on a neighbourhood level by using an ecometrics approach [31-34]. A linear three-level multi-level model (with neighbourhoods, individuals, items as levels) was fitted with the items measuring social cohesion as the dependent variables and gender, ethnicity, age, education, type of housing the participant lives in and years living in the current home as the independent variables. The neighbourhood residuals from this analysis, the part that cannot be attributed to individual response patterns, constitute the social cohesion variable. Positive values indicate higher than average levels of social cohesion. The reliability of the social cohesion variable was acceptable at 0.66 [35]. The calculations for this variable was done in MLwiN 2.02.

Data analysis

Descriptive statistics were used to show the distribution of variables in the study sample. Pearson correlations were calculated to show the associations between the neighbourhood structural factors and neighbourhood social cohesion.

Multilevel linear models were fitted to examine the associations of individual- and neighbourhood-level predictors with psychological distress [36]. Seven models were fitted. The empty model (model 1) was an intercepts-only model. In Model 2 individual characteristics were entered. In Model 3 the amount of green area was entered. Subsequently, the amount of green area was substituted by neighbourhood SES (model 4), degree of urbanity (model 5), home maintenance (model 6) and social cohesion (model 7). In these models, the neighbourhood variables were transformed to Z-scores. To determine whether the association between neighbourhood SES and psychological distress was attenuated by other neighbourhood characteristics, candidate intermediate factors were entered in Model 2 together with neighbourhood SES. Neighbourhood variables were considered to be candidate intermediate factors if their association with psychological distress was statistically significant. For all models, intraclass correlations (ICC) were calculated to assess the proportion of the total variability in psychosocial distress that is attributable to the neighbourhoods:

$\{variance_{neighbourhood}\}/\{\{variance_{neighbourhood}\}+\{variance_{individual}\}\}$.

All analyses were performed in SPSS 20. Results were considered to be statistically significant at $p<0.05$.

RESULTS

Study sample

The study sample consisted of relatively high percentage women (56%), persons below the age of 55 years (62%), native Dutch (68%), married or living together (57%), persons with university education (32%), employees or self-employed (53%), persons without or with almost no financial difficulties (74%) and persons residing for more than 26 years in their city (50%) (table 1).

Multivariate associations of individual factors with psychological distress

Women reported higher psychological distress than men (β: -1.53, 95%CI -1.73 to -1.34) (table 1). Compared to married persons or cohabitants, widowed persons reported higher psychological distress (β: 1.35, 95%CI 0.97 to 1.74). People with lower levels of education (β: 1.62, 95%CI 1.29 to 1.96) reported higher psychological distress than people with academic education. Unemployed persons, recipients of disability benefits or social assistance benefits (β: 5.54, 95%CI 5.20 to 5.89) reported higher psychological distress than workers. Finally, those who experienced great or some financial difficulty (β: 3.40, 95%CI 3.18 to 3.62), reported higher psychological distress than those without financial difficulties.

Table 1 Characteristics of the study respondents: adults living in the four largest cities in the Netherlands in 2008 (n=18,173) and their associations[a] with psychological distress

		Mean	S.D.	Min.	Max.
Psychological distress		17.15	6.99	10	50
		Percent	β[b]	(95%CI)[c]	
Gender	Man	43.8%	**-1.53**	(-1.73 to -1.34)	
	Woman	56.2%	ref.		
Age	16-34 years	30.7%	**0.99**	(0.52 to 1.45)	
	35-54 years	30.8%	**1.02**	(0.60 to 1.45)	
	55-64 years	16.6%	**-0.56**	(-0.95 to -0.17)	
	≥ 65 years	21.9%	ref.		
Ethnic background	First generation non-Western	16.7%	**1.10**	(0.82 to 1.38)	
	Second generation non-Western	4.5%	**0.94**	(0.46 to 1.42)	
	Western	10.8%	**0.54**	(0.24 to 0.84)	
	Native Dutch	68.0%	ref.		
Marital status	Widow, widower	7.7%	**1.35**	(0.97 to 1.74)	
	Divorced	8.8%	**1.22**	(0.88 to 1.56)	
	Unmarried, never been married	26.8%	**0.64**	(0.40 to 0.89)	
	Married, living together	56.6%	ref.		
Education	Primary school	15.0%	**1.62**	(1.29 to 1.96)	
	Lower general secondary education	28.7%	**0.45**	(0.19 to 0.72)	
	Higher general secondary education	24.2%	0.15	(-0.11 to 0.41)	
	College, university	32.1%	ref.		
Occupation	Housewife, houseman, student	17.5%	0.23	(-0.06 to 0.52)	
	Unemployed, recipient of disability or social assistance benefits	10.2%	**5.54**	(5.20 to 5.89)	
	(Early) retired	19.0%	**0.76**	(0.36 to 1.16)	
	(Self-)employed	53.3%	ref.		
Financial difficulty	Great or some difficulty	26.3%	**3.40**	(3.18 to 3.62)	
	(Almost) no difficulty	73.7%	ref.		
Years of residence in place	0-5 years	15.6%	ref.		
	6-15 years	18.2%	0.19	(-0.13 to 0.51)	
	16-25 years	16.2%	0.12	(-0.22 to 0.46)	
	≥ 26 years	50.0%	**0.47**	(0.14 to 0.79)	

[a] These results are based on multilevel regression analysis adjusted for clustering of individuals within the neighbourhoods.

[b] Bold values are significant ($p<0.05$); Beta represents difference in mean psychological distress relative to reference category.

[c] CI = Confidence Interval.

Descriptive statistics on neighbourhood factors

We found that the amount of green area was not correlated with neighbourhood SES, urban density and home maintenance. All other neighbourhood factors were correlated with each other. The correlations ranged between 0.07 and 0.61 (online supplementary table).

Associations of structural and social neighbourhood factors with psychological distress

Of the total individual differences in psychological distress, 2.87% (Model 1, table 2) could be explained at the neighbourhood level. After including the individual level variables (Model 2 in table 2) the neighbourhood variance was substantially reduced to 0.25%.

Higher neighbourhood SES (β: -0.13, 95%CI -0.24 to -0.02) (table 2) and larger neighbourhood social cohesion (β: -0.16, 95%CI -0.27 to -0.06) were associated with lower psychological distress. No associations were found between green area, urban density, home maintenance and psychological distress.

Table 2 Multilevel regression analysis of psychological distress by neighbourhood factors[a]

		β[b]	(95%CI)[c]	Variance neighbourhood level (estimates and s.e.)	Intraclass correlation (%)
Model 1	Empty model	NA	NA	1.41 (0.21)	2.87
Model 2	Individual level variables	NA	NA	0.10 (0.06)	0.25
Structural Neighbourhood Factors					
Model 3	Green area	-0.03	(-0.14 to 0.07)	0.09 (0.06)	0.24
Model 4	Neighbourhood SES	**-0.13**	(-0.24 to -0.02)	0.08 (0.06)	0.20
Model 5	Urban density	-0.07	(-0.18 to 0.03)	0.08 (0.06)	0.21
Model 6	Home maintenance	-0.06	(-0.17 to 0.04)	0.09 (0.06)	0.23
Social Neighbourhood Factor					
Model 7	Neighbourhood social cohesion	**-0.16**	(-0.27 to -0.06)	0.07 (0.05)	0.19

[a] All neighbourhood factors are in z-score units (per 1 SD increase).

[b] Bold values are significant (p<0.05).

[c] CI = Confidence Interval.

- Model 1 includes only the outcome variable: psychological distress.

- In model 3 to 7 is adjusted for individual level variables: gender, age, ethnic background, marital status, education, occupation, financial difficulties and years of residence.

Pathways linking neighbourhood SES and psychological distress

The association between neighbourhood SES and psychological distress attenuated to non-significance (β:-0.08, 95%CI -0.19 to 0.04) after adding neighbourhood social cohesion to the model (table 3). Neighbourhood social cohesion accounted for 38% ((-0.13 - -0.08)/-0.13)*100%)) of the differences in the association between psychological distress and neighbourhood SES. The other factors did not attenuate this association (not shown).

Table 3 Multilevel regression analysis of psychological distress by neighbourhood social cohesion (mediator) for the pathway of neighbourhood SES on psychological distress

	Model A		Model B	
	β[b]	(95%CI)[c]	β[b]	(95%CI)[c]
Structural Neighbourhood Factor[a]				
Neighbourhood SES	**-0.13**	(-0.24 to -0.02)	-0.08	(-0.19 to 0.04)
Social Neighbourhood Factor[a]				
Neighbourhood social cohesion			**-0.13**	(-0.24 to -0.02)

[a] All neighbourhood factors are in z-score units (per 1 SD increase).

[b] Bold values are significant (p<0.05).

[c] CI = Confidence Interval.

- In both models is adjusted for individual level variables: gender, age, ethnic background, marital status, education, occupation, financial difficulties and years of residence.

DISCUSSION

Despite the pivotal importance of individual characteristics, the results of this study indicate that adults living in neighbourhoods with lower SES or lower social cohesion were more likely to experience psychological distress. Moreover, social cohesion accounted for a considerable part (38%) of the association between neighbourhood SES and psychological distress.

The finding that the association of neighbourhood SES with psychological distress attenuated to non-significance after taking neighbourhood social cohesion into account as a mediator, is in line with Carpiano's framework [37] and other studies [12, 19, 21, 38]. Previous studies have shown that neighbourhood social cohesion mediates the association between neighbourhood SES (and ethnic composition) and psychological distress [21]. Likewise, individually rated social cohesion mediated associations between neighbourhood disadvantage and depressive symptoms in women [19]. Other studies have found that network social capital [38] and individually rated neighbourhood social capital [12] mediate the association between neighbourhoods disadvantage and depressive symptoms.

Neighbourhood inequalities in psychological distress are well reported but underlying mechanisms remain poorly understood. The mediating role of neighbourhood social cohesion contributes to our understanding of how economically disadvantaged neighbourhoods deteriorate mental health among some residents. We found that economically disadvantaged neighbourhoods (i.e. neighbourhoods with higher proportion of citizens with lower education, poverty, and unemployment), had higher levels of depressive symptoms through lower neighbourhood social cohesion. This is in line with neighbourhood disadvantage theories which suggest that economically disadvantaged neighbourhoods lead to disruption in social relationship among the residents [39, 40].

No evidence was found for associations of amount of green, urbanity, and home maintenance with psychological distress. This is in contrast to some other studies, which have shown that people living in poor quality built environments, e.g. percentage of buildings in deteriorating conditions [16] or living in a dwelling with structural problems [41], were more likely to report depression. However, these factors were not measured at the neighbourhood level and the association with depression was not controlled for individual level variables [41]. An alternative explanation is the limited variation in home maintenance between neighbourhoods in this study, which reduces the possibility of finding associations. Also with respect to green space and depression, no significant association was found, while Miles et al. have shown that moderate amounts of green space were associated with fewer depressive symptoms [42]. In this study the results were adjusted for the nested data structure (i.e. multilevel analyses), whereas Miles et al. did not take within-area associations into account. Therefore the results of both studies are not comparable.

Major strengths of this study include the theoretical framework that guided the analysis and interpretation, whereas research on contextual determinants of depressive disorders has been criticized for its poor theoretical basis [8, 43]. Investigating associations of a wide array of neighbourhood characteristics (i.e. neighbourhood SES, urbanity, home maintenance, green area and social cohesion) with psychological distress is rare, but needed according to the framework used. Moreover, the use of multilevel modelling in a large sample allowed unravelling the associations of neighbourhood factors with psychological distress above and beyond individual level factors. Another strength of this study is that neighbourhood factors were derived from other data sources than psychological distress, which prevents same-source bias. With regard to definition of neighbourhood social cohesion, an ecometrics approach was used to arrive at neighbourhood level constructs from individual data. This procedure takes into account that items of social cohesion are not independent of each other but nested within respondents [31, 33].

In order to maximise response, respondents had various options to complete the questionnaire (i.e. paper and pencil, web based or face-to-face interview). Only those who

were offered a face-to-face interview (N=117; <1%) differed from the other groups. This group had on average a lower SES and higher psychological distress than the rest of the sample. It is unclear whether these differences can be attributed to the methodological differences of data collection. However, no substantial changes in the study results should be expected, because of the small size of this group.

Some limitations need to be taken into account when interpreting the results. This is a cross-sectional study, and as such limits causal inference. Furthermore, endogeneity cannot be entirely excluded. While factors were included to adjust for residential self-selection towards particular neighbourhoods, persons living in different neighbourhoods may differ in other respects, such as personality factors. Thus, we cannot entirely rule out an overestimation of the importance of neighbourhood SES and social cohesion. Yet, adjustment for education, occupation, ethnicity, marital status and financial problems may have addressed this problem sufficiently. Selective migration may be responsible for some of the associations found. Depressed persons may have less energy to move away from more deprived neighbourhoods or from neighbourhoods with low social cohesion. Previous research has shown however, that health is a marginal reason for moving [44]. Another limitation is that linear relations between the neighbourhood factors and psychological distress were assumed. Future studies with larger populations in more neighbourhoods should investigate also non-linear associations. Finally, there may have been selective drop-out of respondents, due to eligibility definitions (i.e. data available on socioeconomic factors and psychological distress) or inability to merge neighbourhood data with the individual record (e.g. for those living in industrial areas, for whom no social environmental information was available).

To conclude, adults living in deprived neighbourhoods or in lower social cohesive neighbourhoods experience higher levels of psychological distress. Neighbourhood social cohesion accounted for a considerable part of the differences in the association between neighbourhood SES and psychological distress. Promoting social cohesion may prevent the occurrence of psychological distress and may reduce neighbourhood inequalities in distress.

Key points

- There are few studies in which the associations of various neighbourhood characteristics are examined on depression or psychological distress.
- Especially, the association between neighbourhood social cohesion and psychological distress is understudied. Strong evidence for an inverse association between neighbourhood social cohesion and depression or psychological distress is still lacking.

- This study highlights which neighbourhood characteristics are important as population determinants of mental health. Of the environmental characteristics studied, neighbourhood social cohesion had the strongest (protective) associations with psychological distress.
- There is limited theory about how neighbourhoods may influence depression or psychological distress, especially on the role of neighbourhood social cohesion as a mediator in this process. This study helps us to understand how neighbourhood socioeconomic status shape psychological distress through neighbourhood social cohesion.
- Interventions aimed at improving social interactions among inhabitants in disadvantaged neighbourhoods may prevent the occurrence of psychological distress.

REFERENCES

1 Murray CJ, Vos T, Lozano R*, et al.* Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 2012;380:2197-223.

2 Kessler RC, Chiu WT, Demler O*, et al.* Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of general psychiatry* 2005;62:617-27.

3 de Graaf R, ten Have M, van Gool C*, et al.* Prevalence of mental disorders and trends from 1996 to 2009. Results from the Netherlands Mental Health Survey and Incidence Study-2. *Social psychiatry and psychiatric epidemiology* 2012;47:203-13.

4 Kruijshaar ME, Hoeymans N, Bijl RV*, et al.* Levels of disability in major depression: findings from the Netherlands Mental Health Survey and Incidence Study (NEMESIS). *Journal of affective disorders* 2003;77:53-64.

5 Reupert AE, Maybery DJ, Kowalenko NM. Children whose parents have a mental illness: prevalence, need and treatment. *Medical Journal of Australia* 2012;196:7.

6 Poos MJJC SJ, Groen J, Kommer GJ, Slobbe LCJ. Kosten van ziekten in Nederland 2005, RIVM-rapport nr. 270751019. Bilthoven: RIVM,. 2008

7 Kim D. Blues from the neighborhood? Neighborhood characteristics and depression. *Epidemiologic reviews* 2008;30:101-17.

8 Mair C, Diez Roux AV, Galea S. Are neighbourhood characteristics associated with depressive symptoms? A review of evidence. *Journal of epidemiology and community health* 2008;62:940-6, 8 p following 6.

9 Fone D, Dunstan F, Williams G*, et al.* Places, people and mental health: a multilevel analysis of economic inactivity. *Social science & medicine (1982)* 2007;64:633-45.

10 Fone DL, Lloyd K, Dunstan FD. Measuring the neighbourhood using UK benefits data: a multilevel analysis of mental health status. *BMC public health* 2007;7:69.

11 Gary-Webb TL, Baptiste-Roberts K, Pham L*, et al.* Neighborhood socioeconomic status, depression, and health status in the Look AHEAD (Action for Health in Diabetes) study. *BMC public health* 2011;11:349.

12 Kruger DJ, Reischl TM, Gee GC. Neighborhood social conditions mediate the association between physical deterioration and mental health. *American journal of community psychology* 2007;40:261-71.

13 Muntaner C, Eaton WW, Miech R*, et al.* Socioeconomic position and major mental disorders. *Epidemiologic reviews* 2004;26:53-62.

14 Abada T, Hou F, Ram B. Racially mixed neighborhoods, perceived neighborhood social cohesion, and adolescent health in Canada. *Social science & medicine (1982)* 2007;65:2004-17.

15 Ostir GV, Eschbach K, Markides KS*, et al.* Neighbourhood composition and depressive symptoms among older Mexican Americans. *Journal of epidemiology and community health* 2003;57:987-92.

16 Galea S, Ahern J, Rudenstine S*, et al.* Urban built environment and depression: a multilevel analysis. *Journal of epidemiology and community health* 2005;59:822-7.
17 Whitley R, McKenzie K. Social capital and psychiatry: review of the literature. *Harvard review of psychiatry* 2005;13:71-84.
18 De Silva MJ, McKenzie K, Harpham T*, et al.* Social capital and mental illness: a systematic review. *Journal of epidemiology and community health* 2005;59:619-27.
19 Bassett E, Moore S. Gender Differences in the Social Pathways Linking Neighborhood Disadvantage to Depressive Symptoms in Adults. *PloS one* 2013;8:e76554.
20 Eastwood JG, Jalaludin BB, Kemp LA*, et al.* Bayesian hierarchical spatial regression of maternal depressive symptoms in South Western Sydney, Australia. *SpringerPlus* 2014;3:55.
21 Rios R, Aiken LS, Zautra AJ. Neighborhood contexts and the mediating role of neighborhood social cohesion on health and psychological distress among Hispanic and non-Hispanic residents. *Annals of behavioral medicine : a publication of the Society of Behavioral Medicine* 2012;43:50-61.
22 Carpiano RM. Neighborhood social capital and adult health: an empirical test of a Bourdieu-based model. *Health & place* 2007;13:639-55.
23 McNeill LH, Kreuter MW, Subramanian S. Social environment and physical activity: a review of concepts and evidence. *Social Science & Medicine* 2006;63:1011-22.
24 Veelen Jv, van Dijk A, Ariëns G*, et al.* De G4 op gezondheid uitgemeten. *Over gezondheid en gezondheidsverschillen in de vier grote steden Den Haag: Gemeente Den Haag, dienst OCW* 2009.
25 FEDERA. Code of conduct for medical research. 2012.
26 Kessler RC, Andrews G, Colpe LJ*, et al.* Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychological medicine* 2002;32:959-76.
27 Andrews G, Slade T. Interpreting scores on the Kessler Psychological Distress Scale (K10). *Australian and New Zealand journal of public health* 2001;25:494-7.
28 Statistics Netherlands. Hoe doet het CBS dat nou? Standaarddefinitie allochtonen [How does Statistics Netherlands do this? Standard Definition Immigrants]. Voorburg: Statistics Netherlands 2000:24-5.
29 Bijl R, Boelhouwer J, Pommer E*, et al. The social state of the Netherlands 2009*: Netherlands Institute for Social Research/SCP 2010.
30 Bleije B, Hooimeijer P, van Hulle R*, et al.* Wonen overwogen. *De resultaten van het Woononderzoek Nederland* 2009.
31 Raudenbusch SW, Sampson RJ. Ecometrics: toward a science of assessing ecological settings, with application to the systematic social observation of neighborhoods. *Sociological Methodology* 1999;29:1-41.
32 Mujahid MS, Diez Roux AV, Morenoff JD*, et al.* Assessing the measurement properties of neighborhood scales: from psychometrics to ecometrics. *American journal of epidemiology* 2007;165:858-67.

33 Mohnen SM, Groenewegen PP, Volker B*, et al.* Neighborhood social capital and individual health. *Social science & medicine (1982)* 2011;72:660-7.

34 Prins RG, Mohnen SM, van Lenthe FJ*, et al.* Are neighbourhood social capital and availability of sports facilities related to sports participation among Dutch adolescents? *The international journal of behavioral nutrition and physical activity* 2012;9:90.

35 Hox JJ. *Multilevel analysis: Techniques and applications*. Mahwah, NJ: Lawrence Erlbaum Associates 2002.

36 Twisk JW. *Applied multilevel analysis: a practical guide*: Cambridge University Press 2006.

37 Carpiano RM. Toward a neighborhood resource-based theory of social capital for health: can Bourdieu and sociology help? *Social science & medicine (1982)* 2006;62:165-75.

38 Haines VA, Beggs JJ, Hurlbert JS. Neighborhood disadvantage, network social capital, and depressive symptoms. *Journal of health and social behavior* 2011;52:58-73.

39 Hurd NM, Stoddard SA, Zimmerman MA. Neighborhoods, Social Support, and African American Adolescents' Mental Health Outcomes: A Multilevel Path Analysis. *Child development* 2013;84:858-74.

40 Sampson RJ, Groves WB. Community structure and crime: Testing social-disorganization theory. *American journal of sociology* 1989:774-802.

41 Weich S, Blanchard M, Prince M*, et al.* Mental health and the built environment: cross-sectional survey of individual and contextual risk factors for depression. *The British journal of psychiatry : the journal of mental science* 2002;180:428-33.

42 Miles R, Coutts C, Mohamadi A. Neighborhood urban form, social environment, and depression. *Journal of urban health : bulletin of the New York Academy of Medicine* 2012;89:1-18.

43 Paczkowski MM, Galea S. Sociodemographic characteristics of the neighborhood and depressive symptoms. *Current opinion in psychiatry* 2010;23:337-41.

44 van Lenthe FJ, Martikainen P, Mackenbach JP. Neighbourhood inequalities in health and health-related behaviour: results of selective migration? *Health & place* 2007;13:123-37.

APPENDIX

Online supplementary table Descriptive statistics and Pearson correlation between neighbourhood factors (neighbourhoods = 211) in the four largest cities in the Netherlands, in 2008

	Mean	S.D.	Min.	Max.	1	2	3	4
Structural Neighbourhood Factors								
1. Green area	0.09	0.10	0.00	0.69	1.000	--	--	--
2. Neighbourhood SES	-0.46	1.69	-5.24	2.95	0.087	1.000	--	--
3. Urban density	1.47	0.92	1.00	5.00	0.091	0.293**	1.000	--
4. Home maintenance	3.69	0.37	2.61	5.00	0.071	0.473**	0.607**	1.000
Social Neighbourhood Factor								
5. Neighbourhood social cohesion	-0.20	0.19	-0.70	0.24	0.140*	0.486**	0.439**	0.439**

* p<0.05 ** p<0.01.

CHAPTER 3

Socioeconomic inequalities in psychological distress among urban adults: the moderating role of neighbourhood social cohesion

Erdem, Ö., Van Lenthe, F.J., Prins, R.G., Voorham, T.A., & Burdorf, A.

PloS one. 2016;11(6).

ABSTRACT

Background

Various studies have reported socioeconomic inequalities in mental health among urban residents. This study aimed at investigating whether neighbourhood social cohesion influences the associations between socio-economic factors and psychological distress.

Methods

Cross-sectional questionnaire study on a random sample of 18,173 residents aged 16 years and older from 211 neighbourhoods in the four largest cities in the Netherlands. Psychological distress was the dependent variable (scale range 10-50). Neighbourhood social cohesion was measured by five statements and aggregated to the neighbourhood level using ecometrics methodology. Multilevel linear regression analyses were used to investigate cross-level interactions, adjusted for neighbourhood deprivation, between individual characteristics and social cohesion with psychological distress.

Results

The mean level of psychological distress among urban residents was 17.2. Recipients of disability, social assistance or unemployment benefits reported higher psychological distress (β=5.6, 95%CI 5.2 to 5.9) than those in paid employment. Persons with some or great financial difficulties reported higher psychological distress (β=3.4, 95%CI 3.2 to 3.6) than those with little or no financial problems. Socio-demographic factors were also associated with psychological distress, albeit with much lower influence. Living in a neighbourhood with high social cohesion instead of low social cohesion was associated with a lower psychological distress of 22% among recipients of disability, social assistance or unemployment benefits and of 13% among citizens with financial difficulties.

Conclusions

Residing in socially cohesive neighbourhoods may reduce the influence of lack of paid employment and financial difficulties on psychological distress among urban adults. Urban policies aimed at improving neighbourhood social cohesion may contribute to decreasing socio-economic inequalities in mental health.

INTRODUCTION

Depression is a common health problem among adults in European countries, including the Netherlands [1, 2]. Depression almost doubles the risk of premature mortality [3], and seriously affects quality of life of patients [4] and of those in their immediate environment [5]. It was the fourth leading contributor to the global burden of disease in Europe in 2010 [6], and is expected to be the leading contributor in 2030 [7]. Preventing the onset is an important strategy to reduce the public health burden of depression [8].

The risk of depression is unequally distributed across the population. Those with a low income [9], low level of education [9, 10] or without a job [11] are at an increased risk of depression. The largest cities in the Netherlands host relatively many residents from lower socioeconomic groups [12], which may be one of the reasons of a higher prevalence of depression in those cities (12-15%) as compared to the overall prevalence in the Netherlands (10%) [13]. Explanations for these inequalities include poor material circumstances, lack of social support, and unhealthy behaviours [14]. However, these individual factors cannot entirely explain the observed between-neighbourhood variation in depression in the Netherlands. This suggests that neighbourhood differences in depression are not exclusively attributable to compositional effects, i.e. clustering of residents with low socio-economic characteristics in poor neighbourhoods, but may also be due to contextual effects of neighbourhood features. A rapidly increasing literature points towards the role of social contextual determinants of depression [15, 16] and a role for such determinants in the explanation of inequalities in health outcomes in general. One of these factors is neighbourhood social cohesion, which refers to the extent of connectedness and solidarity between and among neighbours in society. In socially cohesive neighbourhoods the relationships between neighbours are strong and the willingness to help each other is present. Neighbourhood social cohesion is a feature of the community which affects all members of the neighbourhood, and distinctively different from individual-level social networks and social support [17].

Studies have shown mental health benefits of residing in a socially cohesive neighbourhood [18-20]. Living in economically deprived neighbourhoods with a strong social cohesion was associated with better mental health than living in economically deprived neighbourhoods with low levels of social cohesion [21], suggesting a buffering role of neighbourhood social cohesion.

Several studies on social cohesion, social capital and health have presented some evidence for health benefits of residing in a socially cohesive neighbourhood. There are at least three plausible pathways by which social cohesion or social capital can affect individual health [17]. Firstly, social capital may affect health by both facilitating more rapid diffusion of

health-related information and promoting healthy norms of behaviour (e.g. jointly walk with neighbours in a nearby park) or exerting informal social control over unhealthy behaviours (e.g. adolescent drinking, smoking, and drug abuse). Secondly, social capital may affect health by stimulating co-operation between residents to ensure access to local (health) services and amenities. These could include local pressure groups who are lobbying for the provision of services (e.g. playgrounds, recreational facilities, green area, community health clinics). Thirdly, psychosocial processes are a way in which social capital may affect health by giving emotional support (e.g. alleviate the pain of stressful life events) and enhancing self-esteem and mutual respect. Hence, higher levels of neighbourhood social cohesion or social capital may buffer the impact of unfavourable material and social circumstances on depression among lower socioeconomic groups residing in urban areas.

Specifically, we hypothesize that (i) lower educated people, those with financial difficulties and lack of employment residing in the four largest cities of the Netherlands are at an increased risk of depression as compared to those with higher educational level, a higher income and with a job and (ii) that higher levels of neighbourhood social cohesion buffer the relation between individual socio-economic factors and depression.

METHODS

Study design

All municipalities in the Netherlands are required by law to gain insight into the health of the local population every four years. In 2008, the municipal health services of the four largest cities (Amsterdam, The Hague, Rotterdam and Utrecht) in the Netherlands jointly conducted a survey on physical and mental health, social well-being, lifestyle, health care use and demographics of their inhabitants. This survey was linked at neighbourhood level to external surveys on social cohesion and on social deprivation.

Sampling

In each city a random sample was drawn from the municipal population registers aged 16 years and older, stratified by district and age. A total of 42,686 respondents received an invitation. Although no formal power calculation was conducted, this sample size was considered sufficiently large to have at least 100 respondents per neighbourhood. In the Netherlands each citizen is legally required to register his home address in a municipal register and municipal registers are collated to avoid multiple registration. Respondents were asked to fill in a written or web-based questionnaire or to take part in a personal interview when having difficulties to complete the questionnaire. Extra effort was made to target vulnerable groups, i.e. older Turks and Moroccans with limited language skills and residents

of neighbourhoods with a low response in previous surveys. Non-responders were contacted by telephone or visited at their home and were offered personal help to fill in the questionnaire in the language used by the respondent e.g. in Turkish or Arabic.

Response

The overall response was 49% (n= 20,877); 54% in Utrecht, 51% in The Hague, 50% in Amsterdam and 47% in Rotterdam. Response was higher among women than among men and increased with age. The response was highest among Dutch (57%) and lowest among Moroccans (30%) [22]. We omitted 12.8% of the respondents as a consequence of at least one missing item on socio-demographic characteristics, neighbourhood cohesion and deprivation, and psychological distress. The final sample for analysis was 18,173 respondents. These respondents lived in one of 211 neighbourhoods (on average 86 respondents (SD: 63) per neighbourhood).

Definition of a neighbourhood

For social cohesion it is important that the definition of a neighbourhood is a functional social entity. Previous research has found that there is a sense of community in Dutch neighbourhoods which were defined by a 4 digit postcode [23]. These neighbourhoods are often named (e.g. "Delfshaven" or "Vreewijk") to which people identify themselves. Therefore, we defined neighbourhoods based on the 4 digit postcode. In the Netherlands, there are about 4,000 neighbourhoods. These areas comprise on average of approximately 4,000 residents.

Ethical approval was not required as this study relied on secondary anonymized data collected in the context of performing statutory tasks (Public Health Act of the Netherlands), in strict accordance with the national standard [24]. Respondents were informed by letter that by filling out the questionnaire they gave permission for use of anonymous data for research aimed at improving population health in their place of residence. Respondents were contacted through municipal health services and in the dataset available for research purposes all identifying information has been removed. All research activities adhered to the regulations of the Dutch Code of Conduct for Medical Research.

Measures

Psychological Distress

This study used psychological distress as an indicator of depression [25, 26], measured with the Kessler Psychological Distress Scale (K10). The K10 has been developed as a screening instrument for psychological distress in the general population [27]. The K10

discriminates DSM-IV disorders from non-cases [26] and is strongly associated with the Composite International Diagnostic Interview (CIDI) diagnosis of anxiety and affective disorders [25]. In a recent Dutch study, the K10 proved to be reliable (Cronbach's: 0.94) and valid (area under the curve (*AUC:* 0.87)) in detecting any depressive disorders. At the cut-off of 20 points, sensitivity (0.80) and specificity (0.81) are sufficiently high to appreciate the K10 as appropriate screening instrument [28].

The K10 scale consists of 10 questions that measure a person's level of anxiety and depressive symptoms in the previous four weeks. The items included were: "Did you feel …1) tired out for no good reasons?", 2) nervous?", 3) so nervous that nothing could calm you down?", 4) hopeless?", 5) restless or fidgety?", 6) so restless that you could not sit still?", 7) depressed?", 8) that everything was an effort?", 9) so sad that nothing could cheer you up?" and 10) worthless?". Each item has five response categories "none of the time", "a little of the time", "some of the time", "most of the time" and "all of the time". Cronbach's alpha was 0.92, therefore a sum-score was calculated (range 10-50), with higher scores reflecting more psychological distress.

Socio-demographic and socioeconomic factors

Gender, age, ethnicity, marital status and years of residence in their current city were derived from the questionnaires. Ethnicity was defined based on country of birth of parents and the respondent, according to the standard definition of Statistics Netherlands [29]. Marital status was categorized into widow or widower, divorced, unmarried or never been married and married or living together. To control for duration of exposure to neighbourhood context, years of residence in their current city was included in the analysis, measured by the question "Since what year do you live in your current city?" For the analysis, we constructed four categories (0-5 years, 6-15 years, 16-25 and 26 or more years).

Socioeconomic position was measured by the highest educational level attained, categorized into primary school, lower general secondary education, higher general secondary education and college or university. Employment status distinguishes the categories student, housewife or houseman, recipient of social benefits (disability, social assistance, unemployment), (early) pensioner and (self-)employed. Whether people experienced financial deprivation was measured by the question "Have you had difficulty in the past year to make ends meet with the household income?" with answers on a 4-point scale ranging from "great difficulty" to "no difficulty". It was categorized into two levels, by taking "great" and "some", and "almost no" and "no" together.

Neighbourhood social cohesion

The dataset on neighbourhood social cohesion was obtained from WoON 2009, a national survey among ~ 78,000 (response = 59%) randomly selected inhabitants of 18 years and older in the Netherlands (Ministry of Housing, Spatial Planning and Environment) [30]. At the individual-level, it was measured by five questions: “the people in my neighbourhood get along well with each other”, “I live in a close-knit neighbourhood with a lot of solidarity”, “I have a lot of contact with my direct neighbours”, “I have a lot of contact with other neighbours”, “In this neighbourhood, the people hardly know each other”. All questions were answered on a 5-point scale ranging from ”totally disagree” to “totally agree”. The codes of the latter question were reverse-coded. This scale was interpreted a continuous variable with a higher score reflecting a higher social cohesion.

We conceptualized social cohesion to be a neighbourhood construct. Commonly such measures are aggregated to a neighbourhood level by taking the mean of the items measured at the individuals living in the neighbourhoods. However, one of the major disadvantages of this method is that these variables are subject to individual perception. This perception is likely to be influenced by characteristics of the individual (e.g. gender, ethnicity, age). Another disadvantage is that by taking a simple mean value, the reliability of the aggregated measure differs between neighbourhoods, because it is likely that there are more respondents in one neighbourhood than in the other. Finally, the separate items that measure social cohesion are not independent of each other, but nested within individuals. Therefore, the response to one item is likely to be strongly associated with a response on another item. These disadvantages are circumvented by using the ecometrics method, as described by Raudenbush and Sampson [31-34]. This method accounts for the nesting of social cohesion items within individuals, who in turn are nested within the neighbourhoods. A three-level linear regression model was used in which the item scores were the outcome. So, each response to each question by each participant was a separate row in the dataset. A categorical variable, indicating these five social cohesion items was included as level 1 predictor (items nested within individuals and neighbourhoods). The model was adjusted for six level 2 predictors (individual variables nested within neighbourhoods) that may influence the perception of social cohesion: gender, ethnicity, age, education, type of housing the adolescent lives in and years living in the current home. The residuals at the neighbourhood level, which represent the deviations of the outcome scores at the neighbourhood level from the overall mean value at the neighbourhood level (and on which the neighbourhood variance in the model is based), form the part that cannot be attributed to individual response patterns. In other words, these values represent the social cohesion variable at the neighbourhood level that cannot be explained by individual response patterns. Positive values indicate higher than average levels of social cohesion.

Ecometrics also allows to assess the reliability of the social cohesion measure, using the variance at all levels (variance between neighbourhoods, between individuals and between items) [33]. In our study, the reliability, which has a similar interpretation as Cronbach's α was 0.66, which is considered acceptable [35]. For the analysis the neighbourhood social cohesion measure was dichotomized at the mean into high and low social cohesion.

Sensitivity analysis showed almost the same scores on mean psychological distress when another classification of neighbourhood social cohesion (the 33rd percentile versus the 66th percentile) was used.

Neighbourhood confounder

Neighbourhood deprivation was treated as a confounder since it was associated with psychological distress and neighbourhood social cohesion [36]. Hence, we controlled for neighbourhood deprivation to estimate the specific contribution of neighbourhood social cohesion effect to psychological distress. The scores on neighbourhood deprivation (2010) was obtained from The Netherlands Institute for Social Research (SCP), and were based on the average level of income, employment rate, and average level of education in each four digit postal code [37]. A higher score reflects a higher social disadvantage.

Data analysis

Descriptive statistics were used to show the distribution of individual-level factors and to describe the neighbourhood-level factors in the study sample (Table 1). Descriptive statistics of the outcome measure, psychological distress, and the percentage distribution of the variables in the sample were calculated using SPSS Complex Samples, weighting for gender, age and city district. Subsequently, to simultaneously examine individual-level and neighbourhood-level predictors with psychological distress, multilevel linear regression analysis was fitted [38]. We started with an intercepts-only model to test for significant variance in psychological distress between the neighbourhoods. Eight individual-level factors were added to test whether the variance could be accounted for by socio-demographic and socioeconomic factors. Neighbourhood deprivation and neighbourhood social cohesion were included in the model to test the association between neighbourhood social cohesion and psychological distress adjusted for neighbourhood deprivation. The associations of individual-level and neighbourhood level factors with psychological distress are presented in Table 1. All interactions between neighbourhood social cohesion and socio-demographic and socioeconomic factors in relation to psychological distress were tested. In case of significant interactions, combined factors were used in further analysis.

For each model, the intraclass correlation coefficient (ICC), representing the proportion of total variability in psychosocial distress that is attributable to the neighbourhoods, was calculated. These analyses are presented in Table 2. All analyses were performed in SPSS 19. Results were considered to be statistically significant at $p<0.05$.

RESULTS

Study sample

The study sample consisted of relatively high percentage women (56%), native Dutch (68%), married or living together (57%), persons with college or university education (32%), employees or self-employed (53%), persons without or with almost no financial difficulties (74%) and persons residing for more than 26 years in their city (50%) (Table 1).

The intercepts-only model shows that 97.13% of the random variation occurred at the individual-level and 2.87% at the neighbourhood-level (ICC = 2.87%). After adjusting for the differences between the socio-demographic and socioeconomic factors, the ICC decreased to 0.23%, suggesting that the differences in psychological distress between neighbourhoods were almost entirely attributable to the composition of the neighbourhoods.

Socio-demographic and socioeconomic factors and psychological distress

The mean level of psychological distress among urban residents was 17.2 (SD=7.0) (Table 1). Recipients of disability, social assistance or unemployment benefits reported higher psychological distress (β=5.6, 95%CI 5.2 to 5.9) than those in paid employment. Persons with some or great financial difficulties reported higher psychological distress (β=3.4, 95%CI 3.2 to 3.6) than those with little or no financial problems. Socio-demographic factors were also associated with psychological distress, albeit with much lower influence. Men reported lower psychological distress than women (β=-1.5, 95%CI -1.7 to -1.3). Compared to married couples or cohabitants, widowed persons reported higher psychological distress (β=1.4, 95%CI 1.0 to 1.7). Finally, first generation non-Western inhabitants reported higher psychological distress than Dutch inhabitants (β=1.0, 95%CI 0.7 to 1.3).

Neighbourhood social cohesion and psychological distress

Adjusted for socio-demographic and socioeconomic factors, and neighbourhood deprivation, residing in a neighbourhood with low social cohesion was significantly associated with higher psychological distress (β=0.3, 95%CI 0.0 to 0.5) (Table 1).

Table 1 Sample characteristics of 18,173 adults residing in neighbourhoods (n=211) in the four largest cities in the Netherlands in 2008 and their associations[b] with psychological distress

Neighbourhood level		**Mean**	**SD**	**Min.**	**Max.**
Neighbourhood deprivation		0.46	1.69	-2.95	5.24
Neighbourhood social cohesion		-0.20	0.19	-0.70	0.24

Individual level		**Mean**	**SD**	**Min.**	**Max.**
Psychological distress	Weighted[a]	17.16	6.97	10	50
Psychological distress	Unweighted	17.15	6.99	10	50

Multilevel regression results[f]		**Weighted[a] percent**	**Un-weighted percent**	**β[c]**	**(95%CI)**
Socioeconomic factors					
Education	Primary school	11.8%	15.0%	**1.56**	(1.22 to 1.89)
	Lower general secondary education	25.3%	28.7%	**0.39**	(0.13 to 0.66)
	Higher general secondary education	25.7%	24.2%	0.14	(-0.11 to 0.40)
	College, university	37.1%	32.1%	ref.	
Employment status	Student	9.1%	9.0%	-0.16	(-0.55 to 0.23)
	Housewife, houseman	6.7%	8.5%	**0.66**	(0.26 to 1.07)
	Recipients of benefits[d]	10.1%	10.2%	**5.59**	(5.24 to 5.94)
	(Early) retired	12.9%	19.0%	**0.95**	(0.53 to 1.37)
	(Self-)employed	61.3%	53.3%	ref.	
Financial deprivation	Great, some financial difficulty	28.1%	26.3%	**3.38**	(3.16 to 3.61)
	(Almost) no financial difficulty	71.9%	73.7%	ref.	
Socio-demographic factors					
Gender	Man	48.6%	43.8%	**-1.50**	(-1.69 to -1.30)
	Woman	51.4%	56.2%	ref.	
Age	16-34 years	34.8%	30.7%	**1.22**	(0.72 to 1.71)
	35-54 years	37.4%	30.8%	**1.21**	(0.76 to 1.65)
	55-64 years	13.7%	16.6%	**-0.43**	(-0.83 to -0.04)
	≥ 65 years	14.1%	21.9%	ref.	
Ethnic background	First generation non-Western	18.2%	16.7%	**1.00**	(0.71 to 1.28)
	Second generation non-Western	5.1%	4.5%	**0.92**	(0.43 to 1.40)
	Western	11.5%	10.8%	**0.53**	(0.23 to 0.83)
	Native Dutch	65.2%	68.0%	ref.	
Marital status	Widow, widower	4.8%	7.7%	**1.36**	(0.97 to 1.75)
	Divorced	8.4%	8.8%	**1.25**	(0.91 to 1.60)
	Unmarried, never been married	30.2%	26.8%	**0.72**	(0.47 to 0.97)
	Married, living together	56.6%	56.6%	ref.	
Years of residence in place	0-5 years	17.3%	15.6%	ref.	
	6-15 years	21.0%	18.2%	0.15	(-0.17 to 0.48)
	16-25 years	17.8%	16.2%	0.12	(-0.22 to 0.46)
	≥ 26 years	43.9%	50.0%	**0.42**	(0.09 to 0.74)

Table 1 Sample characteristics of 18,173 adults residing in neighbourhoods (n=211) in the four largest cities in the Netherlands in 2008 and their associations[b] with psychological distress (continued)

Multilevel regression results[f]		Weighted[a] percent	Un-weighted percent	β[c]	(95%CI)
Neighbourhood factors					
Neighbourhood deprivation[e]				0.07	(-0.04 to 0.19)
Neighbourhood social cohesion[e]	Low cohesion			**0.26**	(0.04 to 0.49)
	High cohesion			ref.	

CI = confidence interval.

[a] Calculated using SPSS Complex Samples, weighted for gender, age and city district.

[b] These results are based on multilevel regression analysis.

[c] Bold values are significant (p<0.05). Betas represent difference in mean psychological distress as compared to the reference category.

[d] Recipients of disability, social assistance or unemployment benefits.

[e] Neighbourhood deprivation is in z-score units (per 1 SD increase). Neighbourhood social cohesion is dichotomized at the mean into high and low social cohesion.

[f] Intraclass correlation (%): 0.15.

Interactions between neighbourhood social cohesion and socioeconomic factors

The interaction between neighbourhood social cohesion and financial deprivation was statistically significant (Table 2, Model 1). With persons without financial deprivation living in a neighbourhood with high social cohesion as reference, persons with financial deprivation living in a neighbourhood with low social cohesion were more at risk of psychological distress (β=3.7, 95% CI 3.4 to 4.0) than persons with financial deprivation living in a neighbourhood with high social cohesion (β=3.2, 95% CI 2.9 to 3.5).These results suggest that living in a neighbourhood with high social cohesion instead of low social cohesion was associated with a 13% (=(3.70-3.22)/3.70*100%) lower psychological distress among citizens with financial difficulties.

The interaction between neighbourhood social cohesion and employment status was also statistically significant (Table 2, Model 2). Compared to workers in paid employment living in a neighbourhood with high social cohesion, recipients of a benefit living in a neighbourhood with low social cohesion were more at risk of psychological distress (β=6.2, 95% CI 5.8 to 6.7) than recipients of a benefit living in a neighbourhood with high social cohesion (β=4.9, 95% CI 4.4 to 5.4). Thus, unemployed and disabled citizens in neighbourhoods with high social cohesion reported a 22% (=(6.25-4.89/6.25)*100%) lower psychological distress than those in neighbourhoods with low social cohesion.

The interactions between neighbourhood social cohesion and other individual-level factors in relation to psychological distress were non-significant (not shown).

Table 2 Multilevel regression analysis of psychological distress by interactions between neighbourhood social cohesion with financial deprivation (Model 1) and employment status (Model 2)

	Model 1		Model 2	
	β[b] (95%CI)		β[b] (95%CI)	
Constant	**14.05**	(13.50 to 14.61)	**14.03**	(13.47 to 14.59)
Neighbourhood factor				
Neighbourhood deprivation[a]	0.08	(-0.04 to 0.19)	0.08	(-0.04 to 0.19)
Interactions with financial deprivation				
low cohesion x financial deprivation	**3.70**	(3.38 to 4.02)		
high cohesion x financial deprivation	**3.22**	(2.90 to 3.54)		
low cohesion x no financial deprivation	0.18	(-0.07 to 0.43)		
high cohesion x no financial deprivation	ref.			
Interactions with employment status				
low cohesion x student			-0.15	(-0.67 to 0.37)
high cohesion x student			0.06	(-0.46 to 0.58)
low cohesion x housewife, houseman			**0.71**	(0.17 to 1.26)
high cohesion x housewife, houseman			**0.84**	(0.32 to 1.37)
low cohesion x recipients of benefits[c]			**6.25**	(5.79 to 6.70)
high cohesion x recipients of benefits[c]			**4.89**	(4.37 to 5.41)
low cohesion x (early) retired			**1.19**	(0.68 to 1.69)
high cohesion x (early) retired			**0.97**	(0.49 to 1.44)
low cohesion x (self-)employed			0.21	(-0.07 to 0.50)
high cohesion x (self-)employed			ref.	
Random parameters				
Variance neighbourhood level (estimates and s.e.)	0.06 (0.05)		0.06 (0.05)	
Intraclass correlation (%)	0.14		0.14	

CI = confidence interval.

[a] Neighbourhood deprivation is in z-score units (per 1 SD increase).

[b] Bold values are significant (p<0.05). Betas represent difference in mean psychological distress as compared to the reference category. In Model 1 is adjusted for gender, age, ethnicity, marital status, education, employment status and years of residence. In Model 2 is adjusted for gender, age, ethnicity, marital status, education, financial deprivation and years of residence.

[c] Recipients of disability, social assistance or unemployment benefits.

DISCUSSION

Main results

This study showed inequalities in psychological distress by employment status and levels of financial deprivation, with increased risks for unemployed and disabled persons and for those who experienced financial difficulties. Neighbourhood social cohesion modified the associations between financial deprivation or employment status and psychological distress. Living in a neighbourhood with a high level of social cohesion was associated with lower psychological distress among unemployed and disabled citizens and among citizens with financial difficulties. Findings from the current study contribute to knowledge how neighbourhood characteristics can moderate relationships between subgroups of the population and mental health. Whereas we observed almost no effect of neighbourhood social cohesion on psychological distress in the total population, there were strong differential effects within the population. People are influenced by their living environment and our findings showed that high neighbourhood social cohesion provided mental health benefits for the economically deprived groups by partly buffering the adverse effects of being poor and unemployed on mental health. Hence, future studies are encouraged to distinguish between overall influence of social cohesion on all citizens in a neighbourhood and differential influence of social cohesion on specific subgroups.

This study indicates that unemployed or disabled citizens and those who experienced financial difficulties have higher psychological distress if they reside in *less* cohesive neighbourhoods in the four largest cities of the Netherlands. In the introduction three different mechanisms for the impact of social cohesion on health were presented. Applied to our study, it is most likely that neighbourhood social cohesion buffered poor mental health of unemployed and disabled citizens, and citizens with financial difficulties directly by reducing levels of socioeconomic-related stress as a result of the existence of affective support. High neighbourhood social cohesion seems related to fewer daily stressors [39] and trust and mutual respect seem related to better health [40]. Further research is needed to empirically demonstrate a mediating role of support between neighbourhood social cohesion and mental health. Further, higher levels of neighbourhood social cohesion may protect mental health indirectly by promoting physical activity such as joint walk in a nearby park or in green surroundings, which is good for health [34, 41, 42].

High neighbourhood social cohesion did not significantly modify the associations between gender, age, ethnic background, marital status, education and, years of residence and psychological distress. One potential explanation is that the importance of the neighbourhood for those at higher risk of psychological distress for these factors is less than for those with a lower income, without a paid job or disabled. For example, younger adults

were at an increased risk of psychological distress, but the potential benefits of neighbourhood social cohesion are not used, as networks of friends outside the neighbourhood may be more important for them. Similarly, divorced and single persons may need to work to get an income, and as a result spend only little time in their neighbourhood. This would also explain that those without a paid job, and therefore potentially often in the neighbourhood benefit more from social cohesion as compared to those with a paid job. Indeed, in the Netherlands 19% of young persons (15-25 years), 17% of the singles and 16% of people with only primary education have no contact with their neighbours, compared with 12% of the total population. This percentage is even higher among non-Western immigrants, where 20% of this group have no contact with their neighbours [43]. So, neighbours who have no contact with each other do not expect any kind of support from each other. As a consequence, no social or financial support will be available to reduce mental health problems.

Comparison to other literature

Only few studies examined effect modification by neighbourhood social cohesion of the association between individual- or area-level factors and mental health. Our results are in line with the results of Fone et al. [21], who suggested that living within income deprived areas with more social cohesion in the United Kingdom was associated with better mental health than living within income deprived areas with less social cohesion. Contrary to our findings, Stafford et al. found that people living in deprived households or deprived neighbourhoods in England and Scotland were at an increased risk of common mental disorders in neighbourhoods with high levels of attachment compared with neighbourhoods with low levels of attachment [44]. The last result showed how the association between neighbourhood social cohesion and mental health might vary across population groups and that high neighbourhood social cohesion is not always beneficial for mental health or protect against mental health problems. On the other hand, Abada et al. could not demonstrate that living in racially mixed neighbourhoods with high social cohesion was associated with less depressive symptoms among adolescents in Canada [45].

Few studies have explored whether social cohesion modifies the association between individual-level factors and health or lifestyle outcomes. Cramm et al. showed that high neighbourhood social cohesion may act as buffer against the adverse effects of being poor on the well-being of older adults (70 years and older) in the Netherlands [46]. This result can be explained by the fact that the importance of the neighbourhood for older adults is more than for young and adults residents. In the Netherlands merely 8-9% of 65 years and older residents have no contact with their neighbours compared with 12% of the total population [43]. This suggests that older adults spend more time in their neighbourhood and are better

able to make use of potential benefits of neighbourhood social cohesion. Robinette et al. showed that high neighbourhood cohesion buffers the effects of daily stressors, include discrimination, on negative affect i.e. well-being among persons aged 30-84 years in the United States [39], while a study among Asian Americans found that high neighbourhood social cohesion was associated with lower odds of smoking among men, suggesting that social cohesion was protective against smoking under men [47]. Poortinga found that most of the indicators of bonding and bridging (i.e. social cohesion) and linking social capital were significantly positively related to self-rated health, but he found no support for the hypothesis that these three different aspects of social capital help buffer against the detrimental influences of neighbourhood deprivation on self-rated health in England [40]. It is possible that we can get the same conclusions, if we examine different aspect of social cohesion in relation to mental health. Investigations in the future should that prove.

Neighbourhood social cohesion as a function of neighbourhood change

When interpreting these results we must not forgot that neighbourhood environments are not static but subject to change over time. Some physical changes are consequences of revitalization and restructuring through local government. This may lead to displacement of lower income households in a neighbourhood by higher income households, known as the process of gentrification. In turn, gentrification can have positive and negative consequences such as deconcentration of poverty but also displacement of long-term inhabitants that can change social processes in a neighbourhood [48, 49]. Hence, neighbourhood social cohesion itself can be a function of neighbourhood change. Studies have shown that residential mobility seems to weaken the neighbourhood social cohesion [50, 51], which in turn may be associated with increased depressive symptoms [49]. This cross-sectional study cannot investigate these mechanisms.

Strengths and limitations

The use of multilevel regression analysis in a large sample of four major cities in the Netherlands allowed us to unravel the interactions of social cohesion with socio-demographic and socioeconomic factors above and beyond other individual-level factors. In addition, neighbourhood deprivation and social cohesion were derived from other sources than the questionnaire survey on individual factors and psychological distress, which prevents same-source bias. With regard to the construction of neighbourhood social cohesion, an ecometrics approach was used to arrive at neighbourhood level constructs from individual data [31, 33].

Some limitations need to be taken into account when interpreting the results. Our cross-sectional study prohibits causal inference. For example, unobserved confounders may

have resulted in biased estimates of neighbourhood deprivation and social cohesion. Noise pollution from traffic and neighbours or socially insecure and unsafe areas may have caused both a lower neighbourhood welfare, less social cohesion and higher levels of psychological distress. Exclusion of such factors may have resulted in an overestimation of the associations between neighbourhood deprivation or neighbourhood social cohesion and psychological distress. Further, while we included several factors that may influence allocation to living in deprived or affluent neighbourhoods, and to neighbourhoods with low and high social cohesion, persons living in such different neighbourhoods may differ in other respects, such as personality factors. Thus, we cannot entirely rule out an overestimation of the importance of neighbourhood deprivation and social cohesion. Yet, adjustment for education, employment status, ethnicity, marital status and financial deprivation may have tackled this problem already to a substantial amount. Further, selective migration may be responsible for some of the associations found. Depressed persons may have less energy to move away from more deprived neighbourhoods or from neighbourhoods with low social cohesion, and persons with less distress may more often move to more affluent and cohesive neighbourhoods. Previous research has shown, however, that health is a relatively marginal reason for moving to another address [52]. Another limitation is the dichotomization of neighbourhood social cohesion at the midpoint into low cohesion and high cohesion, which has led to loss of variation. However, the current approach facilitates direct comparison of the modification effect with other categorical determinants.

Interpretation and conclusions

Although the mental health of the inhabitants in the four largest cities in the Netherlands depends to a large extent on the socio-demographic and socioeconomic characteristics of individuals and for a small part of neighbourhood characteristics, subsequent analyses gave evidence that neighbourhoods with high social cohesion may partly buffer the adverse effects of low socioeconomic status on mental health. But, neighbourhood social cohesion does not affect us all equally. Living in neighbourhoods with high social cohesion may be more beneficial for persons in financial difficulties and for unemployed or disabled than other groups in relation to health. So, our study gives evidence that living in neighbourhoods rich in social cohesion is potentially of importance in protecting mental health of some socioeconomic vulnerable individuals. This could have implications for reducing depression among adults in urban cities. Although in the Netherlands, all citizens are assured of subsistence as a result of long-standing socio-economic policy, the economic position of citizens with a low socioeconomic status still requires attention. Policymakers need to be aware of the existence of financial disadvantaged groups who are at higher risk of depression as a result of residing in low social cohesion neighbourhoods. Hence, urban

policies should focus on improving social cohesion in low cohesive neighbourhoods and attention is needed for improving the economic position of financially disadvantaged groups in low cohesive neighbourhoods.

What is already known on this subject?

- Research has shown that neighbourhood social cohesion is an important characteristic of the social environment, but little research has examined its association with depression or psychological distress.
- Strong evidence for an inverse association between neighbourhood social cohesion and depression or psychological distress is still lacking.
- Especially, whether social cohesion modifies the association between individual-level factors and depression or psychological distress is understudied.

What this study adds?

- Neighbourhood social cohesion moderates the associations between financial deprivation or employment status and psychological distress.
- Living in a neighbourhood with a high instead of low social cohesion was associated with a lower psychological distress of 22% among unemployed and disabled citizens and of 13% among citizens with financial difficulties.
- Neighbourhood social cohesion does not affect all persons equally. It may partly buffer the adverse effects of low socioeconomic status on mental health.

REFERENCES

1 Kessler R, Aguilar-Gaxiola S, Alonso J*, et al.* Special articles. The global burden of mental disorders: an update from the WHO World Mental Health (WMH) surveys. *Epidemiologia e psichiatria sociale* 2009;18:23.

2 Paykel ES, Brugha T, Fryers T. Size and burden of depressive disorders in Europe. *European neuropsychopharmacology* 2005;15:411-23.

3 Cuijpers P, Smit F. Excess mortality in depression: a meta-analysis of community studies. *Journal of affective disorders* 2002;72:227-36.

4 Kruijshaar ME, Hoeymans N, Bijl RV*, et al.* Levels of disability in major depression: findings from the Netherlands Mental Health Survey and Incidence Study (NEMESIS). *Journal of affective disorders* 2003;77:53-64.

5 Reupert AE, Maybery DJ, Kowalenko NM. Children whose parents have a mental illness: prevalence, need and treatment. *Medical Journal of Australia* 2012;196:7.

6 Murray CJ, Vos T, Lozano R*, et al.* Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 2012;380:2197-223.

7 Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. *PLoS medicine* 2006;3:e442.

8 Cuijpers P, van Straten A, Smit F*, et al.* Preventing the onset of depressive disorders: a meta-analytic review of psychological interventions. *American Journal of Psychiatry* 2008;165:1272-80.

9 Lorant V, Deliege D, Eaton W*, et al.* Socioeconomic inequalities in depression: a meta-analysis. *American journal of epidemiology* 2003;157:98-112.

10 Peyrot WJ, Middeldorp CM, Jansen R*, et al.* Strong effects of environmental factors on prevalence and course of major depressive disorder are not moderated by 5-HTTLPR polymorphisms in a large Dutch sample. *Journal of affective disorders* 2013;146:91-9.

11 Fryers T, Melzer D, Jenkins R*, et al.* The distribution of the common mental disorders: social inequalities in Europe. *Clinical practice and epidemiology in mental health : CP & EMH* 2005;1:14.

12 Netherlands S. *De Nederlandse samenleving 2012 [Dutch Society 2012]*. Den Haag/Heerlen: Statistics Netherlands 2012.

13 Netherlands S. Health, lifestyle and medical contacts. 2008/2011.

14 Stansfeld S, Head J, Fuhrer R*, et al.* Social inequalities in depressive symptoms and physical functioning in the Whitehall II study: exploring a common cause explanation. *Journal of epidemiology and community health* 2003;57:361-7.

15 Kim D. Blues from the neighborhood? Neighborhood characteristics and depression. *Epidemiologic reviews* 2008;30:101-17.

16 Mair C, Diez Roux AV, Galea S. Are neighbourhood characteristics associated with depressive symptoms? A review of evidence. *Journal of epidemiology and community health* 2008;62:940-6, 8 p following 6.

17 Kawachi I, Berkman L. Social cohesion, social capital, and health. *Social epidemiology* 2000:174-90.

18 Ahern J, Galea S. Collective efficacy and major depression in urban neighborhoods. *American journal of epidemiology* 2011;173:1453-62.

19 Echeverria S, Diez-Roux AV, Shea S*, et al.* Associations of neighborhood problems and neighborhood social cohesion with mental health and health behaviors: the Multi-Ethnic Study of Atherosclerosis. *Health & place* 2008;14:853-65.

20 Rios R, Aiken LS, Zautra AJ. Neighborhood contexts and the mediating role of neighborhood social cohesion on health and psychological distress among Hispanic and non-Hispanic residents. *Annals of behavioral medicine : a publication of the Society of Behavioral Medicine* 2012;43:50-61.

21 Fone D, Dunstan F, Lloyd K*, et al.* Does social cohesion modify the association between area income deprivation and mental health? A multilevel analysis. *Int J Epidemiol* 2007;36:338-45.

22 Veelen Jv, van Dijk A, Ariëns G*, et al.* De G4 op gezondheid uitgemeten. *Over gezondheid en gezondheidsverschillen in de vier grote steden Den Haag: Gemeente Den Haag, dienst OCW* 2009.

23 Völker B, Flap H, Lindenberg S. When are neighbourhoods communities? Community in Dutch neighbourhoods. *European Sociological Review* 2007;23:99-114.

24 van Bergen AP, Hoff SJ, van Ameijden EJ*, et al.* Measuring Social Exclusion in Routine Public Health Surveys: Construction of a Multidimensional Instrument. *PloS one* 2014;9:e98680.

25 Andrews G, Slade T. Interpreting scores on the Kessler Psychological Distress Scale (K10). *Australian and New Zealand journal of public health* 2001;25:494-7.

26 Kessler RC, Andrews G, Colpe LJ*, et al.* Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychological medicine* 2002;32:959-76.

27 Kessler R, Mroczek D. Final versions of our non-specific psychological distress scale. *Memo dated March* 1994;10:1994.

28 Donker T, Comijs H, Cuijpers P*, et al.* The validity of the Dutch K10 and extended K10 screening scales for depressive and anxiety disorders. *Psychiatry Research* 2010;176:45-50.

29 Statistics Netherlands. Hoe doet het CBS dat nou? Standaarddefinitie allochtonen [How does Statistics Netherlands do this? Standard Definition Immigrants]. Voorburg: Statistics Netherlands 2000:24-5.

30 Bleije B, Hooimeijer P, van Hulle R*, et al.* Wonen overwogen. *De resultaten van het Woononderzoek Nederland* 2009.

31 Raudenbusch SW, Sampson RJ. Ecometrics: toward a science of assessing ecological settings, with application to the systematic social observation of neighborhoods. *Sociological Methodology* 1999;29:1-41.

32 Mujahid MS, Diez Roux AV, Morenoff JD*, et al.* Assessing the measurement properties of neighborhood scales: from psychometrics to ecometrics. *American journal of epidemiology* 2007;165:858-67.

33 Mohnen SM, Groenewegen PP, Volker B*, et al.* Neighborhood social capital and individual health. *Social science & medicine (1982)* 2011;72:660-7.

34 Prins RG, Mohnen SM, van Lenthe FJ*, et al.* Are neighbourhood social capital and availability of sports facilities related to sports participation among Dutch adolescents? *The international journal of behavioral nutrition and physical activity* 2012;9:90.

35 Hox JJ. *Multilevel analysis: Techniques and applications*. Mahwah, NJ: Lawrence Erlbaum Associates 2002.

36 Erdem O, Prins RG, Voorham TA*, et al.* Structural neighbourhood conditions, social cohesion and psychological distress in the Netherlands. *European journal of public health* 2015;25:995-1001.

37 Bijl R, Boelhouwer J, Pommer E*, et al. The social state of the Netherlands 2009*: Netherlands Institute for Social Research/SCP 2010.

38 Merlo J, Chaix B, Yang M*, et al.* A brief conceptual tutorial on multilevel analysis in social epidemiology: interpreting neighbourhood differences and the effect of neighbourhood characteristics on individual health. *Journal of epidemiology and community health* 2005;59:1022-9.

39 Robinette JW, Charles ST, Mogle JA*, et al.* Neighborhood cohesion and daily well-being: Results from a diary study. *Social Science & Medicine* 2013;96:174-82.

40 Poortinga W. Community resilience and health: The role of bonding, bridging, and linking aspects of social capital. *Health & place* 2012;18:286-95.

41 Hanson S, Jones A. Is there evidence that walking groups have health benefits? A systematic review and meta-analysis. *British Journal of Sports Medicine* 2015:bjsports-2014-094157.

42 Mohnen SM, Völker B, Flap H*, et al.* Health-related behavior as a mechanism behind the relationship between neighborhood social capital and individual health-a multilevel analysis. *BMC public health* 2012;12:116.

43 Netherlands S. Social contacts and social participation. 2012.

44 Stafford M, De Silva M, Stansfeld S*, et al.* Neighbourhood social capital and common mental disorder: testing the link in a general population sample. *Health & place* 2008;14:394-405.

45 Abada T, Hou F, Ram B. Racially mixed neighborhoods, perceived neighborhood social cohesion, and adolescent health in Canada. *Social science & medicine (1982)* 2007;65:2004-17.

46 Cramm JM, van Dijk HM, Nieboer AP. The importance of neighborhood social cohesion and social capital for the well being of older adults in the community. *The Gerontologist* 2013;53:142-52.

47 Kandula NR, Wen M, Jacobs EA*, et al.* Association between neighborhood context and smoking prevalence among Asian Americans. *American journal of public health* 2009;99:885.

48 Kennedy M, Leonard P. *Dealing with neighborhood change: A primer on gentrification and policy choices*: Brookings Institution Washington, DC 2001.

49 Mair C, Roux AD, Golden S*, et al.* Change in neighborhood environments and depressive symptoms in New York City: the multi-ethnic study of atherosclerosis. *Health & place* 2015;32:93-8.

50 Mennis J, Dayanim SL, Grunwald H. Neighborhood collective efficacy and dimensions of diversity: a multilevel analysis. *Environment and Planning A* 2013;45:2176-93.

51 Twigg L, Taylor J, Mohan J. Diversity or disadvantage? Putnam, Goodhart, ethnic heterogeneity, and collective efficacy. *Environment and planning A* 2010;42:1421.

52 van Lenthe FJ, Martikainen P, Mackenbach JP. Neighbourhood inequalities in health and health-related behaviour: results of selective migration? *Health & place* 2007;13:123-37.

CHAPTER 4

Ethnic inequalities in psychological distress among urban residents in the Netherlands: A moderating role of neighbourhood ethnic diversity?

Erdem, Ö., Burdorf, A., & Van Lenthe, F.J.

Health & place. 2017;46:175-182.

ABSTRACT

The main purpose of this study was to investigate whether neighbourhood ethnic diversity moderated the association between ethnicity and psychological distress in the four largest cities of Netherlands. Multilevel linear regression analysis was used to assess whether the association between ethnicity and psychological distress differed by levels of neighbourhood ethnic diversity. Results showed that the Turkish and Moroccan residents reported significantly higher psychological distress than native Dutch and Surinamese residents. In high ethnic diverse neighbourhoods Turkish residents reported significantly less psychological distress than in low ethnic diverse neighbourhoods. Ethnic diversity amplifies the risk of depression for some but not all ethnic minorities.

INTRODUCTION

Health inequalities between ethnic minority groups and natives in Western societies are consistently reported [1, 2]. In the Netherlands, more than 20% of the population is of non-Dutch origin, and this is about 50% in the major cities (e.g. Amsterdam and Rotterdam). The three largest ethnic minority groups are from Turkey, Morocco and Surinam and form 7% of the Dutch population. However, in the four major Dutch cities, they represent a substantial part of the population: 23% of the residents in Rotterdam, Amsterdam and The Hague and 16% in Utrecht [3]. Whereas the prevalence of poor self-reported health of Dutch natives is 15%, prevalences are substantially higher among Turks (45%), Moroccans (39%) and Surinamese (29%) [4].

Depressive disorders rank fourth in terms of diseases that cause the greatest burden of diseases in the Netherlands [5, 6]. Depression is more common among ethnic minorities than native Dutch. The 5-year risk of treatment for depression in a major city in the Netherlands was 4-5 times higher for Turks and Moroccans and about 2 times higher for Surinamese compared to native Dutch [7]. Similarly, the risk of antidepressant and antipsychotic drug prescriptions was higher for Turks and Moroccans in the Netherlands [8].

Research has linked depression to features of neighbourhood environment [9]. There are indications that the impact of the neighbourhood environment (e.g. neighbourhood problems, neighbourhood social cohesion) on depression is different across ethnic groups [10, 11]. Among the neighbourhood factors hypothesized to be related to mental health of ethnic minority groups is neighbourhood ethnic diversity. It has been suggested that ethnic diversity is associated with higher levels of social cohesion [12]. It has also been suggested that social cohesion will be reduced in ethnic diverse neighbourhoods [13], resulting in more mental health problems. In the short run, ethnic diversity may reduce social solidarity and social capital in neighbourhoods. In such neighbourhoods members of all ethnic minority groups tend to “hunker down”, whereby trust in other ethnic groups and even in own ethnic group is lower, the number of friends is lower and altruism and community cooperation rarer [13]. A recent review on neighbourhood ethnic diversity and its effects on social cohesion supports partly this view. Ethnic diversity only weakens intraneighbourhood social cohesion: people living in ethnically diverse neighbourhood are less likely to trust their neighbours or to have contact with them. Contrary, ethnic diversity is not related to less interethnic social cohesion [14]. These mechanisms may have detrimental effects on (mental) health. Adverse changes in neighbourhood environments (i.e. reduced social cohesion) may influence changes in depressive symptoms [15]. In addition, stressful social relations with neighbours and friends are associated with increased mortality risk [16].

However, our understanding of the interplay between ethnicity, ethnic diversity, and (mental) health is hampered by the variety of measures to depict ethnic diversity in neighbourhoods [17]. Most studies have used the “majority-minority” (i.e. segregation) approach, whereby diversity is measured by the proportion of individuals belonging to an ethnic group in a neighbourhood. Such a straightforward classification may be sufficient in situations where there is only one major and one minor group in a neighbourhood, but this is seldom the case. Often, ethnic groups are not dispersed completely across cities, and, thus, neighbourhoods tend to contain various ethnic groups. Hence, several studies have used more refined categories, such as percentage African American, Hispanic, or Asian residents in a neighbourhood [18]. Meanwhile, studies suggest that ethnic diversity in neighbourhoods is conceptually distinct from ethnic segregation, as described above. Measures of diversity need to reflect the complete diversity in ethnic composition within a neighbourhood [17, 19]. Budescu and Budescu (2012) suggested to use the “concentration index”, a complete measure of ethnic diversity that considers the distribution of several ethnic minority groups that compose the population in the neighbourhood. This measure is “sensitive to the relative proportion of each ethnic or racial group to the overall composition in a particular context” [17] and “captures both the number of ethnic minority groups in the neighbourhood as well as the relative representation of these groups” [20]. We treat ethnic diversity as the degree of ethnic heterogeneity within neighbourhoods. This is not the same as ethnic segregation or ethnic density which represent other aspects of ethnic composition of the neighbourhood.

This metric of neighbourhood ethnic diversity has been used to examine the association between neighbourhood ethnic diversity and mental health, such as maternal depressive symptoms [21], depressive symptoms or difficulties among adolescents [22, 23], psychoses [24], and child behavioural and emotional problems [20]. These studies provided some evidence that residing in a neighbourhood with a high ethnic diversity was associated with more mental health problems [20, 21, 24]. However, evidence on a moderating effect of neighbourhood ethnic diversity on the association between individual-level ethnicity and mental health has been equivocal to date. The main purpose of this study was to investigate (i) the association of ethnicity with psychological distress (an indicator for depression) in the multi-ethnic cities in the Netherlands and (ii) whether neighbourhood ethnic diversity moderates the association between ethnicity and psychological distress for the three largest ethnic minority groups.

METHODS

Data source and participants

We conducted secondary analysis on survey data (G4 Gezondheidsenquête 2008) gathered in 2008 among citizens aged 16 years and older in the four largest Dutch cities by the Public Health Services in Amsterdam, Rotterdam, The Hague and Utrecht [25]. The data includes information on physical and mental health, social well-being, lifestyle, health care use, socioeconomic status and demographics of the participants.

The survey was based on a random sample of 42,686 residents aged 16 years and older from four municipal population registers, stratified by city district and age. Respondents were asked to fill in a written or web-based questionnaire or to take part in a personal interview when having difficulties to complete the questionnaire. Extra effort was made to target vulnerable groups, i.e. older Turks and Moroccans with limited language skills and residents of neighbourhoods with a low response in previous surveys. Non-responders were contacted by telephone or visited at their home and were offered personal help to fill in the questionnaire in the language used by the respondent e.g. in Turkish or Arabic.

The overall response was 49% (n=20,877); 54% in Utrecht, 51% in The Hague, 50% in Amsterdam and 47% in Rotterdam. The response was higher among women than among men and increased with age. The response was highest among native Dutch (57%) and lowest among Moroccans (30%) [25].

Definition of a neighbourhood

In the Netherlands, neighbourhoods are areas with a reasonably similar type of buildings of same age, and often delineated by natural boundaries, which makes neighbourhoods relatively homogeneous socioculturally [26]. Previous research has shown that there is a sense of community within Dutch neighbourhoods [27]. In the Netherlands, neighbourhoods may be defined by the four digit postal code, which corresponds to the route of a postman. These four digit postal code areas are quite similar to neighbourhoods and often have well-established names to which people identify themselves. We defined neighbourhoods based on the four digit postal code. The respondents lived in one of 208 neighbourhoods (on average 86 respondents (SD: 63) per neighbourhood). In the Netherlands, there are about 4000 neighbourhoods. These areas comprise on average of approximately 4000 residents.

Ethical approval was not required as this study relied on secondary anonymized data collected in the context of performing statutory tasks (Public Health Act of the Netherlands), in strict accordance with the national standard [28]. Respondents were informed by letter that by filling out the questionnaire they gave permission for use of anonymous data for research aimed at improving population health in their place of residence. Respondents were

contacted through municipal health services and in the dataset available for research all identifying information has been removed. All research activities adhered to the regulations of the Dutch Code of Conduct for Medical Research [29].

Measures

Outcome measure: psychological distress

This study used psychological distress as an indicator of depression [30, 31], measured with the Kessler Psychological Distress Scale (K10). The K10 has been developed as a screening instrument for psychological distress in the general population [32]. The K10 discriminates Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) disorders from non-cases [31] and is strongly associated with the Composite International Diagnostic Interview (CIDI) diagnosis of anxiety and affective disorders [30]. In a recent Dutch study, the K10 proved to be reliable (Cronbach's: 0.94) and valid (area under the curve (*AUC:* 0.87)) in detecting any depressive disorders. At the cut-off of 20 points, sensitivity (0.80) and specificity (0.81) are sufficiently high to appreciate the K10 as appropriate screening instrument [33]. The K10 scale consists of 10 questions that measure a person's level of anxiety and depressive symptoms in the previous four weeks. The items included were: "Did you feel …1) tired out for no good reasons?", 2) nervous?", 3) so nervous that nothing could calm you down?", 4) hopeless?", 5) restless or fidgety?", 6) so restless that you could not sit still?", 7) depressed?", 8) that everything was an effort?", 9) so sad that nothing could cheer you up?" and 10) worthless?". Each item has five response categories "none of the time", "a little of the time", "some of the time", "most of the time" and "all of the time". Cronbach's alpha was 0.92, therefore a sum-score was calculated (range 10-50), with higher scores reflecting more psychological distress.

Definition of ethnic origin

Ethnic background of the respondents was determined by the country of birth of parents and the respondent, according to the standard definition of Statistics Netherlands [34]. If a citizen, or (one of) his or her parents, was born outside the Netherlands, this country of birth determined the ethnic background. If the parents were born in different foreign countries, the country of birth of the mother determined the ethnic background. Citizens who are Dutch-born and whose parents were also Dutch-born were considered native Dutch. We concentrated our analyses on respondents from Turkey, Morocco and Surinam, who are the three largest ethnic minority groups in the Netherlands and we limited our analyses to respondents who answered all questions required for the analyses, yielding a sample: Surinamese (n=1085), Turks (n=842) and Moroccans (n=669), and native Dutch (n=12,361). We did not include data on respondents from other ethnic minorities living in the Netherlands.

The main reason for this is that they are too diverse (for example, there are 169 nationalities living in Rotterdam) and only form a small part of the sample to analyse. Turks, Moroccans and Surinamese have a different migration history. Turkish and Moroccan young men initially came as labour migrants to the Netherlands from the early 1960s onwards, and later settled permanently with their families, while the migration of Surinamese is related to the colonial past with strongest migration to the Netherlands shortly before independence of Surinam, a country in South America, in 1975.

Neighbourhood ethnic diversity

As measure for neighbourhood ethnic diversity we used the concentration index [17, 35]. The index was computed based on information about the percentage of Turkish, Moroccans, Surinamese, other ethnic minority groups, Western and native Dutch residents, that was retrieved from Statistics Netherlands [36]. This distinction between six ethnic categories are commonly used in urban data registries. We used the following formula:

$$D_c = 1 - \sum_{i-1}^{g} p_i^2$$

where *(D_c)* is the level of neighbourhood ethnic diversity, *(p)* is the proportion of residents belonging to an ethnic minority group *(i)*, and *(g)* is the number of different ethnic minority groups in the neighbourhood. It can be interpreted as the probability that two randomly selected individuals from the same neighbourhood belong to different ethnic minority groups. The index ranging from 0 to 1, with 0 representing a neighbourhood in which every individual belongs to the same ethnic group and 1 representing a neighbourhood in which every individual belongs to a different ethnic group. Hence, higher scores reflect more ethnic diversity. For example, in a particular neighbourhood (i.e. Bloemhof in Rotterdam) with 29% native Dutch, 26% Turks, 10% Moroccans, 11% Surinamese, 5% Antillean, 12% other non-Western and 7% other Western the neighbourhood ethnic diversity score is 0.80. On the other hand, in another neighbourhood (i.e. Driemond in Amsterdam) with 86% native Dutch, 1% Turks, 3% Surinamese, 1% Antillean, 1% other non-Western and 8% other Western the neighbourhood ethnic diversity score is 0.25.

In the present study, the neighbourhood ethnic diversity score ranged from 0.15 to 0.84 and in line with previous studies we reclassified it into tertiles [20, 22]. The first category (low diversity) ranged from 0.15 to 0.51, the second category (medium diversity) from 0.52 to 0.69 and the third category (high diversity) from 0.70 to 0.84.

Neighbourhood and individual-level confounding

Neighbourhood socioeconomic status (SES) was used as a confounder since it was associated with mental health status and neighbourhood ethnic composition [18, 37]. Hence, we controlled for neighbourhood SES to estimate the specific contribution of neighbourhood ethnic diversity to psychological distress. The scores on neighbourhood SES was obtained from The Netherlands Institute for Social Research (SCP), and were based on the average level of income, employment rate, and average level of education at four digit postal codes in 2010 [38]. The scores were reclassified into tertiles in order to distinguish neighbourhoods with low, intermediate, and high SES.

The individual-level confounders gender, age, marital status, years of residence in their current city, education and employment status were derived from the questionnaires. Marital status was categorized into widow or widower, divorced, unmarried or never been married and married or living together. To adjust for the duration of exposure to neighbourhood context, years of residence in the city was included in the analysis, measured by the question "Since what year do you live in your current city?". For the analysis, we constructed four categories (0-5 years, 6-15 years, 16-25 and 26 or more years). Education was measured by the highest educational level attained, categorized into primary school, lower general secondary education, higher general secondary education and college or university. Employment status distinguishes the categories student, housewife or houseman, recipient of social benefits (disability, social assistance, unemployment), (early) pensioner and (self-)employed. Whether people experienced financial deprivation was measured by the question "Have you had difficulty in the past year to make ends meet with the household income?" with answers on a 4-point scale ranging from “great difficulty” to “no difficulty”. It was categorized into two levels, by taking “great” and “some”, and “almost no” and “no” together.

Data analysis

Descriptive statistics were used to show the distribution of individual-level factors in the study sample (table 1). The proportions of the three major ethnic groups and native Dutch were calculated in neighbourhoods with low, medium and high ethnic diversity (table 2). Pearson correlations were calculated to show the associations between neighbourhood ethnic diversity and the percentages of ethnic minority groups. Differences in psychological distress were depicted between the three major ethnic groups and native Dutch in neighbourhoods with low, medium and high ethnic diversity (figure 1).

Subsequently, multilevel linear regression analysis was fitted to examine the association between individual-level ethnicity and the moderating role of neighbourhood ethnic diversity (table 3). We started with an intercepts-only model to test for significant

variance in psychological distress between the neighbourhoods. We built our model step by step by introducing the main effects of ethnicity and neighbourhood ethnic diversity. Model 1 investigated the association between ethnicity and psychological distress adjusted for individual-level factors. Model 2 tested the association between neighbourhood ethnic diversity and psychological distress above and beyond the individual-level factors, including ethnicity. Model 3 then investigated the influence of neighbourhood SES on the association between neighbourhood ethnic diversity and psychological distress, adjusted for individual-level factors and ethnicity, because studies have shown that neighbourhood SES was associated with mental health status and neighbourhood ethnic composition [18, 37].

Finally, in table 4 we investigated whether neighbourhood ethnic diversity moderated the association with psychological distress for the three largest ethnic minority groups. All analyses were performed in SPSS 19. Results were considered to be statistically significant at $p < 0.05$.

RESULTS

The study sample consisted of relatively more women (56%), persons below the age of 55 years (60%), native Dutch (83%), married or living together (58%), persons with college or university education (32%), employees or self-employed (53%), persons without or with almost no financial difficulties (75%) and persons residing for more than 26 years in their city (53%) (table 1).

Table 1 Sample characteristics of 14,957 adults residing in the four largest cities in the Netherlands in 2008

		N	Percent	Mean	S.D.	Min.	Max.
Psychological distress		14,957	100	17.1	7.0	10	50
Gender	Man	6,588	44.0				
	Woman	8,369	56.0				
Age	16-34 years	4,487	30.0				
	35-54 years	4,511	30.2				
	55-64 years	2,484	16.6				
	≥ 65 years	3,475	23.2				
Ethnic background	Turks	842	5.6				
	Moroccans	669	4.5				
	Surinamese	1,085	7.3				
	Native Dutch	12,361	82.6				
Marital status	Widow or widower	1,202	8.0				
	Divorced	1,243	8.3				
	Unmarried or never been married	3,908	26.1				
	Married or living together	8,604	57.5				
Education	Primary school	2,244	15.0				
	Lower general secondary education	4,449	29.7				
	Higher general secondary education	3,553	23.8				
	College, university	4,711	31.5				
Employment status	Student, housewife, houseman	2,597	17.4				
	Unemployed, disabled	1,411	9.4				
	(Early) retired	3,022	20.2				
	(Self-)employed	7,927	53.0				
Financial deprivation	Great, some financial difficulty	3,767	25.2				
	(Almost) no financial difficulty	11,190	74.8				
Years of residence in city	0-5 years	2,109	14.1				
	6-15 years	2,497	16.7				
	16-25 years	2,366	15.8				
	≥ 26 years	7,985	53.4				

Neighbourhood ethnic diversity and the proportions of ethnic minority groups

The proportions of the three major ethnic groups and native Dutch in neighbourhoods within the lowest, medium and highest tertile of ethnic diversity are presented in table 2. The average percentage of Turks, Moroccans and Surinamese in neighbourhoods is higher with increasing ethnic diversity in the neighbourhoods (ranges between 1% and 14%), but they are not the main group in distinct neighbourhoods. Native Dutch are always the largest group in any neighbourhood in the Netherlands, although their average percentage goes down (ranges between 77% and 35%) with increasing ethnic diversity in the neighbourhoods. Comparable patterns were observed for Rotterdam, Den Haag, Utrecht, and Amsterdam.

The percentage of native Dutch was significantly negatively correlated with the percentage of Turks (r=-0.82, p<0.001), Moroccans (r=-0.72, p<0.001) and Surinamese (r=-0.74, p<0.001). Neighbourhood ethnic diversity was significantly positively related to the percentage of Turks (r=0.74, p<0.001), Moroccans (r=0.70, p<0.001) and Surinamese (r=0.67, p<0.001), and was significantly negatively correlated with the percentage of native Dutch (r=-0.95, p<0.001).

Table 2 Proportion of the three major ethnic groups and native Dutch in neighbourhoods within the lowest, medium and highest tertile of ethnic diversity in the four largest cities in the Netherlands in 2008

	Low diversity			**Medium diversity**			**High diversity**		
	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.
Turks	1.2	0.0	6.0	3.4	0.0	9.1	12.5	0.7	32.0
Moroccans	1.8	0.0	8.9	5.1	0.0	32.1	13.8	1.5	35.2
Surinamese	2.8	0.0	8.9	6.0	0.9	16.5	12.6	2.4	39.9
Native Dutch	76.5	64.3	91.8	60.8	44.8	68.7	35.4	9.6	51.9

Ethnic minority groups, neighbourhood ethnic diversity, and psychological distress

The intercepts-only model shows that 96.5% of the random variation occurred at the individual-level and 3.5% at the neighbourhood-level: Intraclass correlation (ICC)=3.5%. After adjusting for individual-level factors in table 3 Model 1, the ICC decreased to 0.16%, suggesting that the differences in psychological distress between neighbourhoods were almost entirely attributable to the composition of the neighbourhoods.

The associations of individual ethnicity and neighbourhood ethnic diversity with psychological distress are presented in table 3. In model 1, adjusted for individual-level factors (gender, age, marital status, education, employment status, financial difficulties and years of residence), the Turkish (β: 3.68, 95%CI 3.21-4.15) and Moroccan (β: 2.01, 95%CI 1.50-2.52) residents reported higher psychological distress than native Dutch residents. In model 2, adjusted for individual-level factors and ethnicity, living in high ethnically diverse neighbourhoods was significantly associated with higher psychological distress (β: 0.35, 95%CI 0.07-0.63) compared to living in low ethnically diverse neighbourhoods. In the fully-adjusted model (model 3) including individual-level factors, ethnicity and neighbourhood SES, the association between high neighbourhood ethnic diversity and psychological distress reduced by 9% and was no longer significant (β: 0.32, 95%CI -0.04-0.67).

Table 3 Multilevel regression analysis of psychological distress by neighbourhood ethnic diversity and ethnicity[c] (N=14,957 individuals and N=208 neighbourhoods)

	Model 1			Model 2			Model 3		
	β[a]	(95%CI)[b]		β[a]	(95%CI)[b]		β[a]	(95%CI)[b]	
Intercept	**14.89**	14.33	15.45	**14.72**	14.14	15.31	**14.71**	14.13	15.30
Individual-level									
Ethnicity									
Turks	**3.68**	3.21	4.15	**3.56**	3.08	4.04	**3.56**	3.08	4.04
Moroccans	**2.01**	1.50	2.52	**1.90**	1.38	2.42	**1.89**	1.37	2.42
Surinamese	0.30	-0.10	0.70	0.21	-0.20	0.61	0.21	-0.20	0.61
Native Dutch	ref.			ref.			ref.		
Neighbourhood-level									
Neighbourhood ethnic diversity (tertiles)									
Low				ref.			ref.		
Medium				0.17	-0.09	0.44	0.17	-0.10	0.44
High				**0.35**	0.07	0.63	0.32	-0.04	0.67
Neighbourhood SES (tertiles)									
Low							0.05	-0.31	0.41
Medium							0.04	-0.24	0.32
High							ref.		
Random effects									
ICC (%)	0.16			0.15			0.15		

[a] Bold values are significant (p<0.05); Beta represents difference in mean psychological distress relative to reference category.

[b] CI=Confidence Interval.

[c] All models are adjusted for individual-level factors: gender, age, marital status, education, employment status, financial difficulties and years of residence.

Figure 1 shows the mean psychological distress score for the ethnic minority groups and Dutch natives stratified by neighbourhood ethnic diversity (in tertiles). A clear pattern was found among the native Dutch and Surinamese residents where an upward trend in psychological distress scores was observed with increasing neighbourhood ethnic diversity. Mean psychological distress scores among Turkish and Moroccan residents were higher than those of native Dutch and Surinamese residents. In addition, among Turkish residents, the mean psychological distress score was higher in neighbourhoods with low diversity than in neighbourhoods with medium or high diversity.

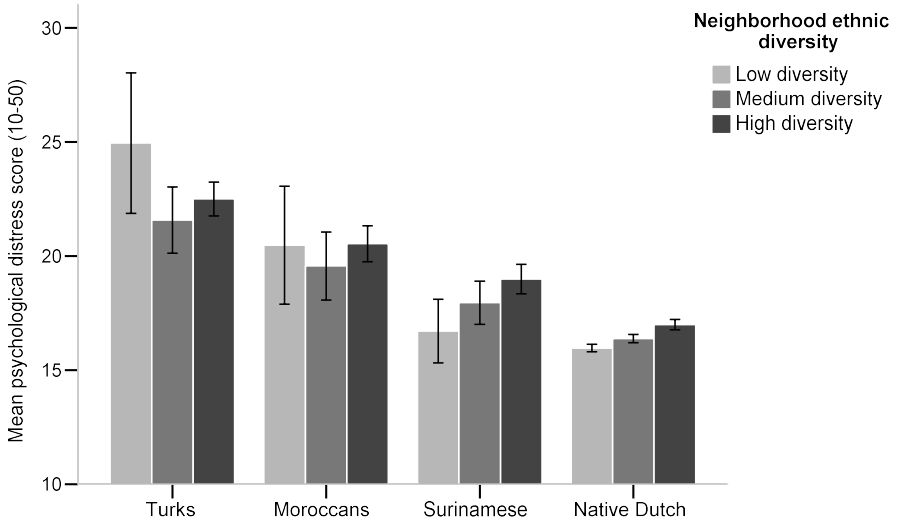


Figure 1 Psychological distress score by ethnicity stratified by neighbourhood ethnic diversity, with 95% CI

Moderation by neighbourhood ethnic diversity

Table 4 shows the associations between ethnic minority groups and psychological distress, stratified by neighbourhood ethnic diversity, adjusted for individual-level factors and neighbourhood SES. Compared to the native Dutch residing in low ethnic diversity neighbourhoods, Turkish residents in low ethnic diversity neighbourhoods (β: 6.23, 95%CI 4.43-8.03) reported higher psychological distress than Turkish residents in medium (β: 3.61, 95%CI 2.60-4.61) or in high ethnic diversity neighbourhoods (β: 3.75, 95%CI 3.15-4.34). Moroccan residents reported higher psychological distress irrespectively of the level of neighbourhood diversity, compared to the native Dutch residing in low ethnic diversity neighbourhoods. Among Surinamese respondents only those residing in high ethnic diversity neighbourhoods reported higher psychological distress.

Table 4 Multilevel regression of psychological distress by ethnicity stratified by low, medium and high neighbourhood ethnic diversity[c] (tertiles)

	Low diversity			Medium diversity			High diversity		
	β[a]	(95%CI)[b]		β[a]	(95%CI)[b]		β[a]	(95%CI)[b]	
Turks	**6.23**	4.43	8.03	**3.61**	2.60	4.61	**3.75**	3.15	4.34
Moroccans	**2.07**	0.31	3.84	**1.31**	0.26	2.36	**2.45**	1.79	3.11
Surinamese	0.09	-1.06	1.25	0.32	-0.43	1.07	**0.61**	0.05	1.17
Native Dutch	ref.			0.23	-0.05	0.51	0.33	-0.03	0.70

[a] Bold values are significant (p<0.05); Beta represents difference in mean psychological distress relative to reference category.

[b] CI=Confidence Interval.

[c] All estimates are adjusted for gender, age, marital status, education, employment status, financial difficulties, years of residence and neighbourhood SES.

DISCUSSION

This study showed that ethnicity was significantly associated with psychological distress among adults (aged 16 years and older) in the four largest cities in the Netherlands. Turkish and Moroccan residents reported higher psychological distress than native Dutch residents and Surinamese residents. Our results demonstrated heterogeneity in the associations between ethnicity and psychological distress by neighbourhood ethnic diversity. Although we found that residing in a high ethnic diversity neighbourhood was associated with more psychological distress among all participating residents, the moderation analysis showed that Turkish residents in high ethnic diverse neighbourhoods reported less psychological distress than Turkish residents in low ethnic diverse neighbourhoods. This moderating effect was not observed for other ethnic minorities.

Methodological considerations

Following the suggestion of Budescu and Budescu we used as measure of ethnic diversity the “concentration index”. This measure, also known as the Racial Diversity Index [20], the Simpson Diversity Index [39], or the Herfindahl Index [40], has a simple interpretation: it is the probability that two randomly selected individuals from the same neighbourhood do have a different ethnicity. The index captures the complete ethnic diversity in a neighbourhood. In major Dutch cities, where various ethnic minority groups live together, measuring diversity by using the proportion of a single ethnic group will neglect the existence of other ethnic minority groups. Hence, in our context, the majority-minority approach would have been insensitive to the ethnic background of non-Turks or non-Moroccans residents in the neighbourhood and would have failed to capture the full meaning of diversity.

A strength of this study is the use of multilevel modelling in a large sample of four major cities in the Netherlands, allowing us to explore associations between neighbourhood ethnic diversity and psychological distress and to unravel the interactions between ethnicity and neighbourhood ethnic diversity. It is important to note that in studies on ethnic density (i.e. the proportion of people of the same ethnic minority group in a neighbourhood), levels and distribution of ethnic density across neighbourhoods are of great importance to detect associations. A systematic review on ethnic density effects on physical morbidity, mortality and health behaviours found that most studies among ethnic minorities in the United Kingdom reported null associations between ethnic density and health, which is likely the result of low levels of ethnic density in surveys (the highest category of ethnic density was often categorized as 30%) and smaller samples of ethnic minority groups [41]. This may have also been true for the ethnic density study on psychological distress in the Netherlands [42], in which ethnic density was not associated with psychological distress in any of the three ethnic minority groups (Turks, Moroccans and Surinamese). The ethnic density studies with smaller sample sizes (<500) tend to report null associations, while those with greater sample size (>4000) report protective ethnic density effects [41, 43]. Hence, studies with smaller samples of ethnic minorities and a limited range in ethnic density have limited statistical power to detect meaningful associations. However, because the diversity index considers the distribution of all ethnic minority groups that compose the population in the neighbourhood, it has less problems of this kind of methodological limitations to detect meaningful associations.

Some limitations need to be taken into account when interpreting the results. Firstly, this is a cross-sectional study, and as such limits causal inference. For example, unobserved confounders may have resulted in biased estimates of neighbourhood SES, neighbourhood ethnic composition, and ethnicity. Low rental rates, poorly maintained houses or ethnic discrimination may have caused both a lower neighbourhood welfare, ethnically homogeneous neighbourhoods and higher levels of psychological distress. Exclusion of such factors may have resulted in an overestimation of the associations between neighbourhood ethnic diversity and psychological distress. Further, while we included several factors that may influence allocation to living in deprived or affluent neighbourhoods, and ethnically homogenous or heterogeneous neighbourhoods, persons living in such different neighbourhoods may differ in other respects, such as personality factors (e.g. neuroticism, extraversion and conscientiousness) which is linked to depression [44]. Thus, we cannot entirely rule out an overestimation of the importance of neighbourhood SES and neighbourhood ethnic composition. Yet, adjustment for education, employment status, financial deprivation and marital status may have tackled this problem already to a substantial amount.

Secondly, selective migration may be responsible for some of the associations. This plays a role when people want to move to neighbourhoods with a specific ethnic composition and this relocation depends on health-related factors. For example, unhealthy persons may more often move to neighbourhoods with a specific ethnic composition for contact with family, friends and compatriots, and because of ethnic health services (e.g. nursing home with attention to ethnic differences or a family doctor who speaks the same language). Previous research has shown, however, that health is a relatively marginal reason for moving to another address [45].

Thirdly, despite extensive efforts to include ethnic minorities and those with a lower socioeconomic position, participation was low in the survey. While the total response was 49%, the response was highest among native Dutch (57%) and lowest among Moroccans (30%) [25]. To the extent that the response was highest among persons with few depressive symptoms, this may have led to an underestimation of the impact of ethnic minority status on psychological distress. On the other hand, we expect this effect to be small, because the distribution of ethnic minority groups in the study sample deviates only slightly from the distribution in the population [25].

Fourthly, the existence and strength of neighbourhood effects on mental health may be spatial scale dependent [40, 46]. We defined neighbourhoods based on the four digit postal code. To the extent, however, that experiences of discrimination and social support operate at smaller spatial scales, we may have underestimated the association between neighbourhood diversity and psychological distress. This may also have affected the moderating role of ethnic diversity.

Fifthly, to adjust for the duration of exposure to neighbourhood context, years of residence in the city was included in the analysis. We consider this as a proxy-measure since years of residence in the neighbourhood was not measured.

A final limitation may be the categorization of neighbourhood ethnic diversity index into tertiles, which has led to loss of variation. However, the current approach is in line with other studies [20] and facilitates direct comparison of the modification effect with ethnic minority groups.

Comparison with previous studies

As far as we know, there are only three studies that have examined the moderating effect of neighbourhood ethnic diversity on the association between individual-level ethnicity and mental health [20, 22, 24]. In a study on behavioural and emotional problems in 3 year olds in Rotterdam, the Netherlands, ethnic inequalities between Dutch and non-Dutch children were greatest in low diversity neighbourhoods, slightly smaller in high diversity neighbourhoods and smallest in medium diversity neighbourhoods [20]. By contrast, in a

study on psychotic disorders in a major city (The Hague), in the Netherlands, ethnic inequalities in developing a psychotic disorder did not depend on ethnic diversity [24]. Similarly, in a study in UK, ethnic inequalities in the psychological well-being among adolescents did not depend on ethnic diversity [22]. The results of our study may differ from the previous studies due to the use of different ethnic groups (Turks, Moroccans and Surinamese versus Indian, Pakistani and Bangladeshi), age groups (adults versus children) and mental health outcomes (psychological distress versus behavioural and emotional problems).

Meaning of findings

This study showed that neighbourhood ethnic diversity is important for understanding ethnic inequalities in depression in an urban context. Several mechanisms support our findings that mental health for Turkish residents in high ethnic diversity neighbourhoods was better than for Turkish residents residing in low ethnic diversity neighbourhoods. A reason may be that members of ethnic minorities are more often surrounded by members of their own ethnicity in more diverse neighbourhoods. In our study population, on average, 13% of Turks and Surinamese and 14% of Moroccans live in high ethnic diversity neighbourhoods against respectively 1%, 3% and 2% in low ethnic diversity neighbourhoods (table 2). This mechanism is similar as the one given for the association between ethnic density and mental health [43]. In high ethnic density neighbourhoods mental health benefits may be derived from mitigated discrimination and enhanced social support. Ethnic minorities who live in areas of high ethnic density experience less prejudice and discrimination [47, 48] and have higher social support that may explains partly the association with mental health [49, 50]. These are the same pathways through which ethnic diversity may also exerting an influence on mental health of ethnic minorities. Indeed, a recent study in the Netherlands showed that Turks (37%) and Moroccans (41%) reported the lowest rates of discrimination (personal experience of discrimination: occasionally-(very) often), while Surinamese the highest rates (47%). On the other hand, the own-group social interaction in leisure time was highest among Turks (67%), lowest among Surinamese (34%), while Moroccans took middle position (57%). Further, among Turks the “best friend” was most often from their own-group (90%). This percentage was lower among Moroccans (75%) and Surinamese (55%) [42, 51]. Although the latter two indicators do not directly measure social support, they give an indication about the ethnicity of the persons with whom people like to interact. So, it is plausible that in time of need they will ask their best friends for support.

Conclusion

We found ethnic inequalities in mental health among adult residents in the four major cities of the Netherlands. Compared to native Dutch, Turkish and Moroccans residents reported higher psychological distress. Although the mental health of the residents in high ethnic diverse neighbourhoods was worse than those in low ethnic diverse neighbourhoods, subsequent analyses provided evidence that Turkish residents respond differently to ethnic diversity than Surinamese and Moroccans residents. Turkish residents in high ethnic diverse neighbourhoods reported less psychological distress than Turkish residents in low ethnic diverse neighbourhoods. This moderation effect was not observed for other ethnic minorities. Policymakers need to be aware of the existence of urban residents who are at higher risk of depression as a result of residing in high ethnic diverse neighbourhoods. However, this is not a general rule. We showed that Turkish residents in low ethnic diverse neighbourhoods are at higher risk of depression than Turkish residents in medium and high ethnic diverse neighbourhoods. Future studies should investigate why Turkish residents respond differently to ethnic diversity than Surinamese and Moroccans residents. In addition, policymakers need to be aware of an increase in depression in general population: based on demographics trends, it is expected that the number of doctor diagnoses of depression will increase by 6% between 2011 and 2030 in the Netherlands [52].

What this study adds?

- Studies suggested that living in high ethnic diverse neighbourhoods was linked to more mental health problems.
- But, the moderating effect on the association between ethnicity and mental health has been equivocal to date.
- Living in high ethnic diverse neighbourhoods is linked to better mental health in Turkish residents.
- Ethnic diversity seems to have ethnic-specific effects on mental health.

REFERENCES

1 Kobayashi KM, Prus S, Lin Z. Ethnic differences in self-rated and functional health: does immigrant status matter? *Ethnicity and Health* 2008;13:129-47.

2 Nielsen SS, Krasnik A. Poorer self-perceived health among migrants and ethnic minorities versus the majority population in Europe: a systematic review. *International journal of public health* 2010;55:357-71.

3 CBS. Regional core statistics the Netherlands. Statistics Netherlands 2013.

4 Devillé W, Uiters E, Westert G*, et al.* Perceived health and consultation of GPs among ethnic minorities compared to the general population in the Netherlands. *Morbidity, performance and quality in primary care: Dutch general practice on stage Oxxon: Radcliffe Publishing* 2006;85:96.

5 Murray CJ, Vos T, Lozano R*, et al.* Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 2012;380:2197-223.

6 RIVM. Global Burden of Disease. National Institute of Public Health and the Environment 2007.

7 Selten J, Laan W, Kupka R*, et al.* Risk of psychiatric treatment for mood disorders and psychotic disorders among migrants and Dutch nationals in Utrecht, The Netherlands. *Social psychiatry and psychiatric epidemiology* 2012;47:271-8.

8 Wittkampf LC, Smeets HM, Knol MJ*, et al.* Differences in psychotropic drug prescriptions among ethnic groups in the Netherlands. *Social psychiatry and psychiatric epidemiology* 2010;45:819-26.

9 Mair C, Diez Roux AV, Galea S. Are neighbourhood characteristics associated with depressive symptoms? A review of evidence. *Journal of epidemiology and community health* 2008;62:940-6, 8 p following 6.

10 Echeverria S, Diez-Roux AV, Shea S*, et al.* Associations of neighborhood problems and neighborhood social cohesion with mental health and health behaviors: the Multi-Ethnic Study of Atherosclerosis. *Health & place* 2008;14:853-65.

11 Gary TL, Stark SA, LaVeist TA. Neighborhood characteristics and mental health among African Americans and whites living in a racially integrated urban community. *Health & place* 2007;13:569-75.

12 Bécares L, Stafford M, Laurence J*, et al.* Composition, concentration and deprivation: exploring their association with social cohesion among different ethnic groups in the UK. *Urban Studies* 2011;48:2771-87.

13 Putnam RD. E pluribus unum: Diversity and community in the twenty-first century the 2006 Johan Skytte Prize Lecture. *Scandinavian political studies* 2007;30:137-74.

14 Meer Tvd, Tolsma J. Ethnic diversity and its effects on social cohesion. *Annual Review of Sociology* 2014;40:459-78.

15 Mair C, Roux AD, Golden S*, et al.* Change in neighborhood environments and depressive symptoms in New York City: the multi-ethnic study of atherosclerosis. *Health & place* 2015;32:93-8.

16 Lund R, Christensen U, Nilsson CJ*, et al.* Stressful social relations and mortality: a prospective cohort study. *Journal of epidemiology and community health* 2014;68:720-7.

17 Budescu DV, Budescu M. How to measure diversity when you must. *Psychological methods* 2012;17:215.

18 Mair C, Roux AVD, Osypuk TL*, et al.* Is neighborhood racial/ethnic composition associated with depressive symptoms? The multi-ethnic study of atherosclerosis. *Social Science & Medicine* 2010;71:541-50.

19 Eastwood JG, Kemp LA, Jalaludin BB*, et al.* Neighborhood adversity, ethnic diversity, and weak social cohesion and social networks predict high rates of maternal depressive symptoms: a critical realist ecological study in South Western Sydney, Australia. *International Journal of Health Services* 2013;43:241-66.

20 Flink IJ, Prins RG, Mackenbach JJ*, et al.* Neighborhood ethnic diversity and behavioral and emotional problems in 3 year olds: results from the Generation R study. *PloS one* 2013;8:e70070.

21 Eastwood JG, Jalaludin BB, Kemp LA*, et al.* Bayesian hierarchical spatial regression of maternal depressive symptoms in South Western Sydney, Australia. *SpringerPlus* 2014;3:55.

22 Astell-Burt T, Maynard MJ, Lenguerrand E*, et al.* Racism, ethnic density and psychological well-being through adolescence: evidence from the Determinants of Adolescent Social well-being and Health longitudinal study. *Ethnicity & health* 2012;17:71-87.

23 Seaton EK, Yip T. School and neighborhood contexts, perceptions of racial discrimination, and psychological well-being among African American adolescents. *Journal of Youth and Adolescence* 2009;38:153-63.

24 Veling W, Susser E, Selten J-P*, et al.* Social disorganization of neighborhoods and incidence of psychotic disorders: a 7-year first-contact incidence study. *Psychological medicine* 2015;45:1789-98.

25 Veelen Jv, van Dijk A, Ariëns G*, et al.* De G4 op gezondheid uitgemeten. *Over gezondheid en gezondheidsverschillen in de vier grote steden Den Haag: Gemeente Den Haag, dienst OCW* 2009.

26 Reijneveld SA, Verheij RA, de Bakker DH. The impact of area deprivation on differences in health: does the choice of the geographical classification matter? *Journal of epidemiology and community health* 2000;54:306-13.

27 Völker B, Flap H, Lindenberg S. When are neighbourhoods communities? Community in Dutch neighbourhoods. *European Sociological Review* 2007;23:99-114.

28 van Bergen AP, Hoff SJ, van Ameijden EJ*, et al.* Measuring Social Exclusion in Routine Public Health Surveys: Construction of a Multidimensional Instrument. *PloS one* 2014;9:e98680.

29 FEDERA. Code of conduct for medical research. 2012.

30 Andrews G, Slade T. Interpreting scores on the Kessler Psychological Distress Scale (K10). *Australian and New Zealand journal of public health* 2001;25:494-7.

31 Kessler RC, Andrews G, Colpe LJ*, et al.* Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychological medicine* 2002;32:959-76.

32 Kessler R, Mroczek D. Final versions of our non-specific psychological distress scale. *Memo dated March* 1994;10:1994.

33 Donker T, Comijs H, Cuijpers P*, et al.* The validity of the Dutch K10 and extended K10 screening scales for depressive and anxiety disorders. *Psychiatry Research* 2010;176:45-50.

34 Statistics Netherlands. Hoe doet het CBS dat nou? Standaarddefinitie allochtonen [How does Statistics Netherlands do this? Standard Definition Immigrants]. Voorburg: Statistics Netherlands 2000:24-5.

35 Sturgis P, Brunton-Smith I, Kuha J*, et al.* Ethnic diversity, segregation and the social cohesion of neighbourhoods in London. *Ethnic and Racial Studies* 2014;37:1286-309.

36 CBS. Core statistics neighborhoods 2004-2008. Statistics Netherlands 2008.

37 Bécares L, Nazroo J, Jackson J. Ethnic Density and Depressive Symptoms Among African Americans: Threshold and Differential Effects Across Social and Demographic Subgroups. *American journal of public health* 2014;104:2334-41.

38 Bijl R, Boelhouwer J, Pommer E*, et al. The social state of the Netherlands 2009*: Netherlands Institute for Social Research/SCP 2010.

39 Munniksma A, Scheepers P, Stark TH*, et al.* The Impact of Adolescents' Classroom and Neighborhood Ethnic Diversity on Same-and Cross-Ethnic Friendships Within Classrooms. *Journal of Research on Adolescence* 2016.

40 Veldhuizen EM, Musterd S, Dijkshoorn H*, et al.* Association between Self-Rated Health and the Ethnic Composition of the Residential Environment of Six Ethnic Groups in Amsterdam. *International journal of environmental research and public health* 2015;12:14382-99.

41 Bécares L, Shaw R, Nazroo J*, et al.* Ethnic density effects on physical morbidity, mortality, and health behaviors: a systematic review of the literature. *American journal of public health* 2012;102:e33-e66.

42 Schrier AC, Peen J, de Wit MA*, et al.* Ethnic density is not associated with psychological distress in Turkish-Dutch, Moroccan-Dutch and Surinamese-Dutch ethnic minorities in the Netherlands. *Social psychiatry and psychiatric epidemiology* 2014;49:1557-67.

43 Shaw RJ, Atkin K, Bécares L*, et al.* Impact of ethnic density on adult mental disorders: narrative review. *The British Journal of Psychiatry* 2012;201:11-9.

44 Klein DN, Kotov R, Bufferd SJ. Personality and depression: explanatory models and review of the evidence. *Annual review of clinical psychology* 2011;7:269.

45 van Lenthe FJ, Martikainen P, Mackenbach JP. Neighbourhood inequalities in health and health-related behaviour: results of selective migration? *Health & place* 2007;13:123-37.

46 Veldhuizen EM, Stronks K, Kunst AE. Assessing associations between socio-economic environment and self-reported health in Amsterdam using bespoke environments. *PloS one* 2013;8:e68790.

47 Bécares L, Nazroo J, Stafford M. The buffering effects of ethnic density on experienced racism and health. *Health & place* 2009;15:700-8.

48 Halpern D. Minorities and mental health. *Social Science & Medicine* 1993;36:597-607.

49 Hurd NM, Stoddard SA, Zimmerman MA. Neighborhoods, Social Support, and African American Adolescents' Mental Health Outcomes: A Multilevel Path Analysis. *Child development* 2013;84:858-74.

50 Vogt Yuan AS. Racial composition of neighborhood and emotional well-being. *Sociological Spectrum* 2007;28:105-29.

51 Huijnk W, Dagevos J. *Closer together? Socio-cultural position of the four largest non-Western migrant groups in the Netherlands (in Dutch: Dichter bij elkaar? De sociaal-culturele positie van niet-westerse migranten in Nederland)*. The Hague: The Netherlands Institute for Social Research 2012.

52 RIVM. Prognosis incidence of mood disorders. National Institute of Public Health and the Environment 2017.

APPENDIX

Online supplementary table Multilevel regression analysis of psychological distress by neighbourhood ethnic diversity and ethnicity[c] (N=14,957 individuals and N=208 neighbourhoods)

	Model 1			Model 2			Model 3		
	β[a]	(95%CI)[b]		β[a]	(95%CI)[b]		β[a]	(95%CI)[b]	
Intercept	**14.89**	14.33	15.45	**14.72**	14.14	15.31	**14.71**	14.13	15.30
Individual level									
Gender									
Man	**-1.63**	-1.84	-1.43	**-1.64**	-1.85	-1.43	**-1.64**	-1.85	-1.43
Woman	ref.			ref.			ref.		
Age									
16-34 years	**0.51**	0.01	1.01	**0.54**	0.04	1.04	**0.54**	0.03	1.04
35-54 years	**0.68**	0.22	1.14	**0.72**	0.25	1.18	**0.72**	0.25	1.18
55-64 years	**-0.65**	-1.06	-0.23	**-0.62**	-1.04	-0.21	**-0.62**	-1.04	-0.21
≥ 65 years	ref.			ref.			ref.		
Ethnic background									
Turks	**3.68**	3.21	4.15	**3.56**	3.08	4.04	**3.56**	3.08	4.04
Moroccans	**2.01**	1.50	2.52	**1.90**	1.38	2.42	**1.89**	1.37	2.42
Surinamese	0.30	-0.10	0.70	0.21	-0.20	0.61	0.21	-0.20	0.61
Native Dutch	ref.			ref.			ref.		
Marital status									
Widow or widower	**1.42**	1.01	1.84	**1.40**	0.99	1.82	**1.40**	0.99	1.82
Divorced	**1.46**	1.07	1.84	**1.44**	1.06	1.82	**1.44**	1.06	1.82
Unmarried or never been married	**0.78**	0.51	1.05	**0.77**	0.50	1.03	**0.77**	0.50	1.03
Married or living together	ref.			ref.			ref.		
Education									
Primary school	**1.39**	1.02	1.76	**1.37**	1.00	1.74	**1.36**	0.99	1.73
Lower general secondary education	**0.44**	0.15	0.73	**0.42**	0.13	0.71	**0.41**	0.12	0.70
Higher general secondary education	0.15	-0.13	0.43	0.14	-0.15	0.42	0.13	-0.15	0.42
College, university	ref.			ref.			ref.		
Employment status									
Student, housewife, houseman	0.01	-0.31	0.33	0.02	-0.30	0.34	0.02	-0.30	0.34
Unemployed, disabled	**5.57**	5.17	5.96	**5.56**	5.17	5.95	**5.56**	5.16	5.95
(Early) retired	**0.68**	0.25	1.11	**0.69**	0.26	1.11	**0.69**	0.26	1.11
(Self-)employed	ref.			ref.			ref.		
Financial deprivation									
Great, some financial difficulty	**3.27**	3.02	3.52	**3.26**	3.01	3.51	**3.26**	3.01	3.51
(Almost) no financial difficulty	ref.			ref.			ref.		
Years of residence in city									
0-5 years	ref.			ref.			ref.		
6-15 years	0.02	-0.34	0.39	0.03	-0.34	0.39	0.03	-0.34	0.39
16-25 years	-0.25	-0.63	0.13	-0.24	-0.62	0.14	-0.24	-0.62	0.14
≥ 26 years	0.14	-0.22	0.50	0.14	-0.22	0.50	0.14	-0.22	0.50
Neighbourhood level									
Neighbourhood ethnic diversity (tertiles)									
Low				ref.			ref.		
Medium				0.17	-0.09	0.44	0.17	-0.10	0.44
High				**0.35**	0.07	0.63	0.32	-0.04	0.67

Online supplementary table Multilevel regression analysis of psychological distress by neighbourhood ethnic diversity and ethnicity[c] (N=14,957 individuals and N=208 neighbourhoods) (continued)

	Model 1		Model 2		Model 3		
	β[a]	(95%CI)[b]	β[a]	(95%CI)[b]	β[a]	(95%CI)[b]	
Neighbourhood SES (tertiles)							
Low					0.05	-0.31	0.41
Medium					0.04	-0.24	0.32
High					ref.		
Random effects							
ICC (%)	0.16		0.15		0.15		

[a] Bold values are significant (p<0.05); Beta represents difference in mean psychological distress relative to reference category.

[b] CI=Confidence Interval.

[c] All models are adjusted for individual level factors: gender, age, marital status, education, employment status, financial difficulties and years of residence.

CHAPTER 5

Income inequality and psychological distress at neighbourhood and municipality level: An analysis in the Netherlands

Erdem, Ö., Van Lenthe, F.J., & Burdorf, A.

Health & Place. 2019;56:1-8.

ABSTRACT

This study examines the associations between income inequality at neighbourhood and municipality level and psychological distress in a country with a relatively low income inequality, the Netherlands. Multilevel linear regression analyses were used to investigate associations between income inequality and mean income at the neighbourhood (n=7,803) and municipality (n=406) level and psychological distress (scale range 10-50), in a country-wide sample of 343,327 individuals, adjusted for gender, age, ethnicity, marital status, education and household income. No significant association was found between neighbourhood income inequality and psychological distress after adjustment for individual and neighbourhood level confounding. However, a higher neighbourhood income inequality in neighbourhoods with the middle to highest mean neighbourhood incomes was associated with more psychological distress. Individuals living in municipalities with the highest income inequality reported 2.5% higher psychological distress compared to those living in municipalities with the lowest income inequality. Income inequality seems to matter more for mental health at the municipality than neighbourhood level.

INTRODUCTION

The prevalence of depressive symptoms has increased steadily in most European countries, which suggests an involvement of macro-social factors [1]. A recent meta-analysis showed that higher income inequality is related to poorer mental health, although the effect sizes are small [2]. The majority of studies linking income inequality to mental health outcomes are conducted at the country-level, because income inequality measured in small areas is thought to be less related to health, whereas mean income levels are thought to be more important [3, 4].

Some of the proposed mechanisms for a link between income inequality and mental health however, may operate at lower-than-country levels. According to the status anxiety hypothesis, income inequality affects mental health through the negative consequences of social comparisons [5]. It can be argued that such comparisons exert an impact upon persons in small geographic units as well [4]. Similarly, income inequality in neighbourhoods may affect environmental determinants of mental health, such as safety or social cohesion [6, 7]. Empirical studies of the association between income inequality in small areas and (mental) health have shown mixed results, with some studies finding that greater income inequality is significantly associated with depression [8], poor self-rated health [9] or emotional distress [10], whereas other studies reported no significant association with self-rated health [7, 11-13] or depressive symptoms [14]. Surprisingly, a few studies even reported that greater income inequality is associated with a lower prevalence of common mental disorders [3] or lower risks for depression [15].

A potential reason for these mixed findings is that the size of the geographic unit matters. To the best of our knowledge, only three studies examined the role of the geographic scale in testing the association between income inequality and (mental) health [3, 16, 17]. Income inequalities measured at different geographical levels have different meanings and relate to other contextual characteristics. Thus, a lack of a significant association between income inequality and mental health at one level does not necessarily negate the possibility that income inequality relates to mental health at another level [16].

Further, the (adverse) health effects of income inequality may depend on the mean welfare level of small areas. The degree of income inequality in small areas with a high mean income is presumably larger than in small areas with a low mean income. Two studies found that mental health effects of greater inequality were contingent on the mean welfare level of small areas, but with opposite results [3, 18].

The Netherlands is a country with a relatively low income inequality, e.g. a Gini coefficient of 0.278 in 2013, whereas the mean Gini coefficient across OECD countries was 0.315 [19]. It is among the few countries that did not experience an increase in income

inequality since the mid-1980s [20]. Linkage of neighbourhood and municipality income to uniformly collected national public health survey data in 2012 created an excellent opportunity to investigate (1) the associations of income inequality and mean income at the neighbourhood and municipality level (as an indicator of welfare level) with psychological distress, and (2) whether the strength of the association between income inequality and psychological distress depends on the mean income of neighbourhoods and municipalities.

METHODS

Data source and participants

This study was based on a national public health survey *(Gezondheidsmonitor Volwassenen GGD-en, CBS en RIVM)* carried out in 2012 by 28 public health services, Statistics Netherlands and National Institute for Public Health and the Environment in the Netherlands [21]. The response was 45-50%. In total, the data include information on 376,384 citizens aged 19 years and older on physical and mental health status, social well-being, health behaviour, and individual characteristics. Statistics Netherlands has enriched the data at the individual level with information on ethnicity and standardized household income and linked the data with information on the Gini coefficient and mean income at the neighbourhood and municipality level.

From the 376,384 potential respondents, data were missing on the outcome measure (n=11,102 (2.9%)), the neighbourhood in which they live (n=773 (0.2%)), the neighbourhood Gini coefficient (n=8,965 (2.4%)), the neighbourhood ethnic composition (n=12,194 (3.2%)), and the municipal Gini coefficient (n=23 (0.01%)). As a result, information of 343,327 (91.2%) persons were used in the analyses.

Ethical approval was not required as this study relied on secondary anonymized data collected in the context of performing statutory tasks (Public Health Act of the Netherlands), in strict accordance with the national standard. In the dataset available for research all identifying information was removed. All research activities adhered to the regulations of the Dutch Code of Conduct for Medical Research.

Definition of a neighbourhood

Although previous studies in the Netherlands have used the four-digit postal code area (about 4,000 neighbourhoods) that reflects the route postmen walk, we were able to use the more refined division of the neighbourhood classification system of Statistics Netherlands (about 12,000 neighbourhoods) whereby neighbourhood boundaries were determined by local authorities themselves within their municipality. These neighbourhoods are often delineated by natural boundaries, consist of similar type of buildings, are characterized by

sociocultural homogeneous groups [22] and are more likely to be perceived as neighbourhoods by their residents than the four digit postal code area [23].

Measures

Neighbourhood and municipal income inequality

Neighbourhood and municipal income inequality were estimated by the Gini coefficient, which is the most commonly used measure of income inequality [24, 25]. We used the Gini coefficient that was calculated for every neighbourhood and municipality over the year 2012 by Statistics Netherlands using the standardized disposable household income. Statistics Netherlands has used the cut-off point of 0.51 for extreme Gini values at the neighbourhood and municipality level (73 cases). The value of the Gini coefficient varies between 0 and 1 where 0 corresponds to total income equality which means that every household is earning the same income and 1 corresponds to total income inequality which means that one household is earning the locality's entire income. The Gini coefficients were categorized into lowest, low, middle, high and highest by quintiles, separately for neighbourhoods and for municipalities.

Neighbourhood and municipal level factors

As a measure for neighbourhood and municipal income we used standardized disposable household income that was calculated for every neighbourhood and municipality by Statistics Netherlands over the year 2012. We divided it into quintiles.

The neighbourhood and municipal ethnic composition were retrieved from Statistics Netherlands and were defined as the percentage of residents from non-Western ethnic backgrounds in a neighbourhood or municipality. Ethnicity was defined based on country of birth of parents and the respondent, according to the standard definition of Statistics Netherlands [26]. Similarly, we divided both factors into quintiles.

The degree of urbanity of the neighbourhood and municipality, obtained from Statistics Netherlands, was the number of addresses per km^2 in 2012. Data were defined by Statistics Netherlands in five categories: more than 2,499 addresses (urban); 1,500-2,499 addresses (semi-urban); 1,000-1,499 addresses (intermediate urban-rural); 500-999 addresses (semi-rural); up to 499 addresses (rural).

Psychological distress outcome measure

This study used psychological distress as an indicator of depression [27, 28], measured with the Kessler Psychological Distress Scale (K10). The K10 has been developed as a screening instrument for psychological distress in the general population [29]. The K10 discriminates DSM-IV disorders from non-cases [28] and is strongly associated with the Composite

International Diagnostic Interview (CIDI) diagnosis of anxiety and affective disorders [27]. In a recent Dutch study, the K10 proved to be reliable (Cronbach's: 0.94) and valid (area under the curve (*AUC:* 0.87)) in detecting any depressive disorders. At the cut-off of 20 points, sensitivity (0.80) and specificity (0.81) are sufficiently high to appreciate the K10 as appropriate screening instrument [30]. The K10 scale consists of 10 questions that measure a person's level of anxiety and depressive symptoms in the previous four weeks. The items included were: "Did you feel …1) tired out for no good reasons?", 2) nervous?", 3) so nervous that nothing could calm you down?", 4) hopeless?", 5) restless or fidgety?", 6) so restless that you could not sit still?", 7) depressed?", 8) that everything was an effort?", 9) so sad that nothing could cheer you up?" and 10) worthless?". Each item has five response categories "none of the time", "a little of the time", "some of the time", "most of the time" and "all of the time". Cronbach's alpha was 0.92, therefore a sum-score was calculated (range 10-50), with higher scores reflecting more psychological distress.

Individual factors

Gender, age, ethnic background, marital status, and education were derived from the questionnaire. Ethnicity was defined based on country of birth of parents and the respondent, according to the standard definition of Statistics Netherlands [26]. Marital status was categorized into widow or widower, divorced, unmarried or never been married and married or living together. Education reflected the highest obtained educational level and was categorized into primary school, lower general secondary education, higher general secondary education and college or university. Standardized household income was calculated by Statistics Netherlands and was categorized into lowest (max. €15,200), low (max. €19,400), middle (max. €24,200), high (max. €31,000) and highest (>€31,000) by national quintiles [21].

Statistical analysis

Descriptive statistics were used to report general characteristics of the study population. Since residents were nested within neighbourhoods, we used multilevel linear regression analysis to examine the relationship between neighbourhood income inequality and psychological distress, while controlling for individual and neighbourhood level factors (table 2). First, we fitted an intercept-only model to test for significant variance in psychological distress between the neighbourhoods (not shown, available upon request). Second, we added neighbourhood income inequality to test the association between neighbourhood income inequality and psychological distress (model 1). Then, we added the six individual level factors gender, age, ethnicity, marital status, education, and household income (model 2) and neighbourhood level factors (mean income, ethnic composition, and urbanity) (model

3) to test whether the association between neighbourhood income inequality and psychological distress could be accounted for by individual level and neighbourhood level factors. Finally, we added the neighbourhood income x neighbourhood income inequality interaction term to determine whether the association between neighbourhood income inequality and psychological distress differed between low-income and high-income neighbourhoods (model 4). If the interaction term was statistically significant, we used a figure to visualize the interaction by depicting the predicted fixed psychological distress scores from model 4.

The same approach (i.e. sequence of models) was used to examine whether income inequality within municipalities was associated with psychological distress, while controlling for individual and municipal level factors.

For each model, the intraclass correlation coefficient (ICC) was calculated, representing the proportion of total variability in psychosocial distress that is attributable to the neighbourhoods or municipalities. All analyses were performed in SPSS 22. Results were considered to be statistically significant at $p<0.05$.

Results

The study population characteristics are presented in table 1. The mean psychological distress score for the 343,327 respondents was 15.9 (SD=6.4) and varied between 15.7 (SD=6.1) for Dutch and 22.4 (SD=9.8) for Turks, and between 14.9 (SD=5.3) for high-educated and 18.6 (SD=8.1) for low-educated persons. Income and educational inequalities in psychological distress were of similar size. The mean Gini coefficient across all municipalities and neighbourhoods was 0.26, with smaller variation between municipalities (range 0.21-0.44) than neighbourhoods (0.11-0.51). The mean income across all municipalities was equal to that of neighbourhoods, respectively €24,553 (SD=2,512) versus €24,768 (SD=5,023), with smaller variation between municipalities (range €17,900-€37,800) than neighbourhoods (€6,697-€81,775). The 7,803 included neighbourhoods had a mean population size of 2,028 (SD=2,166) residents, ranging between 55-27,495. The 406 included municipalities had a mean population size of 40,949 (SD=63,931) residents, ranging between 930-790,110.

Table 1 Sample characteristics of 343,327 adults residing in 406 municipalities and 7,803 neighbourhoods in the Netherlands, 2012

				Psychological distress score	
		n	Percent	Mean	SD
Individual level (n=343,327)					
Total	Total	343,327	100	15.9	6.4
Gender	Men	156,391	45.6	15.0	6.0
	Women	186,936	54.4	16.7	6.6
Age group	19-24 years	18,941	5.5	16.9	6.5
	25-29 years	14,366	4.2	16.5	6.5
	30-34 years	16,295	4.7	16.2	6.4
	35-39 years	17,202	5.0	16.1	6.5
	40-44 years	22,847	6.7	15.9	6.5
	45-49 years	25,340	7.4	16.0	6.6
	50-54 years	26,552	7.7	16.1	6.7
	55-59 years	27,257	7.9	16.0	6.5
	60-64 years	28,572	8.3	15.3	6.1
	65-69 years	50,828	14.8	14.8	5.7
	70-74 years	35,930	10.5	15.4	6.0
	75 years and above	59,197	17.2	16.8	6.5
Ethnic background	Turks	3,054	0.9	22.4	9.8
	Moroccans	2,137	0.6	20.8	9.4
	Surinamese, Netherlands Antilles and Aruba	4,886	1.4	18.3	8.4
	Other non-Western and Cape Verde	6,048	1.8	19.0	8.3
	Western	30,793	9.0	16.6	6.8
	Dutch	296,409	86.3	15.7	6.1
Marital status	Unknown	3,985	1.2	17.5	7.5
	Widow or widower	36,268	10.6	17.3	6.8
	Divorced	21,978	6.4	18.2	7.9
	Unmarried or never been married	39,874	11.6	17.2	7.0
	Married or living together	241,222	70.3	15.3	5.9
Education	Unknown	9,446	2.8	17.4	7.5
	Primary school	31,736	9.2	18.6	8.1
	Lower general secondary education	117,119	34.1	16.2	6.5
	Higher general secondary education	94,351	27.5	15.6	6.0
	College, university	90,675	26.4	14.9	5.3
Quintiles of income[a]	Unknown	2,073	0.6	17.6	7.5
	Lowest (max. €15,200)	34,265	10.0	18.4	8.0
	Low (max. €19,400)	65,546	19.1	17.1	7.1
	Middle (max. €24,200)	73,426	21.4	16.0	6.3
	High (max. €31,000)	81,468	23.7	15.3	5.7
	Highest (>€31,000)	86,549	25.2	14.6	5.1

	Mean	SD	Min.	Max.
Neighbourhood level (n=7,803)				
Income inequality[b]	0.26	0.06	0.11	0.51
Income in *euro*[c]	24,768	5,023	6,697	81,775
Population (n)	2,028	2,166	55	27,495
Municipality level (n=406)				
Income inequality[b]	0.26	0.03	0.21	0.44
Income in *euro*[c]	24,553	2,512	17,900	37,800
Population (n)	40,949	63,931	930	790,110

[a] Standardized household income.

[b] Income inequality was measured using the neighbourhood and municipality level Gini coefficient.

[c] Income was measured using standardized disposable household income at the neighbourhood and municipality level.

Neighbourhood income inequality and psychological distress

Table 2 presents the results of the successive multilevel models. The intercepts-only model showed that 97.39% of the random variation occurred at the individual level and 2.61% at the neighbourhood level (ICC=2.61%). After adding neighbourhood income inequality in model 1 and individual level factors in model 2, the ICC decreased to 2.57% and 0.93%, respectively, suggesting that the differences in psychological distress between neighbourhoods were almost entirely attributable to the composition of the neighbourhoods.

Model 1 shows an inverse linear association, with a higher neighbourhood income inequality being associated with less psychological distress. In neighbourhoods with the highest income inequality, the population-average distress score appeared to be almost 3% lower than in the neighbourhoods with the lowest income inequality [(-0.46/15.99)*100=-3%]. The inclusion of individual level factors (gender, age, ethnicity, marital status, education and household income) attenuated the magnitude of the association between neighbourhood income inequality and psychological distress, but the association remained statistically significant (model 2). After adding neighbourhood level factors (mean income, ethnic composition and urbanity (model 3)), the direction of the association between income inequality and psychological distress changed, but the association found between neighbourhood income inequality and psychological distress was no longer statistically significant.

Model 3 further shows that a lower mean neighbourhood income, a higher neighbourhood ethnic composition and a higher degree of urbanity were significantly associated with more psychological distress.

Table 2 Associations between individual psychological distress and neighbourhood income inequality adjusted for individual and neighbourhood level factors (343,327 adults in 7,803 neighbourhoods)

	Model 1			Model 2			Model 3		
	Neighbourhood income inequality			Neighbourhood income inequality and individual level factors[d]			Neighbourhood income inequality, individual[d] and neighbourhood level factors		
	β[a]	(95%CI)[b]		β[a]	(95%CI)[b]		β[a]	(95%CI)[b]	
Intercept	**15.99**	15.92	16.05	**14.64**	14.54	14.74	**14.09**	13.96	14.21
Neighbourhood income inequality[c]									
Lowest	ref.			ref.			ref.		
Low	**-0.21**	-0.33	-0.08	**-0.10**	-0.19	-0.00	0.02	-0.06	0.11
Middle	**-0.26**	-0.37	-0.16	**-0.10**	-0.18	-0.02	0.06	-0.02	0.13
High	**-0.37**	-0.48	-0.26	**-0.11**	-0.20	-0.02	0.03	-0.05	0.12
Highest	**-0.46**	-0.57	-0.36	**-0.14**	-0.22	-0.06	0.00	-0.09	0.08
Neighbourhood income[e]									
Lowest							**0.53**	0.43	0.64
Low							**0.13**	0.04	0.22
Middle							0.00	-0.08	0.09
High							0.00	-0.08	0.08
Highest							ref.		
% non-Western immigrants [f]									
Lowest							ref.		
Low							**0.11**	0.02	0.19
Middle							**0.23**	0.13	0.32
High							**0.34**	0.25	0.44
Highest							**0.47**	0.35	0.58
Urbanity[g]									
Urban							**0.25**	0.13	0.37
Semi-urban							**0.30**	0.20	0.40
Intermediate urban-rural							**0.26**	0.17	0.36
Semi-rural							**0.15**	0.07	0.24
Rural							ref.		
Random parameters, variance (SE)[h]									
Level 1: individual	**39.38**	(0.10)		**36.46**	(0.09)		**36.46**	0.09	
Level 2: neighbourhood	**1.04**	(0.03)		**0.34**	(0.02)		**0.20**	0.01	
ICC (%)	2.57			0.93			0.55		

[a] Bold values are significant ($p < 0.05$); Beta represents difference in mean psychological distress relative to reference category.

[b] CI Confidence Interval.

[c] Income inequality was measured using quintiles of the neighbourhood level Gini coefficient.

[d] Models are adjusted for individual level factors: gender, age, ethnicity, marital status, education and household income.

[e] Standardized disposable household income at the neighbourhood level (in quintiles).

[f] Percentage of residents from non-Western ethnic backgrounds in a neighbourhood (in quintiles).

[g] Based on the number of addresses per km^2: more than 2,499 addresses (urban); 1,500-2,499 addresses (semi-urban); 1,000-1,499 addresses (intermediate urban rural); 500-999 addresses (semi-rural); up to 499 addresses (rural).

[h] In the intercepts-only model is the individual level variance (SE): 39.39 (0.10) and neighbourhood level variance (SE): 1.06 (0.04).

There appeared to be a significant interaction between neighbourhood income and neighbourhood income inequality in relation to psychological distress (figure 1). A higher neighbourhood income inequality was associated with more psychological distress, particularly in neighbourhoods with the middle to highest mean neighbourhood incomes. In the neighbourhoods with the lowest mean incomes, a linear association between neighbourhood income inequality and psychological distress was not observed. Among individuals living in neighbourhoods with the highest mean income, those living in the neighbourhoods with the highest income inequality reported 2% [((β=15.1-β=14.8)/β=14.8)*100] higher psychological distress scores compared to those living in neighbourhoods with the lowest income inequality.

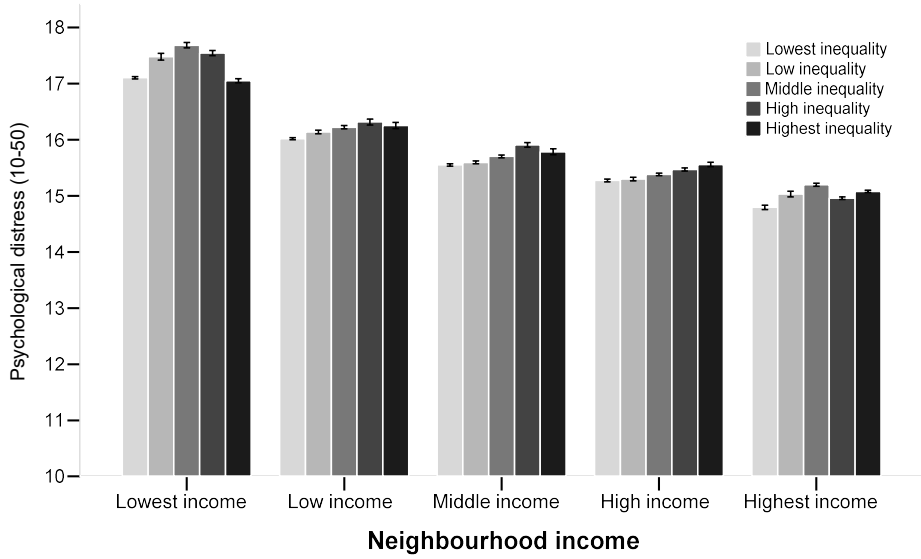


Figure 1 Predicted mean fixed scores of psychological distress by neighbourhood income and neighbourhood income inequality (from model 4)

Municipal income inequality and psychological distress

The intercepts-only model showed that 99.08% of the random variation occurred at the individual level and 0.92% at the municipality level (ICC=0.92%) (table 3). After adding municipal income inequality in model 1 and individual level factors in model 2, the ICC decreased to 0.88% and 0.54%, respectively, suggesting that the differences in psychological distress between municipalities were almost entirely attributable to the composition of the municipalities.

Table 3, model 1, shows that a higher municipal income inequality was associated with more psychological distress. After adjustment for individual level factors (model 2) and municipal level factors (model 3), the association between municipal income inequality and psychological distress remained statistically significant. Residing in municipalities with the highest income inequality was significantly associated with more psychological distress (β=0.34, 95%CI 0.13 to 0.56) compared to residing in municipalities with the lowest income inequality. In other words, individuals living in municipalities with the highest income inequality reported on average a 2.5% higher psychological distress level [(0.34/13.86)*100=2.5%] compared to those living in municipalities with the lowest income inequality.

Model 3 further shows that a higher municipal ethnic composition and a higher degree of urbanity, but not the highest degree of urbanity were significantly associated with more psychological distress. No significant association was found between mean municipal income and psychological distress.

Finally, there was no significant interaction between mean municipal income and municipal income inequality in relation to psychological distress.

Table 3 Associations between individual psychological distress and municipal income inequality adjusted for individual and municipal level factors (343,327 adults in 406 municipalities)

	Model 1			**Model 2**			**Model 3**		
	Municipal income inequality			Municipal income inequality and individual level factors[d]			Municipal income inequality, individual[d] and municipal level factors		
	β[a]	(95%CI)[b]		β[a]	(95%CI)[b]		β[a]	(95%CI)[b]	
Intercept	**15.53**	15.41	15.65	**14.20**	14.08	14.33	**13.86**	13.65	14.08
Municipal income inequality[c]									
Lowest	**ref.**			**ref.**			**ref.**		
Low	0.07	-0.11	0.25	0.13	-0.01	0.28	0.11	-0.03	0.25
Middle	-0.07	-0.25	0.10	0.06	-0.08	0.20	0.05	-0.09	0.20
High	0.02	-0.20	0.25	0.16	-0.02	0.34	0.11	-0.08	0.30
Highest	**0.39**	0.14	0.64	**0.50**	0.31	0.70	**0.34**	0.13	0.56
Municipal income[e]									
Lowest							0.09	-0.10	0.29
Low							0.02	-0.15	0.20
Middle							0.09	-0.07	0.25
High							0.06	-0.11	0.22
Highest							**ref.**		
% non-Western immigrants[f]									
Lowest							**ref.**		
Low							0.07	-0.07	0.22
Middle							**0.19**	0.01	0.37
High							**0.33**	0.09	0.56
Highest							**0.47**	0.15	0.80
Urbanity[g]									
Urban							0.21	-0.14	0.55
Semi-urban							**0.31**	0.08	0.54
Intermediate urban rural							**0.26**	0.07	0.46
Semi-rural							**0.18**	0.04	0.33
Rural							**ref**.		
Random parameters, variance (SE)[h]									
Level 1: individual	**39.91**	(0.10)		**36.56**	(0.09)		**36.56**	(0.09)	
Level 2: municipal	**0.35**	(0.03)		**0.20**	(0.02)		**0.16**	(0.02)	
Random effects									
ICC (%)	0.88			0.54			0.43		

[a] Bold values are significant ($p < 0.05$); Beta represents difference in mean psychological distress relative to reference category.

[b] CI Confidence Interval.

[c] Income inequality was measured using quintiles of the municipal level Gini coefficient.

[d] Models are adjusted for individual level factors: gender, age, ethnicity, marital status, education and household income.

[e] Standardized disposable household income at the municipality level (in quintiles).

[f] Percentage of residents from non-Western ethnic backgrounds in a municipality (in quintiles).

[g] Based on the number of addresses per km^2: more than 2,499 addresses (urban); 1,500-2,499 addresses (semi-urban); 1,000-1,499 addresses (intermediate urban rural); 500-999 addresses (semi-rural); up to 499 addresses (rural).

[h] In the intercepts-only model is the individual level variance (SE): 39.91 (0.10) and municipal level variance (SE): 0.37 (0.03).

DISCUSSION

Summary of main findings

We found no significant association between neighbourhood income inequality and psychological distress, after adjustment for individual and neighbourhood level factors. However, we found a significant interaction between neighbourhood income inequality and neighbourhood income in relation to psychological distress. A higher neighbourhood income inequality in neighbourhoods with the middle to highest mean neighbourhood incomes was associated with more psychological distress, whereas no such effect was found in neighbourhoods with the lowest mean income levels. At the municipality level, we found a significant association between municipal income inequality and psychological distress, after adjustment for individual and municipal level factors. Individuals living in municipalities with the highest income inequality reported more psychological distress than those living in municipalities with the lowest income inequality. We found no differential impact from municipal income inequality on psychological distress by mean municipal income. Our results suggest that income inequality at the municipality level is more important as a risk factor for mental health than municipal mean income, while at the neighbourhood level, mean income is more important than income inequality.

Comparison with other studies and possible explanations

Our results at the neighbourhood level endorse the conclusion of a Dutch city study that neighbourhood income inequality was not important for the health-related quality of life of the residents of Maastricht neighbourhoods [31]. This study from the city of Maastricht used an index of socioeconomic deprivation and two non-standard measures of income inequality: the house prices and the proportion of low and high incomes. In contrast to our country-wide study, no interaction effects between socioeconomic deprivation and any of the income inequality indicators were found.

Our study is in line with a previous study, conducted in the county of Stockholm, Sweden, that found no association between high income inequality at the neighbourhood level and self-rated poor health. At the municipality level, high income inequality seemed to matter for self-rated health [17].

On the other hand, our results were not corroborated in a study from the United Kingdom [3], that concluded that a higher income inequality was associated with better mental health in affluent neighbourhoods only. In fact, we found the opposite: a higher neighbourhood income inequality was associated with poorer mental health in affluent neighbourhoods. At the regional level, Fone et al. found that a higher income inequality was

associated with poorer mental health and that this association was not contingent on the level of mean incomes, which is in line with our results.

The different findings at the neighbourhood and municipality/regional level suggest that it is important to consider the level of geographic unit when studying mental health effects of income inequality. Additional evidence of country-wide studies with focus on the role of geographic scale may shed further light on the robustness of our findings.

Several mechanisms have been proposed for the associations between income inequality and mental health [3, 5]. Firstly, the social capital hypothesis posits that higher levels of income inequality lead to lower levels of social capital (e.g. lower trust and mutual aid), resulting in poorer health. Secondly, the neo-materialist hypothesis argues that income inequality leads to an underinvestment in social goods or public infrastructure (e.g. welfare, education, transportation) within a community, which in turn leads to poorer mental health. For example, neighbourhoods or municipalities with high income inequality might have fewer resources, such as mental health care facilities and psychological counsellors. Third, the status anxiety hypothesis suggests that income inequality leads to invidious comparisons with poorer health as a result: the perception of low social status and inferiority produces negative emotions (e.g. shame), which lead to poorer health through stress responses. The latter hypothesis may probably explain best why a higher income inequality was associated with more psychological distress in neighbourhoods with the middle to highest mean neighbourhood incomes. It seems likely that social status of (rich or poor) residents is considered more important in these neighbourhoods compared with poor neighbourhoods and the residents may have to work harder to maintain their social status, and therefore may experience greater stress. The fear of a ‘deep fall’, feelings of work or life failure and invidious social comparisons may increase residents’ stress. Hence, status competition present in rich but (highly) unequal neighbourhoods may lead to higher psychological distress. Further investigation is required to identify the underlying mechanisms why neighbourhood income inequality seems to matter for mental health more in neighbourhoods with a high income.

Although beyond the scope of our study, we found a significant inverse association between neighbourhood income and psychological distress such that living in neighbourhoods with higher income was associated with better mental health. This is in line with previous studies [12, 32, 33] and a confirmation of the community absolute income hypothesis, which postulates that individual (mental) health improves as the community in which the individual lives becomes richer [32].

Sensitivity analysis: comparison with other income inequality measures

Although the use of the Gini coefficient in income inequality research is very common, there is the possibility that other measures of income inequality might lead to different results. In addition, the Gini coefficient is insensitive to the shape of the income distribution within areas: a high Gini value could be produced by either a high proportion of people with very high incomes (right-skewed distribution) or very low incomes (left-skewed distribution) [3, 24]. As complementary measures to the Gini coefficient, the P80/P20 ratio and Relative Interquartile Range (Relative IQR) were examined. The P80/P20 ratio is sensitive to inequalities in the top and the bottom of the spectrum of the income distribution in a population, while the Relative IQR is sensitive to inequalities in the middle of the spectrum of income distribution. The results for the three income inequality measures at the neighbourhood level were similar, in that they appeared not to be associated with psychological distress. Only one significant association was observed: residing in neighbourhoods with a middle-income inequality, as measured by the P80/P20 ratio, was significantly associated with more psychological distress compared to residing in neighbourhoods with the lowest income inequality (see Table S1 in Appendix S1). At the municipality level, the results for the three income inequality measures were in the same direction and essentially similar: residing in municipalities with the highest income inequality was significantly associated with more psychological distress compared to residing in municipalities with the lowest income inequality (see Table S2 in Appendix S1). The associations between the Relative IQR and psychological distress were stronger. In sum, at the neighbourhood and municipality level, the three income inequality measures gave essentially the same results with psychological distress.

Strengths and limitations

A major strength of this study is that the sample is large and nationally representative for residents from municipalities and neighbourhoods in the Netherlands. We were able to use the Gini coefficient and mean income of 406 out of 415 municipalities and of 7,803 of nearly 12,000 neighbourhoods, after merging the sample with additional information provided by Statistics Netherlands. This data linkage facilitated a multilevel analysis at a smaller spatial scale than the often used four-digit postal code area (7,803 versus about 4,000). Further, the design of the study allowed us to control for household income, a common prior cause of income inequality and health outcomes [34].

There are, however, also some limitations that may have influenced our findings. First, we used cross-sectional data to examine the association between income inequality and psychological distress, which limits causal inference. Although reverse causation is not immediately obvious as an explanation, residual confounding cannot be excluded, such as

ethnic discrimination [35] or personality factors (e.g. neuroticism, extraversion and conscientiousness) which are linked to depression [36]. It is plausible that these factors are more common in neighbourhoods and municipalities with higher income inequality. Further investigations using longitudinal data and adjustment for other relevant factors are needed to confirm the causal link between higher income inequality in small areas and worse mental health. Second, psychological distress was self-reported. To the extent that income inequality is associated with over reporting, associations between income inequality and distress may have been overestimated. To the extent that the mean income of neighbourhoods and municipalities is associated with over reporting, adjustment may have resulted in an underestimation of the associations between income inequality and psychological distress. Third, selective migration may be responsible for some of the associations found. Depressed persons may have less opportunities to move away from poor neighbourhoods or from neighbourhoods with high income inequality. Yet, previous studies showed that health was a marginal reason for moving [37] and that migration did not enlarge inequalities in health between poor and rich neighbourhoods [38].

Implications

Our findings need to be interpreted with caution given the cross-sectional design of our study. They suggest that income inequality in affluent neighbourhoods and municipalities is a risk factor for mental health of the residents in the Netherlands, although far less important than resident's social and economic factors. These individual level factors (gender, age, ethnicity, marital status, education and household income) determine to a large extent the mental health of the residents, while income inequality at the neighbourhood and municipality level only explain a small part of the differences in mental health between neighbourhoods and municipalities. So, policies and efforts to promote mental health should focus in the first place on the social and economic determinants of mental health. In addition to that, improving the welfare level (mean income) in poor neighbourhoods should get more attention than reducing income inequality in affluent neighbourhoods.

What this study adds

- Results on income inequality in small areas and mental health are mixed.
- Mental health effects of neighbourhood income inequality depend on neighbourhood income.
- Municipal income inequality is more important as a risk factor for mental health than municipal income.

REFERENCES

1 Subramanian S, Belli P, Kawachi I. The macroeconomic determinants of health. *Annual review of public health* 2002;23:287-302.

2 Ribeiro WS, Bauer A, Andrade MCR*, et al.* Income inequality and mental illness-related morbidity and resilience: a systematic review and meta-analysis. *The Lancet Psychiatry* 2017.

3 Fone D, Greene G, Farewell D*, et al.* Common mental disorders, neighbourhood income inequality and income deprivation: small-area multilevel analysis. *The British Journal of Psychiatry* 2013;202:286-93.

4 Wilkinson RG, Pickett KE. Income inequality and population health: a review and explanation of the evidence. *Social Science & Medicine* 2006;62:1768-84.

5 Layte R. The association between income inequality and mental health: testing status anxiety, social capital, and neo-materialist explanations. *European Sociological Review* 2011;28:498-511.

6 Roux A-VD. Neighborhoods and health: where are we and were do we go from here? *Revue d'epidemiologie et de sante publique* 2007;55:13-21.

7 Wen M, Browning CR, Cagney KA. Poverty, affluence, and income inequality: neighborhood economic structure and its implications for health. *Social Science & Medicine* 2003;57:843-60.

8 Chiavegatto Filho ADP, Kawachi I, Wang YP*, et al.* Does income inequality get under the skin? A multilevel analysis of depression, anxiety and mental disorders in Sao Paulo, Brazil. *Journal of epidemiology and community health* 2013:jech-2013-202626.

9 Ichida Y, Kondo K, Hirai H*, et al.* Social capital, income inequality and self-rated health in Chita peninsula, Japan: a multilevel analysis of older people in 25 communities. *Social Science & Medicine* 2009;69:489-99.

10 Vilhjalmsdottir A, Gardarsdottir RB, Bernburg JG*, et al.* Neighborhood income inequality, social capital and emotional distress among adolescents: A population-based study. *Journal of adolescence* 2016;51:92-102.

11 Bjornstrom EE. The neighborhood context of relative position, trust, and self-rated health. *Social Science & Medicine* 2011;73:42-9.

12 Hou F, Myles J. Neighbourhood inequality, neighbourhood affluence and population health. *Social Science & Medicine* 2005;60:1557-69.

13 Wong IO, Cowling BJ, Lo S-V*, et al.* A multilevel analysis of the effects of neighbourhood income inequality on individual self-rated health in Hong Kong. *Social Science & Medicine* 2009;68:124-32.

14 Fernández-Niño JA, Manrique-Espinoza BS, Bojorquez-Chapela I*, et al.* Income inequality, socioeconomic deprivation and depressive symptoms among older adults in Mexico. *PloS one* 2014;9:e108127.

15 Marshall A, Jivraj S, Nazroo J*, et al.* Does the level of wealth inequality within an area influence the prevalence of depression amongst older people? *Health & place* 2014;27:194-204.

16 Chen Z, Crawford CAG. The role of geographic scale in testing the income inequality hypothesis as an explanation of health disparities. *Social Science & Medicine* 2012;75:1022-31.

17 Rostila M, Kölegård ML, Fritzell J. Income inequality and self-rated health in Stockholm, Sweden: a test of the 'income inequality hypothesis' on two levels of aggregation. *Social Science & Medicine* 2012;74:1091-8.

18 Boydell J, Van Os J, McKenzie K*, et al.* The association of inequality with the incidence of schizophrenia. *Social psychiatry and psychiatric epidemiology* 2004;39:597-9.

19 OCDE IIT. Why Less Inequality Benefits All. Paris: OECD Publishing 2015.

20 Pickett KE, Wilkinson RG. Income inequality and health: a causal review. *Social Science & Medicine* 2015;128:316-26.

21 Statistics Netherlands. Opbouw en instructie totaalbestand Gezondheidsmonitor Volwassenen 2012. 2015.

22 Reijneveld SA, Verheij RA, de Bakker DH. The impact of area deprivation on differences in health: does the choice of the geographical classification matter? *Journal of epidemiology and community health* 2000;54:306-13.

23 Vervoort M, Dagevos J, Flap H. Ethnic concentration in the neighbourhood and majority and minority language: A study of first and second-generation immigrants. *Social Science Research* 2012;41:555-69.

24 De Maio FG. Income inequality measures. *Journal of epidemiology and community health* 2007;61:849-52.

25 Kondo N, Sembajwe G, Kawachi I*, et al.* Income inequality, mortality, and self rated health: meta-analysis of multilevel studies. *Bmj* 2009;339:b4471.

26 Statistics Netherlands. Hoe doet het CBS dat nou? Standaarddefinitie allochtonen [How does Statistics Netherlands do this? Standard Definition Immigrants]. Voorburg: Statistics Netherlands 2000:24-5.

27 Andrews G, Slade T. Interpreting scores on the Kessler Psychological Distress Scale (K10). *Australian and New Zealand journal of public health* 2001;25:494-7.

28 Kessler RC, Andrews G, Colpe LJ*, et al.* Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychological medicine* 2002;32:959-76.

29 Kessler R, Mroczek D. Final versions of our non-specific psychological distress scale. *Memo dated March* 1994;10:1994.

30 Donker T, Comijs H, Cuijpers P*, et al.* The validity of the Dutch K10 and extended K10 screening scales for depressive and anxiety disorders. *Psychiatry Research* 2010;176:45-50.

31 Drukker M, Feron FJ, Van Os J. Income inequality at neighbourhood level and quality of life. *Social psychiatry and psychiatric epidemiology* 2004;39:457-63.

32 Subramanian S, Delgado I, Jadue L*, et al.* Income inequality and health: multilevel analysis of Chilean communities. *Journal of Epidemiology & Community Health* 2003;57:844-8.

33 Klijs B, Kibele EU, Ellwardt L*, et al.* Neighborhood income and major depressive disorder in a large Dutch population: results from the LifeLines Cohort study. *BMC public health* 2016;16:773.

34 Kawachi I, Subramanian S. Income inequality. *Social epidemiology* 2014;126.

35 Ikram UZ, Snijder MB, Fassaert TJ*, et al.* The contribution of perceived ethnic discrimination to the prevalence of depression. *The European Journal of Public Health* 2015;25:243-8.

36 Klein DN, Kotov R, Bufferd SJ. Personality and depression: explanatory models and review of the evidence. *Annual review of clinical psychology* 2011;7:269.

37 van Lenthe FJ, Martikainen P, Mackenbach JP. Neighbourhood inequalities in health and health-related behaviour: results of selective migration? *Health & place* 2007;13:123-37.

38 Jongeneel-Grimen B, Droomers M, Stronks K*, et al.* Migration does not enlarge inequalities in health between rich and poor neighbourhoods in The Netherlands. *Health & place* 2011;17:988-95.

APPENDIX S1

Table S1 Associations between individual psychological distress and neighbourhood income inequality (Gini coefficient, P80/P20 ratio and Relative Interquartile Range (IQR)) adjusted for individual[d] and neighbourhood level factors (343,327 adults in 7,803 neighbourhoods)

	Model 3			**Model 3**			**Model 3**		
	Neighbourhood income inequality (Gini coefficient)[c]			Neighbourhood income inequality (P80/P20 ratio)[c]			Neighbourhood income inequality (Relative IQR)[c]		
	β[a]	(95%CI)[b]		β[a]	(95%CI)[b]		β[a]	(95%CI)[b]	
Intercept	**14.09**	13.96	14.21	**14.04**	13.91	14.17	**14.09**	13.96	14.21
Neighbourhood income inequality									
Lowest	ref.			ref.			ref.		
Low	0.02	-0.06	0.11	0.07	-0.01	0.15	0.01	-0.06	0.09
Middle	0.06	-0.02	0.13	**0.11**	0.03	0.19	0.02	-0.07	0.10
High	0.03	-0.05	0.12	0.07	-0.01	0.16	0.05	-0.04	0.14
Highest	0.00	-0.09	0.08	0.05	-0.04	0.14	0.00	-0.09	0.09
Neighbourhood income[e]									
Lowest	**0.53**	0.43	0.64	**0.56**	0.46	0.66	**0.53**	0.43	0.63
Low	**0.13**	0.04	0.22	**0.15**	0.06	0.24	**0.13**	0.04	0.22
Middle	0.00	-0.08	0.09	0.01	-0.07	0.10	0.01	-0.08	0.09
High	0.00	-0.08	0.08	0.01	-0.08	0.09	0,00	-0.08	0.09
Highest	ref.			ref.			ref.		
% non-Western immigrants[f]									
Lowest	ref.			ref.			ref.		
Low	**0.11**	0.02	0.19	**0.10**	0.02	0.18	**0.11**	0.02	0.19
Middle	**0.23**	0.13	0.32	**0.22**	0.12	0.31	**0.23**	0.14	0.33
High	**0.34**	0.25	0.44	**0.33**	0.23	0.43	**0.34**	0.25	0.44
Highest	**0.47**	0.35	0.58	**0.44**	0.33	0.56	**0.47**	0.35	0.59
Urbanity[g]									
Urban	**0.25**	0.13	0.37	**0.25**	0.13	0.37	**0.25**	0.13	0.37
Semi-urban	**0.30**	0.20	0.40	**0.31**	0.21	0.41	**0.30**	0.20	0.40
Intermediate urban-rural	**0.26**	0.17	0.36	**0.27**	0.18	0.37	**0.27**	0.17	0.36
Semi-rural	**0.15**	0.07	0.24	**0.16**	0.07	0.24	**0.15**	0.07	0.24
Rural	ref.			ref.			ref.		
Random effects									
ICC (%)	0.55			0.55			0.55		

[a] Bold values are significant ($p < 0.05$); Beta represents difference in mean psychological distress relative to reference category.

[b] CI Confidence Interval.

[c] Income inequality at the neighbourhood level was measured: (1) using quintiles of the Gini coefficient, (2) quintiles of the P80/P20 ratio and (3) quintiles of the relative interquartile range. The P80/P20 is the ratio of the income earned by the top 20% of households to that by the income earned by the poorest 20% of households. The relative interquartile range (Relative IQR) is the seventy-fifth percentile minus the twenty-fifth percentile, divided by the median. Interpretation of these three measures is the same: the higher the score, the greater is the level of income inequality.

[d] Models are adjusted for individual level factors: gender, age, ethnicity, marital status, education and household income.

[e] Standardized disposable household income at the neighbourhood level (in quintiles).

[f] Percentage of residents from non-Western ethnic backgrounds in a neighbourhood (in quintiles).

[g] Based on the number of addresses per km^2: more than 2,499 addresses (urban); 1,500-2,499 addresses (semi-urban); 1,000-1,499 addresses (intermediate urban rural); 500-999 addresses (semi-rural); up to 499 addresses (rural).

Table S2 Associations between individual psychological distress and municipal income inequality (Gini coefficient, P80/P20 ratio and Relative Interquartile Range (IQR)) adjusted for individual[d] and municipal level factors (343,327 adults in 406 municipalities)

	Model 3 Municipal income inequality (Gini coefficient)[c]			**Model 3** Municipal income inequality (P80/P20 ratio)[c]			**Model 3** Municipal income inequality (Relative IQR)[c]		
	β[a]	(95%CI)[b]		β[a]	(95%CI)[b]		β[a]	(95%CI)[b]	
Intercept	**13.86**	13.65	14.08	**13.91**	13.70	14.13	**13.71**	13.50	13.93
Municipal income inequality									
Lowest	ref.			ref.			ref.		
Low	0.11	-0.03	0.25	0.03	-0.10	0.17	**0.16**	0.02	0.29
Middle	0.05	-0.09	0.20	0.00	-0.16	0.15	**0.18**	0.03	0.34
High	0.11	-0.08	0.30	0.08	-0.09	0.25	**0.33**	0.14	0.52
Highest	**0.34**	0.13	0.56	**0.26**	0.06	0.47	**0.50**	0.26	0.73
Municipal income[e]									
Lowest	0.09	-0.10	0.29	0.05	-0.14	0.25	**0.22**	0.02	0.41
Low	0.02	-0.15	0.20	-0.01	-0.18	0.17	0.16	-0.02	0.33
Middle	0.09	-0.07	0.25	0.06	-0.10	0.23	**0.18**	0.01	0.34
High	0.06	-0.11	0.22	0.05	-0.11	0.22	0.15	-0.02	0.31
Highest	ref.			ref.			ref.		
% non-Western immigrants[f]									
Lowest	ref.			ref.			ref.		
Low	0.07	-0.07	0.22	0.07	-0.08	0.22	0.07	-0.08	0.21
Middle	**0.19**	0.01	0.37	**0.20**	0.02	0.38	0.15	-0.02	0.33
High	**0.33**	0.09	0.56	**0.33**	0.09	0.56	0.24	-0.00	0.47
Highest	**0.47**	0.15	0.80	**0.50**	0.18	0.83	**0.33**	0.00	0.67
Urbanity[g]									
Urban	0.21	-0.14	0.55	0.21	-0.14	0.56	0.16	-0.19	0.51
Semi-urban	**0.31**	0.08	0.54	**0.30**	0.07	0.53	**0.32**	0.09	0.54
Intermediate urban rural	**0.26**	0.07	0.46	**0.28**	0.08	0.47	**0.31**	0.12	0.50
Semi-rural	**0.18**	0.04	0.33	**0.18**	0.03	0.34	**0.21**	0.06	0.35
Rural	ref.			ref.			ref.		
Random effects									
ICC (%)	0.43			0.43			0.41		

[a] Bold values are significant ($p < 0.05$); Beta represents difference in mean psychological distress relative to reference category.

[b] CI Confidence Interval.

[c] Income inequality at the municipality level was measured: (1) using quintiles of the Gini coefficient, (2) quintiles of the P80/P20 ratio and (3) quintiles of the relative interquartile range. The P80/P20 is the ratio of the income earned by the top 20% of households to that by the income earned by the poorest 20% of households. The relative interquartile range (Relative IQR) is the seventy-fifth percentile minus the twenty-fifth percentile, divided by the median. Interpretation of these three measures is the same: the higher the score, the greater is the level of income inequality.

[d] Models are adjusted for individual level factors: gender, age, ethnicity, marital status, education and household income.

[e] Standardized disposable household income at the municipality level (in quintiles).

[f] Percentage of residents from non-Western ethnic backgrounds in a municipality (in quintiles).

[g] Based on the number of addresses per km^2: more than 2,499 addresses (urban); 1,500-2,499 addresses (semi-urban); 1,000-1,499 addresses (intermediate urban rural); 500-999 addresses (semi-rural); up to 499 addresses (rural).

CHAPTER 6

Health-related behaviours mediate the relation between ethnicity and (mental) health in the Netherlands

Erdem, Ö., Riva, E., Prins, R.G., Burdorf, A., & Van der Doef, M.

Ethnicity & health. 2017;1-14.

ABSTRACT

Objective

Ethnic minorities in the Netherlands experience worse (mental) health than Dutch natives. So far, socioeconomic factors, discrimination, and the migration process have been identified as underlying factors, neglecting the potential role of health-related behaviours. This study investigates the mediating effect of lack of physical activity, smoking and alcohol consumption on ethnic inequalities in (mental) health in the Netherlands.

Design

Data from a municipal health survey (2012) in the four largest cities in the Netherlands, including 15,633 Dutch natives, 1,297 Surinamese, 850 Turks and 779 Moroccans were analysed. Mediation analyses were performed on the associations between ethnicity and psychological distress (range 10-50) and self-rated health (range 1-5).

Results

Being from an ethnic minority was associated with higher distress and poorer self-rated health, especially for Turks (higher distress 4.69, 95%CI 4.22 to 5.16; poorer health 0.35, 95%CI 0.30 to 0.40). Moroccans and Turks were the least physically active, Turks smoked the most, and Dutch natives drank the most. Lack of physical activity partially mediated the association between Turks (6% respectively 11%) and Moroccans (13% respectively 9%) for psychological distress and self-rated health. Smoking played a mediating role (3%) in Turks.

Conclusion

Lower physical activity and smoking more cigarettes partly explained ethnic health inequalities in the Netherlands. The current findings suggest that intervening and facilitating certain ethnic groups in engaging in health behaviours could contribute to improving their health and reduce ethnic health inequalities.

INTRODUCTION

There have been consistent reports in the literature of health inequalities between ethnic minority groups and natives around the world [1, 2]. Also in The Netherlands, 45% of Turks, 39% of Moroccan and 29% of Surinamese, which are the three largest ethnic minority groups in the Netherlands, experience their health as poor compared to 15% of Dutch natives [3]. In addition, recent studies show that Turks and Moroccans use more antidepressants than Dutch natives [4]. Self-rated health is an important predictor of mortality [5], and psychological distress is associated with increased risk of cerebrovascular disease [6]. To reduce ethnic health inequalities, it is important to identify factors that contribute to these inequalities.

Previous studies sought the explanation of these ethnic health inequalities primarily in differences in socioeconomic circumstances [7, 8]. Alcántara and colleagues found an association between downward social mobility after migration and poor physical and mental health [9]. Forced migration, the complexity of the acculturation process and a lack of social network were also found to be related to mental illness [10]. Studies that considered racial discrimination found that perceived discrimination was associated with poorer physical and mental health [11, 12].

Although socioeconomic circumstances can partly explain the ethnic health inequalities observed, other factors are likely to be at play as well. Other well-established determinants of health, such as health-related behaviours, have received considerable less attention in research aimed to explain ethnic (mental) health inequalities. Health-related behaviours such as physical inactivity, smoking and alcohol consumption are related to both poorer self-rated health [13-15] and being from a non-Western ethnicity [16-18]. Therefore, these behaviours are potential factors that explain ethnic health-inequalities.

Physical inactivity is the fourth leading cause of death worldwide [19], increasing the risk of colon and breast cancer, coronary heart diseases, stroke, diabetes type 2 and is responsible for 9% premature mortality worldwide [20]; is associated with higher depressive symptoms and lower emotional well-being [21]. Likewise, smoking is an important cause of several diseases such as coronary heart diseases, COPD and various types of cancer [22]. Additionally, it was found that smoking increases the risk of depressive symptoms [23]. Alcohol consumption affects health depending on the amount consumed; binge drinking is associated with depression [24] whilst light to moderate alcohol consumption, in older ages, is associated with a reduced risk of cardiovascular disease [25] and dementia [26].

Furthermore, there is a growing body of evidence suggesting a relation between belonging to an ethnic minority and engaging in a less healthy lifestyle. Of the largest ethnic groups in the Netherlands, Moroccans engage the least in physical activity: only a quarter of

them meets the national guidelines of recommended physical activity, followed by Turks and Surinamese [27]. In the Netherlands, Turks smoke more than Dutch natives, Moroccans the least while Surinamese smoke as much as Dutch natives [28]. On the other hand, alcohol consumption is less common amongst Turks and Moroccans than Dutch natives [28].

In summary, ethnic minority groups experience more psychological distress and worse health than Dutch natives, they engage less in health-related behaviours, with the exception of alcohol consumption, and it is well-known that health-related behaviours are associated with enhanced physical and mental health. However, it is not clear whether these health-related behaviours are important mediators of the association between ethnicity and (mental) health. Therefore, the aim of this study was to investigate whether health-related behaviours mediate the relation between belonging to an ethnic minority and experiencing poor (mental) health in the Netherlands.

METHODS

Data Source and Participants

We conducted secondary analysis on survey data gathered in 2012 among citizens aged 19 years and older by the four Public Health Services in Amsterdam, Rotterdam, The Hague and Utrecht in collaboration with National Institute for Public Health and Environment (RIVM) and Statistics Netherlands (CBS). The data includes information on demographics, socioeconomic status, mental and physical health, chronic disease, social wellbeing, health-related behaviours, and health care use of the participants. From the records of the municipal administration in each city, a random stratified sample by district and age was drawn of all citizens aged 19 years and older (71,301 adults). Participants had the possibility of filling in a digital or paper questionnaire or to participate in an interview either by phone or face-to-face at their home. In total 28,653 respondents completed the questionnaire resulting in a response of 40%. We focused our analyses to respondents from the three largest ethnic minority groups in the Netherlands: Surinamese (n = 1,297), Turks (n = 850) and Moroccans (n = 779), and native Dutch (n = 15,633), because in the four major Dutch cities (Amsterdam, Rotterdam, The Hague and Utrecht), the three largest ethnic minority groups represent a substantial part of the population: 23% of the residents in Rotterdam, Amsterdam and The Hague and 16% in Utrecht. Across the country, they form only 7% of the Dutch population [29].

By participating in this survey respondents gave permission to use their answers for scientific purposes. The dataset is anonymous and the Dutch Code of Conduct for Medical Research allows the use of anonymous data for research purposes, without an explicit informed consent [30].

Measures

Ethnic origin

Ethnic background of the respondents was determined by the country of birth of parents and the respondent, according to the standard definition of Statistics Netherlands [31]. If a citizen, or (one of) his or her parents, is born outside the Netherlands, this country of birth determines the ethnic background. If the parents were born in different foreign countries, the country of birth of the mother determines the ethnic background. Citizens who are Dutch-born and whose parents are also Dutch-born are considered native Dutch.

Psychological Distress

The Kessler Psychological Distress Scale (K10) was used as an indicator for mental health [32]. As shown by Andrews & Slade [33] the scale has a high sensitivity and specificity for diagnosis of DSM-IV or ICD-10 anxiety or affective disorders. The K10 scale consists of 10 questions that measure a person's level of anxiety and depressive symptoms in the previous four weeks. The items included were: "Did you feel …1) tired out for no good reasons?", 2) nervous?", 3) so nervous that nothing could calm you down?", 4) hopeless?", 5) restless or fidgety?", 6) so restless that you could not sit still?", 7) depressed?", 8) that everything was an effort?", 9) so sad that nothing could cheer you up?" and 10) worthless?". Each item has five response categories "none of the time", "a little of the time", "some of the time", "most of the time" and "all of the time". Cronbach's alpha was 0.93, therefore a sum-score was calculated (range 10-50), with higher scores reflecting more psychological distress.

Self-rated health

Self-rated health was measured with the question: How would you describe your general health? Five answers were possible: 1) excellent, 2) very good, 3) good, 4) fair and 5) poor [5].

Health-related behaviours

Hours of physical activity per day were assessed with the Dutch version of the *S*hort *QU*estionnaire to *AS*sess *H*ealth-enhancing physical activity (SQUASH), which has been validated in the European-Dutch population [34]. The questionnaire covers items on four domains: 1) commuting (walking and bicycling), 2) occupational or school-related, 3) household, and 4) leisure time (walking, bicycling, gardening, odd jobs and sports) and consists of three main queries: days per week, average time per day and intensity. Briefly, results from the SQUASH, i.e. all activities regardless of intensity, were converted to hours per day. Smoking was assessed asking how many cigarettes on overage per day were

smoked. Alcohol consumption considered how many glasses of alcohol of any kind on average per week were drunk.

Covariates

Gender, age (3 categories: 19-34, 35-64 and older than 65); marital status (4 categories: married or living together, unmarried, divorced and widowed) and city (Amsterdam, Rotterdam, The Hague and Utrecht) were derived from the questionnaires. Socioeconomic covariates were education (4 categories: primary school, lower general secondary education, higher general secondary education, and college or university) and income per year (quintiles: less than 15,200 euro, 15,200-19,400 euro, 19,401-24,200 euro, 24,201-31,000 euro and >31,000 euro).

Data analysis

Univariate analyses (one-way ANOVA and Chi-square test) were used to assess the associations between ethnicity and individual factors. The method of Baron & Kenny was used to conduct a mediation analysis for each ethnic group compared to Dutch natives [35]. In this approach a set of three regression analyses was conducted as shown in the conceptual mediation model (Figure 1).

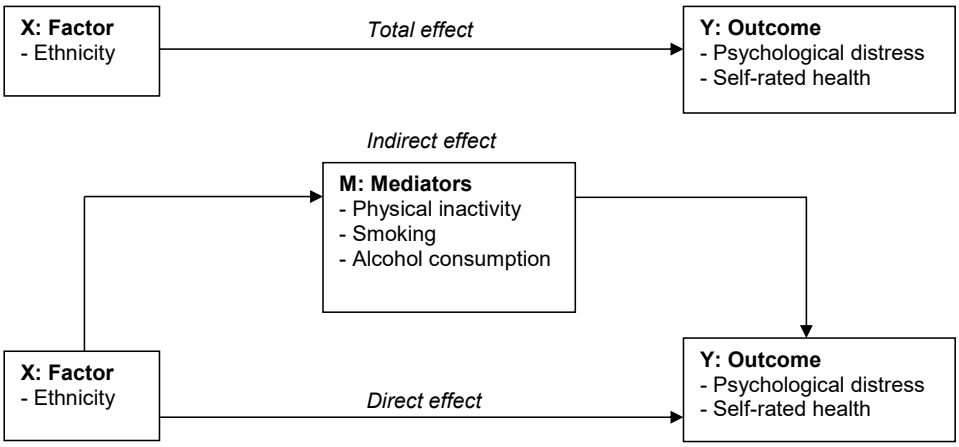


Figure 1. Conceptual mediation model

First, to identify whether there were ethnic health disparities, the association between ethnicity and the outcome variables was tested (*the total effect)*. Then, the association between ethnicity and the potential mediators was investigated to identify whether there are ethnic differences in the mediating variables. Finally, the association between ethnicity and the outcome variables was tested adjusted for the mediators (*the direct effect*). These latter analyses give also results of the association of the mediators with the outcome variables adjusted for ethnicity. *The indirect effect* is the effect of ethnicity on the outcome variables through the mediators and can be calculated by multiplying the estimated coefficients of the associations between ethnicity and the mediators with the estimated coefficients of the associations between the mediators and the outcome variables (see Figure 1). The proportion mediated was calculated by the total effect minus direct effect dividing by the total effect. No mediation analysis was performed if the potential mediators did not meet the assumptions: 1) ethnicity must be significantly associated with mediators, 2) mediators must be significantly associated with the health outcomes (psychological distress and self-rated health). The mediation analyses were conducted using the SPSS macro PROCESS of Preacher & Hayes. This macro calculates and tests the indirect effects by bootstrapping to generate a confidence interval around the indirect effect [36]. All analyses were adjusted for gender, age, marital status, education, income and city as they are also considered to be determinants of health [7]. Analyses were conducted in SPSS 19 and a result was considered to be statistically significant if the *p*-value was <0.05.

The conceptual mediation model hypothesizes that (a) ethnic minorities may have poorer health behaviours than native Dutch, and (b) that these poorer health behaviours are associated with poorer self-rated health and more psychological distress. Hence, in cases where ethnic minority groups demonstrated more desirable health behaviours than native Dutch, no mediation analysis was performed. Since the differences in (mental) health between Dutch natives and ethnic minorities may be associated with unhealthy behaviours among ethnic minorities, we focused in this study only on the unhealthy behaviours among ethnic minorities to reduce the health gap with Dutch natives.

RESULTS

Descriptive statistics

Compared to Dutch natives, ethnic minority groups showed less favourable health outcomes, i.e. higher psychological distress and lower self-reported health (Table 1). Moroccans engaged the least in physical activity whilst Dutch natives the most; Dutch natives drank the

most glasses of alcohol per week whilst Moroccan the least. Turks smoked the most. Ethnic minority groups received less education and earned substantially less than Dutch natives.

Table 1 Characteristics of the study respondents: ethnic minority groups living in the four largest cities in the Netherlands in 2012 (N= 18,559)

	Ethnicity				
	Turks (N=850) M (SD)	Moroccans (N=779) M (SD)	Surinamese (N=1,297) M (SD)	Dutch natives (N=15,633) M (SD)	
Health outcomes					
Psychological distress (10-50)	22.9 (10.1)	20.2 (9.2)	19.1 (8.8)	16.3 (6.5)	*
Self-rated health (1-5)	2.6 (0.9)	2.6 (1.0)	2.4 (0.9)	2.1 (0.8)	*
Health-related behaviours					
Physical activity (hours per day)	5.2 (3.9)	5.1 (3.9)	5.8 (3.8)	5.9 (3.4)	*
Cigarettes smoked (per day)	4.6 (8.9)	1.4 (4.7)	1.9 (4.6)	2.3 (6.0)	*
Glasses of alcohol (per week)	1.1 (4.0)	0.5 (4.8)	3.4 (8.1)	8.0 (10.0)	*
	Percentage of the sample				
Gender					
Man	46.5	49.7	43.1	46.1	
Woman	53.5	50.3	56.9	53.9	
Age					*
19-34 years	37.4	29.3	27.5	26.8	
35-64 years	47.9	51.2	44.9	35.5	
≥ 65 years	14.7	19.5	27.6	37.6	
Marital status					*
Married, living together	64.1	73.4	39.1	57.6	
Unmarried, never been married	20.8	16.0	33.5	25.0	
Divorced	9.9	6.7	19.4	7.9	
Widow, widower	5.2	3.9	7.9	9.5	
Education					*
Primary school	36.7	44.3	19.7	7.5	
Lower general secondary education	20.7	20.4	29.6	28.7	
Higher general secondary education	26.0	21.2	29.1	25.4	
College, university	16.6	14.1	21.6	38.5	
Income in quintiles per year					*
0 to 20% (max 15.200 euro)	41.9	45.6	27.9	13.7	
20 to 40% (max 19.400 euro)	22.9	28.2	21.7	17.0	
40 to 60% (max 24.200 euro)	16.1	14.0	17.1	19.6	
60 to 80% (max 31.000 euro)	12.7	8.2	20.1	22.0	
80 to 100% (> 31.000 euro)	6.4	4.0	13.2	27.6	
Cities					*
Amsterdam	23.9	36.3	26.9	23.8	
Rotterdam	48.2	32.7	42.4	48.5	
The Hague	18.9	13.4	26.6	12.4	
Utrecht	8.9	17.6	4.1	15.3	

* Significant ($p<0.05$), based on the one-way ANOVA and the Chi-square test.

Ethnicity and health-related behaviours

Adjusted for covariates (Table 2), Turks (B: -0.98, 95%CI -1.20 to -0.75) and Moroccans (B: -0.82, 95%CI -1.06 to -0.59) engaged in less physical activity than natives Dutch, Turks smoked more in comparison with Dutch natives (B: 1.10, 95%CI 0.66 to 1.54) whilst Moroccans (B: -2.17, 95%CI -2.61 to -1.72) and Surinamese (B: -1.48, 95%CI -1.82 to -1.15) smoked less than Dutch natives. All three ethnic groups consumed less alcohol than Dutch natives. As Surinamese ethnicity did not significantly predict engaging in physical activity, this was not considered in the mediation analysis. We tested whether there was a significant association between mediators and the health outcomes. Our analyses showed no significant association between alcohol consumption and the health outcomes for Turks, Moroccans, and Surinamese (not shown). As alcohol consumption did not meet the assumption, this was not considered in the mediation analysis. Further, as Moroccans and Surinamese smoked less than Dutch natives, smoking was considered in the mediation analysis only for Turks.

Table 2 Linear regression analysis of ethnicity compared to Dutch on three health-related behaviours[c] in the four largest cities in the Netherlands in 2012

	Physical activity[a]	Smoking[a]	Alcohol[a]
	B[b] (95%CI)	B[b] (95%CI)	B[b] (95%CI)
Turks	**-0.98** (-1.20 to -0.75)	**1.10** (0.66 to 1.54)	**-6.31** (-7.00 to -5.63)
Moroccans	**-0.82** (-1.06 to -0.59)	**-2.17** (-2.61 to -1.72)	**-7.21** (-7.94 to -6.48)
Surinamese	-0.16 (-0.33 to 0.02)	**-1.48** (-1.82 to -1.15)	**-4.31** (-4.87 to -3.76)

Note: CI = confidence interval.

Sample size: Turks (n = 850), Moroccans (n = 779), Surinamese (n = 1,297), and native Dutch (n = 15,633).

[a] Physical activity = hours per day; smoking = cigarettes per day; alcohol = glasses per week.

[b] Bold values are significant (p<0.05).

[c] All models are controlled for individual factors: age, gender, marital status, education, income and city.

Ethnicity and psychological distress and self-rated health

Ethnicity was significantly associated with higher psychological distress and poorer self-rated health (Table 3 and Table 4, Model 1). After controlling for covariates, the results indicate that Turks (B: 4.69, 95%CI 4.22 to 5.16), Moroccans (B: 1.84, 95%CI 1.35 to 2.33), and Surinamese (B: 1.40, 95%CI 1.03 to 1.78) reported higher psychological distress than Dutch natives. Table 4, model 1 shows that Turkish respondents reported the worst self-rated health (B: 0.35, 95%CI 0.30 to 0.40) followed by Moroccans (B: 0.32, 95%CI 0.27 to 0.38) and Surinamese (B: 0.20, 95%CI 0.16 to 0.24).

Table 3 Linear regression analysis of ethnicity compared to Dutch on psychological distress[c] (Model 1) and with health-related behaviours as mediators (Model 2a and 2b) in the four largest cities in the Netherlands in 2012

	Model 1	Model 2a	Model 2b
	B[b] (95%CI)	B[b] (95%CI)	B[b] (95%CI)
Turks			
Psychological distress	**4.69** (4.22 to 5.16)	**4.42** (3.96 to 4.89)	**4.56** (4.10 to 5.03)
Physical activity[a]		**-0.27** (-0.30 to -0.24)	
Smoking[a]			**0.11** (0.10 to 0.13)
Moroccans			
Psychological distress	**1.84** (1.35 to 2.33)	**1.61** (1.12 to 2.10)	na
Physical activity[a]		**-0.28** (-0.31 to -0.25)	
Smoking[a]			na
Surinamese			
Psychological distress	**1.40** (1.03 to 1.78)	na	na
Physical activity[a]		na	
Smoking[a]			na

Note: CI = confidence interval; na: not applicable.
Sample size: Turks (n = 850), Moroccans (n = 779), Surinamese (n = 1,297), and native Dutch (n = 15,633).
[a] Physical activity = hours per day; smoking = cigarettes per day.
[b] Bold values are significant (p<0.05).
[c] All models are controlled for individual factors: age, gender, marital status, education, income and city.

Table 4 Linear regression analysis of ethnicity compared to Dutch on self-rated health[c] (Model 1) and with health-related behaviours as mediators (Model 2a and 2b) in the four largest cities in the Netherlands in 2012

	Model 1	Model 2a	Model 2b
	B[b] (95%CI)	B[b] (95%CI)	B[b] (95%CI)
Turks			
Self-rated health	**0.35** (0.30 to 0.40)	**0.31** (0.26 to 0.36)	**0.34** (0.29 to 0.39)
Physical activity[a]		**-0.05** (-0.05 to -0.04)	
Smoking[a]			**0.01** (0.01 to 0.01)
Moroccans			
Self-rated health	**0.32** (0.27 to 0.38)	**0.29** (0.23 to 0.34)	na
Physical activity[a]		**-0.05** (-0.05 to -0.04)	
Smoking[a]			na
Surinamese			
Self-rated health	**0.20** (0.16 to 0.24)	na	na
Physical activity[a]		na	
Smoking[a]			na

Note: CI = confidence interval; na: not applicable.
Sample size: Turks (n = 850), Moroccans (n = 779), Surinamese (n = 1,297), and native Dutch (n = 15,633).
[a] Physical activity = hours per day; smoking = cigarettes per day.
[b] Bold values are significant (p<0.05).
[c] All models are controlled for individual factors: age, gender, marital status, education, income and city.

Health-related behaviours in relation to psychological distress and self-rated health

Table 3, Model 2a shows that engaging in less physical activity was associated with increased psychological distress amongst Turks (B: -0.27, 95%CI -0.30 to -0.24), and Moroccans (B: -0.28, 95%CI -0.31 to -0.25). Amongst Turks smoking more was associated with higher psychological distress (B: 0.11, 95%CI 0.10 to 0.13) (Model 2b). Similarly, table 4, Model 2a shows that lower levels of physical activity were related to poorer self-rated health amongst both Turks (B: -0.05, 95%CI -0.05 to -0.04) and Moroccans (B: -0.05, 95%CI -0.05 to -0.04), whilst smoking more was associated with poorer self-rated health amongst Turks (B: 0.01, 95%CI 0.01 to 0.01) (Model 2b).

Partial mediation

Figure 2 illustrates the conceptual mediation model for Turks. The upper part of the model depicts the effect of ethnicity (i.e. Turks compared to native Dutch) on psychological distress, without taking into account physical activity as a mediator, while the lower part of the model depicts the effect of ethnicity including physical activity as a mediator. Physical activity significantly mediated the association between being Turkish and experiencing psychological distress, as it weakened the association between ethnicity and psychological distress, explaining 6% ((4.69-4.42/4.69)*100%) of the association [indirect effect: 0.27 (95%CI: 0.19 to 0.36)].

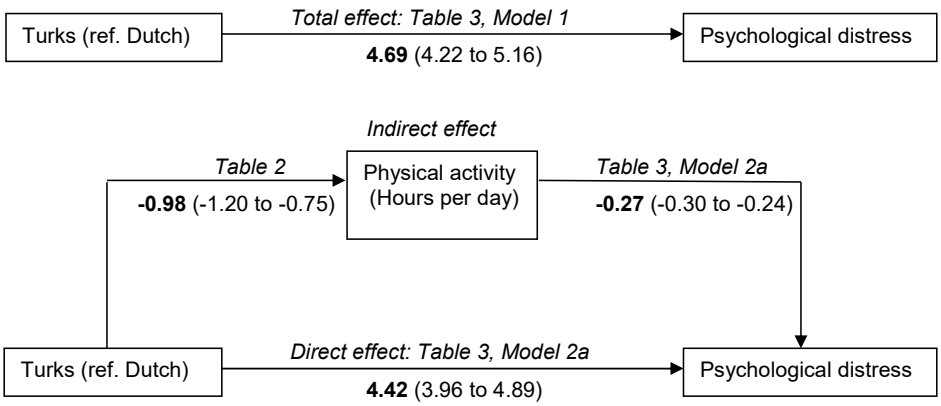


Figure 2. Physical activity as a mediator of the association between Turks compared to native Dutch and psychological distress

Physical activity also significantly mediated the association between being Moroccan and experiencing psychological distress, explaining 13% of the association [indirect effect: 0.23 (95%CI: 0.15 to 0.32)]. Smoking significantly mediated the association between being Turkish and experiencing psychological distress, mediating 3% of the model [indirect effect: 0.13 (95%CI: 0.05 to 0.20)].

Physical activity significantly mediated the association of ethnicity on self-rated health, mediating 11% of the model amongst Turks [indirect effect: 0.05 (95%CI: 0.03 to 0.06)] and 9% amongst Moroccans [indirect effect: 0.04 (95%CI: 0.02 to 0.05)]. Smoking also significantly mediated the association between being Turkish and self-rated health, and accounted for 3% of the model [indirect effect: 0.01 (95%CI: 0.00 to 0.02)].

DISCUSSION

This study showed that Turks, Moroccans and Surinamese in the Netherlands experienced higher levels of psychological distress and poorer self-rated health than Dutch natives. Health-related behaviours explained a small part of the association between ethnicity with psychological distress and self-rated health amongst Turks and Moroccans. For Turks and Moroccans lack of physical activity mediated respectively 6% and 13% of the association between ethnicity and psychological distress, and respectively 11% and 9% of the association between ethnicity and self-rated health. Additionally, for Turks smoking mediated 3% of both associations.

In line with previous studies, Moroccans and Turks engaged less in physical activity than Dutch natives, and Turks smoked more than Dutch natives [27, 28]. Moroccans, Turks and Surinamese, however, drank less alcohol than Dutch natives. Lower occurrence of healthy behaviours amongst ethnic groups may be explained by unfavourable socioeconomic factors, which have shown strong association with health behaviours [37]. It has been shown that highly educated people are less likely to smoke, consume alcohol moderately, and engage more in physical activity [38]. In our study, we found significant associations between ethnicity and health-related behaviours beyond the effects of socioeconomic factors. Furthermore, living in a deprived area may contribute to poor health and a higher smoking prevalence [39]. Most ethnic minorities tend to settle in deprived neighbourhoods where co-ethnics are already present in large numbers. Hence, social norms and social influences may influence engaging in particular behaviours, such as smoking amongst Turks. In addition, many ethnic groups live in neighbourhoods that lack access to environmental resources such as safe parks and recreational facilities which have been proven to increase the intention of engaging in sports [40].

In our study, lower physical activity amongst Turks and Moroccan, and smoking more cigarettes amongst Turks explained a small and similar amount of variance (3% to 13%) in psychological distress and self-rated health. A possible explanation for this partial mediation can be found in the meta-analysis of Loef and Walach which postulates that the combination of multiple lifestyle factors can influence the health of the population more than a single health behaviour [41]. Our research focused on health behaviours separately, possibly renouncing a combined stronger effect. This hypothesis could be supported by the fact that the group who is most psychologically distressed and has the lowest self-rated health are Turks, the group that has the least healthy lifestyle, smoking more and engaging the least in physical activity. Furthermore, as shown by previous research, discrimination, forced migration, downward social mobility after migration, a lack of social support and the complexity of acculturation also play an important role in explaining ethnic health inequalities [9, 10, 12]. A recent study in the Netherlands found that perceived discrimination contributes considerably to depression in ethnic minority groups in Amsterdam. The contributions of perceived discrimination to prevalence of depression were around 25% in Turks and Surinamese and 15% in Ghanaians [11].

Strengths and limitations

To our knowledge, no study until now has investigated whether and to which extent the association between ethnicity and self-rated health and psychological distress is mediated by health-related behaviours. Even though the proportion mediated was small, there was a significant indirect effect which means that the mediators play a weak to moderate role in the association between ethnicity and the health outcomes under study. In addition, the consequences of lack of physical activity and smoking may become increasingly important given the rising levels of physical inactivity [42] and the higher rates of smoking [43] among ethnic minorities. Secondly, using Baron and Kenny's steps together with bootstrapped indirect effects of the mediators in SPSS macro PROCESS of Preacher & Hayes, offers a more rigorous method to calculate and test the significance of the indirect effect.

Some limitations of the present study warrant discussion. First of all, it is important to point out that the mediation analysis in this cross-sectional study does not infer a causal relationship and that the associations found have to be interpreted carefully. It may be the case that ethnic minorities engage in less healthy behaviours as a consequence of poor (mental) health and not vice versa. The health status and its determinants (i.e. socioeconomic status, exposure to discrimination) may shape one's health choices; individuals belonging to ethnic groups who experience discrimination may be more prone to smoke [44]. In the literature there are no definitive conclusions on the direction of association between health-related factors and (mental) health [45, 46]. However, there is substantial

support in the literature for the idea that health-related behaviours affect (mental) health [13, 47]. We believe that longitudinal studies are needed to shed more light on this fundamental question and we also believe that this study provides insight into whether health-related behaviours contribute to explaining ethnic differences in mental health. Secondly, the SQUASH is a commonly used questionnaire in the Netherlands, which has been validated in European-Dutch population, but not in ethnic minority groups [34]. Other authors that used the SQUASH amongst Dutch minorities, considered just some of the items, e.g. intense physical activity, or integrated the questionnaire with other questions about cultural specific physical activities such as for instance dancing [48]. In the current study, the choice was made to calculate the sum of all types of physical activity, as these can all contribute to the general wellbeing of a person or if avoided, to his/her malaise [20]. Lastly, the survey had a low response (40%). It is plausible that respondents have a better physical and mental health than non-respondents. If so, we cannot entirely rule out an overestimation of the results found, although health surveys of the Public Health Services in the Netherlands usually have a higher response than other community-based surveys.

Conclusions

Turks, Moroccans and Surinamese in the Netherlands experienced higher levels of psychological distress and poorer self-rated health than Dutch natives. Health-related behaviours, i.e. physical inactivity and smoking, were weak to moderate mediators of the relation between ethnicity and psychological distress and self-rated health. The findings suggest that promoting engagement in healthy behaviours among ethnic minorities might contribute to a reduction of ethnic health inequalities.

What is already known on this subject?

- Health-related behaviours influence health. It is known that ethnic minorities engage in less healthy behaviours than Dutch natives and that their health is worse than natives.
- Socioeconomic factors, discrimination and immigration process may also influence ethnic group's health.

What this study adds?

- In the Netherlands, the association between ethnicity and higher psychological distress and lower self-rated health is partly mediated by lack of physical activity and smoking.

- The health inequality is partially (3% to 13%) explained by a lower engagement in physical activity amongst Turks and Moroccans, and a higher smoking rate amongst Turks.

REFERENCES

1 Kobayashi KM, Prus S, Lin Z. Ethnic differences in self-rated and functional health: does immigrant status matter? *Ethnicity and Health* 2008;13:129-47.

2 Nielsen SS, Krasnik A. Poorer self-perceived health among migrants and ethnic minorities versus the majority population in Europe: a systematic review. *International journal of public health* 2010;55:357-71.

3 Devillé W, Uiters E, Westert G*, et al.* Perceived health and consultation of GPs among ethnic minorities compared to the general population in the Netherlands. *Morbidity, performance and quality in primary care: Dutch general practice on stage Oxxon: Radcliffe Publishing* 2006;85:96.

4 Wittkampf LC, Smeets HM, Knol MJ*, et al.* Differences in psychotropic drug prescriptions among ethnic groups in the Netherlands. *Social psychiatry and psychiatric epidemiology* 2010;45:819-26.

5 Galenkamp H, Deeg DJ, Braam AW*, et al.* "How was your health 3 years ago?" Predicting mortality in older adults using a retrospective change measure of self-rated health. *Geriatrics & gerontology international* 2013;13:678-86.

6 Hamer M, Kivimaki M, Stamatakis E*, et al.* Psychological distress as a risk factor for death from cerebrovascular disease. *Canadian Medical Association Journal* 2012;184:1461-6.

7 Beck AN, Finch BK, Lin S-F*, et al.* Racial disparities in self-rated health: Trends, explanatory factors, and the changing role of socio-demographics. *Social Science & Medicine* 2014;104:163-77.

8 Wiking E, Johansson S-E, Sundquist J. Ethnicity, acculturation, and self reported health. A population based study among immigrants from Poland, Turkey, and Iran in Sweden. *Journal of epidemiology and community health* 2004;58:574-82.

9 Alcántara C, Chen C-N, Alegría M. Do post-migration perceptions of social mobility matter for Latino immigrant health? *Social Science & Medicine* 2014;101:94-106.

10 Bhugra D, Becker MA. Migration, cultural bereavement and cultural identity. *World Psychiatry* 2005;4:18.

11 Ikram UZ, Snijder MB, Fassaert TJ*, et al.* The contribution of perceived ethnic discrimination to the prevalence of depression. *The European Journal of Public Health* 2015;25:243-8.

12 Williams DR, Neighbors HW, Jackson JS. Racial/ethnic discrimination and health: findings from community studies. *American journal of public health* 2003;93:200-8.

13 Moor I, Rathmann K, Stronks K*, et al.* Psychosocial and behavioural factors in the explanation of socioeconomic inequalities in adolescent health: a multilevel analysis in 28 European and North American countries. *Journal of epidemiology and community health* 2014;68:912-21.

14 Okosun I, Seale J, Daniel J*, et al.* Poor health is associated with episodic heavy alcohol use: evidence from a National Survey. *Public Health* 2005;119:509-17.

15 Rütten A, Abel T, Kannas L*, et al.* Self reported physical activity, public health, and perceived environment: results from a comparative European study. *Journal of epidemiology and community health* 2001;55:139-46.

16 Kuipers MA, Jongeneel-Grimen B, Droomers M*, et al.* Why residents of Dutch deprived neighbourhoods are less likely to be heavy drinkers: the role of individual and contextual characteristics. *Journal of epidemiology and community health* 2013:jech-2012-201242.

17 Reijneveld S, Westhoff M, Hopman-Rock M. Promotion of health and physical activity improves the mental health of elderly immigrants: results of a group randomised controlled trial among Turkish immigrants in the Netherlands aged 45 and over. *Journal of epidemiology and community health* 2003;57:405-11.

18 Troe E-JW, Raat H, Jaddoe VW*, et al.* Smoking during pregnancy in ethnic populations: the Generation R study. *Nicotine & tobacco research* 2008;10:1373-84.

19 Kohl HW, Craig CL, Lambert EV*, et al.* The pandemic of physical inactivity: global action for public health. *The lancet* 2012;380:294-305.

20 Lee I-M, Shiroma EJ, Lobelo F*, et al.* Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *The lancet* 2012;380:219-29.

21 Galper DI, Trivedi MH, Barlow CE*, et al.* Inverse association between physical inactivity and mental health in men and women. *Medicine and Science in Sports and Exercise* 2006;38:173.

22 Vineis P, Alavanja M, Buffler P*, et al.* Tobacco and cancer: recent epidemiological evidence. *Journal of the National Cancer Institute* 2004;96:99-106.

23 Boden JM, Fergusson DM, Horwood LJ. Cigarette smoking and depression: tests of causal linkages using a longitudinal birth cohort. *The British Journal of Psychiatry* 2010;196:440-6.

24 Okoro CA, Brewer RD, Naimi TS*, et al.* Binge drinking and health-related quality of life: do popular perceptions match reality? *American journal of preventive medicine* 2004;26:230-3.

25 Ronksley PE, Brien SE, Turner BJ*, et al.* Association of alcohol consumption with selected cardiovascular disease outcomes: a systematic review and meta-analysis. *Bmj* 2011;342:d671.

26 Ruitenberg A, van Swieten JC, Witteman JC*, et al.* Alcohol consumption and risk of dementia: the Rotterdam Study. *The lancet* 2002;359:281-6.

27 Hildebrandt VH, Bernaards C, Stubbe J. Trendrapport bewegen en gezondheid 2010/2011. 2013.

28 Van Lindert H, Droomers M, Westert G. Een kwestie van verschil: verschillen in zelf-gerapporteerde leefstijl, gezondheid en zorggebruik. *Utrecht/Bilthoven: NIVEL, RIVM* 2004.

29 CBS. Regional core statistics the Netherlands. Statistics Netherlands 2013.

30 FEDERA. Code of conduct for medical research. 2012.

31 Statistics Netherlands. Hoe doet het CBS dat nou? Standaarddefinitie allochtonen [How does Statistics Netherlands do this? Standard Definition Immigrants]. Voorburg: Statistics Netherlands 2000:24-5.

32 Kessler RC, Andrews G, Colpe LJ*, et al.* Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychological medicine* 2002;32:959-76.

33 Andrews G, Slade T. Interpreting scores on the Kessler psychological distress scale (K10). *Australian and New Zealand journal of public health* 2001;25:494-7.

34 Wendel-Vos GW, Schuit AJ, Saris WH*, et al.* Reproducibility and relative validity of the short questionnaire to assess health-enhancing physical activity. *Journal of clinical epidemiology* 2003;56:1163-9.

35 Baron RM, Kenny DA. The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of personality and social psychology* 1986;51:1173.

36 Hayes AF. *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*: Guilford Press 2013.

37 Mackenbach JP. Socio-economic health differences in the Netherlands: a review of recent empirical findings. *Social Science & Medicine* 1992;34:213-26.

38 Brännlund A, Hammarström A, Strandh M. Education and health-behaviour among men and women in Sweden: A 27-year prospective cohort study. *Scandinavian journal of public health* 2013;41:284-92.

39 Rejineveld S. The impact of individual and area characteristics on urban socioeconomic differences in health and smoking. *International journal of epidemiology* 1998;27:33-40.

40 Prins RG, van Empelen P, te Velde SJ*, et al.* Availability of sports facilities as moderator of the intention–sports participation relationship among adolescents. *Health education research* 2010;25:489-97.

41 Loef M, Walach H. The combined effects of healthy lifestyle behaviors on all cause mortality: a systematic review and meta-analysis. *Preventive medicine* 2012;55:163-70.

42 Brodersen NH, Steptoe A, Boniface DR*, et al.* Trends in physical activity and sedentary behaviour in adolescence: ethnic and socioeconomic differences. *British Journal of Sports Medicine* 2007;41:140-4.

43 Karlsen S, Millward D, Sandford A. Investigating ethnic differences in current cigarette smoking over time using the health surveys for England. *The European Journal of Public Health* 2011:ckr097.

44 Corral I, Landrine H. Racial discrimination and health-promoting vs damaging behaviors among African-American adults. *Journal of health psychology* 2012:1359105311435429.

45 Roshanaei-Moghaddam B, Katon WJ, Russo J. The longitudinal effects of depression on physical activity. *General hospital psychiatry* 2009;31:306-15.

46 Teychenne M, Ball K, Salmon J. Physical activity and likelihood of depression in adults: a review. *Preventive medicine* 2008;46:397-411.

47 Koster A, Bosma H, Kempen GI*, et al.* Socioeconomic differences in incident depression in older adults: the role of psychosocial factors, physical health status, and behavioral factors. *Journal of psychosomatic research* 2006;61:619-27.

48 de Hollander EL, Zwart L, de Vries SI*, et al.* The SQUASH was a more valid tool than the OBiN for categorizing adults according to the Dutch physical activity and the combined guideline. *Journal of clinical epidemiology* 2012;65:73-81.

CHAPTER 7

General discussion

This thesis departed from an increased interest in the role of neighbourhoods for health in public health and epidemiology. It was argued that the underlying reasons for this interest were various, including the revitalized interest in understanding the causes of social and ethnic inequalities in health, aligned with the increasing popularity and availability of methods and data-analysis techniques such as multilevel analysis. While the impact of neighbourhoods on many health outcomes were examined, the impact of neighbourhoods on individual mental health problems, like depression, has been understudied. Therefore, this thesis aimed to investigate which and how neighbourhood factors are related to mental health among urban adult residents.

This chapter begins with a summary of the main findings. Then, methodological considerations with regard to the studies in this thesis are delineated, followed by interpretation of the main findings. This chapter ends with recommendations for public health professionals and researchers.

MAIN FINDINGS

Structural neighbourhood conditions, depression and the potential mediating role of neighbourhood social cohesion

In chapter 2, the associations of structural neighbourhood conditions with individual mental health are examined and the potential mediating role of neighbourhood social cohesion is explored. Data from a number of data sources at the neighbourhood level were linked to a population health survey *(G4 Gezondheidsenquête 2008)* to answer this question. Of the neighbourhood factors studied (neighbourhood SES, amount of green area, home maintenance, social cohesion and urbanity) both a high neighbourhood social cohesion and high neighbourhood SES were associated with less psychological distress. Neighbourhood social cohesion had the strongest (inverse) association with psychological distress. The association between neighbourhood SES and psychological distress was mediated partly by social cohesion. In other words, adults living in neighbourhoods with lower SES or lower social cohesion were more likely to experience psychological distress and neighbourhood SES shaped psychological distress through neighbourhood social cohesion. We found no evidence for associations of the amount of green, urbanity and home maintenance with psychological distress.

Do neighbourhood factors moderate the associations of neighbourhood and individual socioeconomic factors or individual ethnicity with depression?

In chapter 3, socioeconomic inequalities in individual mental health and the moderating role of neighbourhood social cohesion are investigated. Ethnic inequalities in individual mental health and the moderating role of neighbourhood ethnic diversity are addressed in chapter 4. We have found inequalities in psychological distress among urban residents by employment status, levels of financial deprivation and ethnicity. Recipients of disability, social assistance or unemployment benefits reported higher psychological distress than those in paid employment. Persons with some or great financial difficulties reported higher psychological distress than those with little or no financial problems. Compared to native Dutch, Turkish and Moroccans residents reported higher psychological distress. Gender, age, marital status, years of residence in place and education were also associated with psychological distress, albeit less strong.

Residing in a neighbourhood with high social cohesion was significantly associated with lower psychological distress among urban residents. Neighbourhood social cohesion moderated the associations between employment status or financial deprivation and psychological distress. Living in a neighbourhood with a high social cohesion instead of a low social cohesion was associated with a lower psychological distress among recipients of disability, social assistance or unemployment benefits and among citizens with financial difficulties. A high neighbourhood social cohesion did not modify the associations between gender, age, ethnicity, marital status, education and, years of residence and psychological distress. Hence, neighbourhood social cohesion does not affect all urban residents equally. It may partly buffer the adverse effects of being poor, unemployed and disabled on depression.

Further, we found that neighbourhood ethnic diversity seems to have ethnic-specific effects on depression. Although residing in a high ethnic diverse neighbourhood was associated with more psychological distress among urban residents, the moderation analysis showed that Turkish residents in high ethnic diverse neighbourhoods reported less psychological distress than Turkish residents in low ethnic diverse neighbourhoods. This moderation effect was not observed for other ethnic minorities (Moroccan and Surinamese residents).

In chapter 5, we examined the associations between income inequality at neighbourhood and municipality level and psychological distress in the context of the relatively low income inequality in the Netherlands. Also, we examined whether the association between neighbourhood income inequality and psychological distress differed between low-income and high-income neighbourhoods. The same question was examined at the municipality level as well. Our study showed that the mean Gini coefficient across all municipalities and neighbourhoods was 0.26, with smaller variation between municipalities

(range 0.21-0.44) than between neighbourhoods (0.11-0.51). We found no significant association between neighbourhood income inequality and psychological distress, after adjustment for individual and neighbourhood level factors. However, we found a significant interaction between neighbourhood income inequality and neighbourhood income in relation to psychological distress. A higher neighbourhood income inequality in neighbourhoods with the middle to highest mean neighbourhood incomes was associated with more psychological distress, whereas no such effect was found in neighbourhoods with the lowest mean income levels. Among individuals living in neighbourhoods with the highest mean income, those living in neighbourhoods with the highest income inequality reported 2% higher psychological distress compared to those living in neighbourhoods with the lowest income inequality.

At the municipality level, we found a significant association between municipal income inequality and psychological distress, after adjustment for individual and municipal level factors. Individuals living in municipalities with the highest income inequality reported 2.5% higher psychological distress compared to those living in municipalities with the lowest income inequality. We found no differential impact from municipal income inequality on psychological distress by mean municipal income. Our results suggest that income inequality at the municipality level is more important as a risk factor for mental health than municipal mean income, while at the neighbourhood level, mean income is more important than income inequality.

Do health-related behaviours mediate the association between individual ethnicity and depression?

In chapter 6 we investigated the mediating effect of a lack of physical activity and smoking on ethnic inequalities in (mental) health. Based on data from the national public health survey carried out in 2012, it appeared that Turks, Moroccans and Surinamese in the Netherlands experienced higher levels of psychological distress and poorer self-rated health than Dutch natives. These results support the findings reported in chapter 4 that Turks and Moroccans experienced higher levels of psychological distress compared to native Dutch, which was based on data from the national public health survey carried out in 2008.

Moroccans and Turks were the least physically active, and Turks smoked the most. Health-related behaviours explained a small part of the association between ethnicity and psychological distress and self-rated health amongst Turks and Moroccans. For Turks and Moroccans lack of physical activity mediated respectively 6% and 13% of the association between ethnicity and psychological distress, and respectively 11% and 9% of the association between ethnicity and self-rated health. Additionally, among Turks smoking mediated 3% of both associations.

METHODOLOGICAL CONSIDERATIONS

Measurement of depression

The Composite International Diagnostic Interview (CIDI) questionnaire is nowadays widely considered as a standard for determining mental disorders, including depression. The CIDI is a comprehensive diagnostic instrument for the assessment of mental disorders according to the definitions and criteria of the Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV). In this thesis however, psychological distress was used as an indicator of depression [1, 2], measured by the Kessler Psychological Distress Scale (K10). The K10 scale consists of 10 items that measure a person's level of anxiety and depressive symptoms in the previous four weeks. Each item has five response categories "none of the time", "a little of the time", "some of the time", "most of the time" and "all of the time". Sum score ranges from 10 to 50, with higher scores reflecting more psychological distress. The K10 has been developed as a screening instrument for anxiety and depressive symptoms in the general population [3] and is becoming increasingly popular because of its brevity and strong psychometric properties [2, 4-8]. The K10 discriminates DSM-IV mental disorders from non-cases [2] and is strongly associated with the CIDI diagnosis of anxiety and affective disorders [1], which is nowadays the standard assessment tool for mental disorders [9]. The K10 therefore can be validly and reliably used to assess anxiety and depressive symptoms.

The K10 was translated into Dutch [10] and, as far as we know, validated by three Dutch studies among different study samples. In a study in primary care, the K10 proved to be reliable (Cronbach's: 0.94) and valid (area under the curve (*AUC:* 0.87)) in detecting any depressive disorders. At a cut-off of 20 points, sensitivity (0.80) and specificity (0.81) appeared sufficiently high to appreciate the K10 as an appropriate screening instrument [11]. Similarly, in a study among disability benefits claimants, the K10 proved to be reliable (Cronbach's: 0.92) and valid (*AUC:* 0.81) to screen for present state DSM-IV mental disorders. At the optimal cut-off score of 24, the sensitivity was 0.72 and the specificity was 0.78 [12]. In a general population sample of Dutch, Turkish and Moroccan participants, the K10 appears to be an adequate instrument to screen for anxiety and depression, with comparable sensitivity (~0.80) and specificity (~0.75), although a higher cut-off score for Turkish and Moroccan participants (22.5) than for Dutch participants (16.5) [9]. Although the use of the K10 is encouraged in the context of inter-ethnic population studies, applying the K10 to investigate the prevalence of common mental disorders requires different cut-off scores to achieve comparable sensitivity and specificity across ethnic groups [9].

In this thesis the K10 scores were used as a continuous variable (range 10-50) in line with other studies [13-15], because of the explorative nature of analyses to test for associations instead of describing prevalence rates of depression across population or ethnic

groups. Further, additional analysis in chapters 2 and 3 showed that the results found from multilevel logistic regression analysis (in which the K10 was dichotomized) pointed to the same direction as those from multilevel linear regression analysis.

Neighbourhood and constructing neighbourhood structural and social factors

Defining neighbourhood

An important aspect when examining environmental factors related to mental health, is how to define a neighbourhood and to construct measures at neighbourhood levels. Neighbourhoods are areas with a reasonably similar type of buildings of same age, and often delineated by natural boundaries, which makes neighbourhoods relatively homogeneous socioculturally [16]. Previous research has shown that there is a sense of community within Dutch neighbourhoods [17]. Neighbourhoods can also be defined by the four digit postal code, which corresponds to the route of a postman. These four digit postal code areas are quite similar to neighbourhoods and often have well-established names to which people identify themselves. In the Netherlands, there are about 4000 neighbourhoods. These areas comprise on average of approximately 4000 residents. In chapters 2-4 we defined neighbourhoods based on the four digit postal code. In chapter 6 we were able to use the more refined division of the neighbourhood classification system of Statistics Netherlands (about 12,000 neighbourhoods) whereby neighbourhood boundaries were determined by local authorities themselves within their municipality. These neighbourhoods are more likely to be perceived as neighbourhoods by their residents than the four digit postal code area [18]. Traditional research on environmental factors has been criticized for the use of administrative neighbourhood boundaries because of scale and boundary effects [19]. According to this, the existence and strength of environmental effects on health are scale dependent. Generally, weaker effects may be found if a larger spatial scale is used (scale effects) and administrative borders may not be relevant in the daily lives of residents, especially for the residents living near the border of administrative areas. Hence, the use of both administratively defined neighbourhoods and by digit postal code defined neighbourhoods in the studies on the environmental effects on (mental) health may underestimate neighbourhood effects. In the literature it is recommended to overcome the scale and boundary effects by using “bespoke environments” or “buffers” [19-21], individually tailored areas around survey respondents in an accurate way. Some public health studies already have applied this approach to assess the association, for example, between the local neighbourhood conditions (i.e. the socioeconomic composition of the surrounding population of each individual) and (mental) health [19, 22] or between the amount of green space in people’s direct living environment and the prevalence of common mental disorders [23] and

the level of physical activity [24]. A major disadvantage of this approach is the need for precise data on place of residence of survey respondents. Data on six digit postal codes or home addresses are needed to create separate neighbourhoods for each individual survey respondents. Therefore, specific permission must be requested at the start of the survey. So, in a time of declining responses within survey research and limiting possibilities to enrich survey data due to privacy issues, this can have a response-reducing effect. Another disadvantage of bespoke environments is neighbourhoods cannot be easily targeted by policy makers who want to set specific policies or interventions for a neighbourhood.

Besides, the boundary effects don't seem to play an important role, since a number of studies that compared administrative areas with alternative definitions of neighbourhood boundaries found similar area effects on health outcomes [19, 25]. Considering the disadvantages of this approach and as long as there is no alternative method, we prefer the use of the more refined division of the neighbourhood classification system of Statistics Netherlands whereby neighbourhood boundaries were determined by local authorities themselves within their municipality.

Constructing measures at neighbourhood level

Conceptualizing and measuring factors at neighbourhood level continues to be a major challenge in epidemiology and public health [26]. In this thesis we used existing data on neighbourhood structural factors including neighbourhood SES, income inequality, ethnic composition, urban density, green area and physical conditions (i.e. quality of housing). These neighbourhood factors are considered to be "objective", because they are based on administrative data (such as household income or ethnicity) or individual-level measures (such as educational level or work status).

In contrast, neighbourhood social factors such as social cohesion considered to be "subjective" as these factors are subject to individual perception. This perception is likely to be influenced by characteristics of the individual (e.g. gender, ethnicity, age). Such measures are often aggregated to a neighbourhood level by taking the mean of the items measured at the individuals living in the neighbourhoods. The reliability and precision of the aggregated measure however, may differ between neighbourhoods, because it is likely that selective response may differ across neighbourhoods due to differences in neighbourhood socio-demographic composition (reliability) and that there are more respondents in one neighbourhood than in the other (precision). Another issue is that the separate items that measure for example social cohesion are not independent of each other, but nested within individuals. Therefore, the response to one item is likely to be strongly associated with a response on another item.

We conceptualized social cohesion as a neighbourhood construct (in chapters 2-3) and circumvented the above mentioned disadvantages by using the ecometrics method, as described by Raudenbush and Sampson [27, 28]. This method accounts for the nesting of social cohesion items within individuals, who in turn are nested within the neighbourhoods. A three-level linear regression model was used in which the item scores were the outcome. So, each response to each question by each participant was a separate row in the dataset. A categorical variable, indicating these five social cohesion items was included as level 1 predictor (items nested within individuals and neighbourhoods). The model was adjusted for six level 2 predictors (individual variables nested within neighbourhoods) that may influence the perception of social cohesion: gender, ethnicity, age, education, type of housing the adolescent lives in and years living in the current home. The residuals at the neighbourhood level, which represent the deviations of the outcome scores at the neighbourhood level from the overall mean value at the neighbourhood level (and on which the neighbourhood variance in the model is based), form the part that cannot be attributed to individual response patterns. In other words, these values represent the social cohesion variable at the neighbourhood level that cannot be explained by individual response patterns.

The use of ecometrics also allows to assess the reliability of the social cohesion measure, using the variance at all levels (variance between neighbourhoods, between individuals and between items) [29] In our thesis, the reliability, which has a similar interpretation as Cronbach's α, was 0.66, which is considered acceptable [30].

Finally, to prevent same-source bias we used other data sources for neighbourhood factors than the health survey of the outcome measure (i.e. individual mental health). Same-source bias is the possibility that the use of self-reported data for both the outcome measure and the neighbourhood factor (individual responses are aggregated) produces a spurious association between the outcome measure and the neighbourhood factor because the outcome measure affects the perception [26]. For example, persons who are depressed may be more likely to report less cohesion between neighbours than healthy persons. We have taken this into account in all chapters, where linking of data was the case.

Causal relationship between neighbourhood factors and individual mental health

In this thesis we investigated associations of a wide array of neighbourhood factors with individual mental health. The use of multilevel modelling in large samples allowed us to unravel the associations of these neighbourhood factors with individual mental health, above and beyond the socio-demographic and socioeconomic characteristics of individuals. We found significant associations between neighbourhood factors (i.e. lower SES, lower social cohesion, higher ethnic diversity, and higher income inequality) and poor mental health. It is well-known that this approach has limitations when interpreting our results. The most

important limitation of the studies presented in this thesis is the use of the cross-sectional data. Cross-sectional studies prohibit causal inferences, as both exposure variables and health outcomes are measured at one point in time. For example, we were not able to identify whether the cause, e.g. lower neighbourhood social cohesion, preceded the effect on mental health. We found that people who live in disadvantaged neighbourhoods (lower social cohesion or lower SES) more often had a poor mental health, but this might be due to selective residential mobility rather than causal neighbourhood effects. There are two hypotheses regarding the pathways linking the neighbourhood conditions to mental health. The social causation hypothesis suggests that poor neighbourhoods cause poor mental health. The circumstances in poor neighbourhoods are harmful to mental health. The selection/drift hypothesis suggests that poor mental health can hinder socioeconomic attainment and lead people to drift into poor neighbourhood environments. People in poor mental health have fewer opportunities and are not able to achieve favourable positions in society [31-33]. To date, the direction of association between neighbourhood SES and individual mental health has been unclear [34, 35], partly due to the cross-sectional design of the majority of previous studies in this field [36-38]. A few longitudinal studies on neighbourhood effects in individual mental health have provided some evidence to support the social selection hypothesis [39-41], while other studies on neighbourhood effects in individual mental health or health behaviours are more supportive for the social causation hypothesis [42, 43]. Studies in the Netherlands showed that health was a marginal reason for moving [44] and that migration did not enlarge inequalities in health between poor and rich neighbourhoods [45]. To rule out the potential confounding effect of selection, the multilevel regression models were adjusted for potential confounders, such as level of education, household income, marital status, and ethnicity. However, confounding by unobserved factors cannot fully be ruled out in such analyses. For example, persons living in different neighbourhoods may differ in other respects, such as residential preferences. A recent Dutch study showed that ethnic minorities are more likely than Dutch to move to ethnic minority-concentration neighbourhoods, probably because they prefer to live among members of their own ethnic group or are attracted by ethnic facilities in those neighbourhoods [46].

Other possibilities to test causality of neighbourhood effects are experimental and quasi-experimental neighbourhood studies but they are rarely feasible [43, 47].

INTERPRETATION OF FINDINGS

This thesis yields new findings with regard to neighbourhood associations with individual mental health and the interplay between neighbourhood- and individual-level factors in explaining individual mental health differences.

Despite small ICC neighbourhood-individual interactions in mental health exist

In this thesis multilevel linear models were fitted to unravel the associations of neighbourhood factors with individual mental health above and beyond individual level factors [48, 49]. Multilevel models, for example, allowed to include individual SES and neighbourhood SES in the same model to disentangle the associations of these two factors at two different levels with individual mental health. In this thesis the results of multilevel linear models showed that living in deprived neighbourhoods or in lower social cohesive neighbourhoods (chapters 2-3), in high ethnic diverse neighbourhoods (chapter 4), or in neighbourhoods with the highest income inequality (chapter 5) was linked to poor mental health above and beyond individual level factors. For all models, intraclass correlations (ICCs) were calculated to assess the proportion of the total variability in the outcome measure (i.e. individual mental health) that is attributable to the neighbourhoods [50]. The ICC is an indication of the correlation of the observations of the residents living in the same neighbourhood. In other words, it is an indication of the dependency of the resident observations within the neighbourhoods [49, 50]. In this thesis the intercepts-only models (which are used to test for significant variance in the outcome measure between the neighbourhoods) showed that approximately 97% of the random variation occurred at the individual-level and approximately 3% at the neighbourhood level (ICC=3%). After adjusting for the differences between the socio-demographic and socioeconomic factors, the ICC was close to 0%, suggesting that the differences in mental health between neighbourhoods were almost entirely attributable to the composition of the neighbourhoods. However, the existence of a small ICC does not necessarily imply that it is not worth exploring neighbourhood associations with individual mental health or interactions between neighbourhood factors and individual-level factors in relation to mental health [48, 50]. Findings from this thesis contribute to knowledge how neighbourhood factors can moderate relationships between subgroups of the population and mental health. In chapter 3 for example, whereas we observed almost no effect of neighbourhood social cohesion on mental health in the total population, there were strong differential effects within the population. People are influenced by their living environment and our findings showed that high neighbourhood social cohesion provided mental health benefits for the economically deprived groups by partly buffering the adverse effects of being poor and unemployed on

mental health. Hence, future studies are encouraged to distinguish between the overall influence of social cohesion on all citizens in a neighbourhood and a differential influence of social cohesion on specific subgroups.

To conclude, as illustrated in figure 1, the existence of a small ICC, which in this case means a small variability between the neighbourhoods, does not necessarily imply that there is no interaction between the neighbourhood factor and the individual-level factor in relation to the individual-level outcome. The association between the individual-level factor and the individual-level outcome can be different for different neighbourhoods. Hence, testing for interactions is definitely worth it and it might be integrated in the standard analytic procedure for neighbourhood studies on mental health.

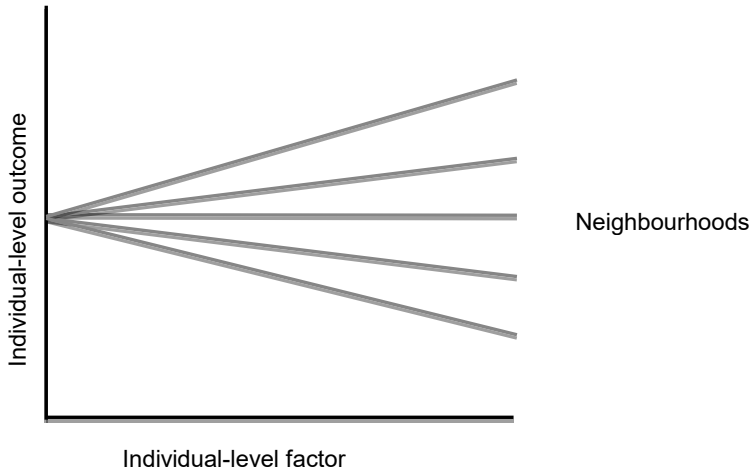


Figure 1 Illustration of the association between the individual-level factor and the individual-level outcome, with an interaction between the neighbourhood and the individual-level factor

Income inequality in municipalities and affluent neighbourhoods is a risk factor for mental health

The majority of studies linking income inequality to mental health outcomes are conducted at the country-level, because income inequality measured in small areas is thought to be less related to health, whereas mean income levels are thought to be more important [51, 52]. Yet, some of the proposed mechanisms for a link may operate at lower-than-country levels. According to the status anxiety hypothesis, income inequality affects mental health through the negative consequences of social comparisons [53]. It can be argued that such comparisons exert an impact upon persons in small geographic units as well [52]. Empirical studies of the association between income inequality in small areas and (mental) health have shown mixed results, with some studies finding that greater income inequality is significantly associated with depression [54], poor self-rated health [55] or emotional distress [56], whereas other studies reported no significant association with self-rated health [57-60] or depressive symptoms [61]. Surprisingly, a few studies even reported that greater income inequality is associated with a lower prevalence of common mental disorders [51] or lower risks for depression [62].

A potential reason for these mixed findings is that the size of the geographic unit matters. Income inequalities measured at different geographical levels have different meanings and relate to other contextual characteristics. Thus, a lack of a significant association between income inequality and mental health at one level does not necessarily negate the possibility that income inequality relates to mental health at another level [63]. Further, the (adverse) health effects of income inequality may depend on the mean welfare level of small areas. The degree of income inequality in small areas with a high mean income is presumably larger than in small areas with a low mean income.

In chapter 5 we investigated the associations of income inequality and mean income at the neighbourhood and municipality level with psychological distress, and whether the strength of the association between income inequality and psychological distress depends on the mean income of neighbourhoods and municipalities. We found that the adverse mental health effects of income inequality at the neighbourhood level depend on the level of mean neighbourhood incomes. A higher neighbourhood income inequality in neighbourhoods with the middle to highest mean neighbourhood incomes was associated with more psychological distress, whereas no such effect was found in neighbourhoods with the lowest mean income levels. Further, income inequality at the municipality level was more important as a risk factor for mental health than the mean income of municipality. We found no differential impact from municipal income inequality on psychological distress by mean municipal income.

Our results at the neighbourhood level endorse the conclusion of a Dutch city study that neighbourhood income inequality was not important for the health-related quality of life

of the residents of Maastricht neighbourhoods [64]. Our study is also in line with a previous study, conducted in the county of Stockholm, Sweden, that found no association between high income inequality at the neighbourhood level and self-rated poor health. At the municipality level, high income inequality seemed to matter for self-rated health [65]. On the other hand, our results were not corroborated in a study from the United Kingdom [51], that concluded that a higher income inequality was associated with better mental health in affluent neighbourhoods only. The different findings at the neighbourhood and municipality level suggest that it is important to consider the level of geographic unit when studying mental health effects of income inequality. Additional evidence of country-wide studies with focus on the role of geographic scale may shed further light on the robustness of our findings.

Lower physical activity and smoking more cigarettes partly explained ethnic health inequalities

Studies in the general population in the Netherlands demonstrated that depression is more common among ethnic minorities than native Dutch [66, 67]. A study in Amsterdam found a prevalence of depression of 7% in Dutch respondents, against 19% in Turkish respondents and 10% in Moroccan respondents. Although socio-economic factors were related to the prevalence of depression, these factors could not explain the ethnic inequalities in mental health [67]. Previous studies showed that differences in socioeconomic circumstances [68, 69], discrimination [70-72], acculturation strategies (e.g. integration) [73, 74], downward social mobility after migration [75], forced migration, the complexity of acculturation and a lack of social support [76] also play an important role in explaining ethnic health inequalities. Although these factors can partly explain the ethnic health inequalities observed, other factors are likely to be at play as well. Other well-established determinants of health, such as health-related behaviours, have received considerable less attention in research aimed to explain ethnic mental health inequalities. In chapter 6, we investigated the mediating effect of a lack of physical activity and smoking on ethnic inequalities in (mental) health. We found that Turks, Moroccans and Surinamese in the Netherlands experienced higher levels of psychological distress and poorer self-rated health than Dutch natives. Further, lower physical activity amongst Turks and Moroccan, and smoking more cigarettes amongst Turks explained a small and similar amount of variance (3–13%) in psychological distress and self-rated health. To our knowledge, no study until now has investigated whether and to which extent the association between individual ethnicity and self-rated health and psychological distress is mediated by health-related behaviours. Even though the proportion mediated was small, there was a significant indirect effect which means that the mediators play some role in the association between individual ethnicity and the health outcomes under study.

Moreover, the consequences of lack of physical activity and smoking may become increasingly important given the rising levels of physical inactivity [77] and the higher rates of smoking [78] among ethnic minorities. The findings suggest that promoting engagement in healthy behaviours among ethnic minorities might contribute to a reduction of ethnic health inequalities.

RECOMMENDATIONS

Recommendations for researchers

Using advanced statistical modelling approaches and alternative study designs in order to confirm the causality of the associations found in cross-sectional studies

An important task for researchers in public health and epidemiology is addressing the issues of causality and self-selection in neighbourhood studies. To date, the direction of association between neighbourhood environmental characteristics and individual mental health is unclear by concerns of bias due to self-selection into neighbourhoods. Partly because the majority of previous studies in this field is based on cross-sectional observational studies. For these studies is not possible to explicitly measure and control all variables that are thought to drive self-selection into neighbourhoods. The problem of self-selection into neighbourhoods in cross-sectional observational studies can be partially addressed by longitudinal data with repeated measurements. This study design, for example, can examine whether people have poorer mental health when they are residing in a disadvantaged neighbourhood compared with another time when the same people are residing in an advantaged neighbourhood [35, 43]. It is also important to acknowledge that the problem of selection bias is not explicitly addressed by longitudinal studies with only 1 baseline measurement of neighbourhood exposure [39]. Studies using longitudinal data with more than one measurement of both neighbourhood factors and individual mental health can make causal inference more robust. Furthermore, research should incorporate advanced statistical modelling approaches in order to guarantee the highest standards of causal inference [31]. An interesting approach is the fixed effects model, whereby can be examined whether the within-individual changes in neighbourhood status are associated with changes in health [39, 40].

In addition to studies using longitudinal data, experimental and quasi-experimental neighbourhood studies can be carried out to validate the causality of the neighbourhood health associations found in cross-sectional observational studies. A disadvantage here is that we hardly know whether the results from experimental studies can be generalized to natural settings of the general population, but more such studies can provide a definite answer. Also a twin study design can partially address the bias of self-selection into

neighbourhoods (by controlling for personality or early childhood environment) [79, 80] and is possibly the best approximation to an experimental design, as is neither practical nor ethical to randomise individuals to different neighbourhood environments [80].

Simultaneously investigating the association between individual- and neighbourhood-level social cohesion with mental health

The places where people live have been hypothesised to explain why some people have worse mental health than others. Social cohesion is a way of conceptualising and measuring the social processes in places. We conceptualized social cohesion as a neighbourhood construct and found evidence for an inverse association between neighbourhood social cohesion and depression in general population and for some vulnerable groups, i.e. unemployed and disabled citizens and citizens with financial difficulties (in chapters 2-3). In contrast, social cohesion has been conceptualised as an individual attribute as well. Studies have found individual-level social cohesion to be inversely related to depression [38, 81, 82]. Scholars have suggested that both individual- and neighbourhood-level social cohesion should be measured because the two are not mutually exclusive. Social cohesion can affect mental health on the individual- and neighbourhood-level at the same time. A recent review shows that there are only few studies that simultaneously investigated the association between individual- and neighbourhood-level social cohesion with common mental disorder [83]. Hence, further research is needed to disentangle the associations of social cohesion at two different levels with individual mental health. In this regard it is important to know which level social cohesion is more important for individual mental health and whether there is an interaction between individual- and neighbourhood-level social cohesion in relation to individual mental health.

The role of income inequality on mental health among adolescents, the elderly and those with low SES

To our knowledge, no prior studies have examined the association between the income inequality at the neighbourhood and municipality level and mental health in the Netherlands. In chapter 5 we found that among individuals living in neighbourhoods with the highest mean income, those living in neighbourhoods with the highest income inequality reported more psychological distress compared to those living in neighbourhoods with the lowest income inequality. Further, individuals living in municipalities with the highest income inequality reported more psychological distress than those living in municipalities with the lowest income inequality. Further research is needed to understand whose health is affected by income inequality in small areas. For example, little is known on the association between the income inequality in small areas and mental health among adolescents, a sensitive

developmental period for the emergence of depression [84]. Other groups at risk include the elderly and those with low SES [85]. Future research must provide insight whether the association between income inequality in small areas and depression is stronger for adolescents, older people and poor people.

Recommendations for public health professionals

Promoting neighbourhood social cohesion

It is important that social cohesion in neighbourhoods is promoted, since this contributes to better mental health in the communities [83]. Two recent systematic reviews on assessing the impact of social cohesion or social capital based interventions on mental health outcomes among adult and older people, have found some protective effects [86, 87]. This thesis shows that adults living in neighbourhoods with higher social cohesion or higher SES experience lower levels of psychological distress. Neighbourhood social cohesion is a more important determinant than neighbourhood SES, as neighbourhood social cohesion had the strongest (protective) associations with psychological distress. Neighbourhood SES shapes psychological distress through neighbourhood social cohesion: neighbourhood social cohesion accounted for a considerable part of the differences in the association between neighbourhood SES and psychological distress. Promoting social cohesion may reduce neighbourhood inequalities in psychological distress.

Neighbourhoods with high social cohesion partly buffer the adverse effects of low socioeconomic status on mental health

Neighbourhood social cohesion does not affect us all equally. This thesis gives evidence that living in neighbourhoods with high social cohesion is more beneficial for persons in financial difficulties and for unemployed or disabled than other groups in relation to mental health. This could have implications for reducing depression or psychological distress among adults. Although in the Netherlands, all citizens are assured of subsistence as a result of long-standing socio-economic policy, the economic position of citizens with a low socioeconomic status still requires attention. Policymakers need to be aware of the existence of financial disadvantaged groups who are at higher risk of depression as a result of residing in low social cohesion neighbourhoods. Hence, urban policies or public health policies should focus on improving social cohesion in low cohesive neighbourhoods and attention is needed for improving the economic position of financially disadvantaged groups in low cohesive neighbourhoods.

A more egalitarian distribution of income

This thesis suggests that individuals are susceptible to the socioeconomic environment of dwelling, including the neighbourhood- and municipal distribution of income. Reducing income inequality within neighbourhoods and municipalities may foster the mental health of the residents. At the national level, socioeconomic policies that promote the fair distribution of income, for example through more progressive taxation, can ensure a more egalitarian distribution of income in the society. At the local level, public health policies and efforts aimed at reducing depression should focus on the social and economic determinants of depression.

Promoting engagement in healthy behaviours among ethnic minorities

The findings suggest that intervening and facilitating certain ethnic groups (i.e. Turks and Moroccans) in engaging in health behaviours (i.e. more physical activity and less smoking) could contribute to improving their mental health and reduce ethnic health inequalities.

REFERENCES

1 Andrews G, Slade T. Interpreting scores on the Kessler Psychological Distress Scale (K10). *Australian and New Zealand journal of public health* 2001;25:494-7.

2 Kessler RC, Andrews G, Colpe LJ*, et al.* Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychological medicine* 2002;32:959-76.

3 Kessler R, Mroczek D. Final versions of our non-specific psychological distress scale. *Memo dated March* 1994;10:1994.

4 Cairney J, Veldhuizen S, Wade TJ*, et al.* Evaluation of 2 measures of psychological distress as screeners for depression in the general population. *The Canadian Journal of Psychiatry* 2007;52:111-20.

5 Kessler RC, Barker PR, Colpe LJ*, et al.* Screening for serious mental illness in the general population. *Archives of general psychiatry* 2003;60:184-9.

6 Hides L, Lubman DI, Devlin H*, et al.* Reliability and validity of the Kessler 10 and Patient Health Questionnaire among injecting drug users. *Australian & New Zealand Journal of Psychiatry* 2007;41:166-8.

7 Arnaud B, Malet L, Teissedre F*, et al.* Validity study of Kessler's psychological distress scales conducted among patients admitted to French emergency department for alcohol consumption–related disorders. *Alcoholism: Clinical and Experimental Research* 2010;34:1235-45.

8 Sakurai K, Nishi A, Kondo K*, et al.* Screening performance of K6/K10 and other screening instruments for mood and anxiety disorders in Japan. *Psychiatry and clinical neurosciences* 2011;65:434-41.

9 Fassaert T, De Wit M, Tuinebreijer W*, et al.* Psychometric properties of an interviewer-administered version of the Kessler Psychological Distress scale (K10) among Dutch, Moroccan and Turkish respondents. *International Journal of Methods in Psychiatric Research* 2009;18:159-68.

10 Alonso J, Angermeyer M, Bernert S*, et al.* Sampling and methods of the European Study of the Epidemiology of Mental Disorders (ESEMeD) project. *Acta Psychiatrica Scandinavica* 2004;109:8-20.

11 Donker T, Comijs H, Cuijpers P*, et al.* The validity of the Dutch K10 and extended K10 screening scales for depressive and anxiety disorders. *Psychiatry Research* 2010;176:45-50.

12 Cornelius BL, Groothoff JW, van der Klink JJ*, et al.* The performance of the K10, K6 and GHQ-12 to screen for present state DSM-IV disorders among disability claimants. *BMC public health* 2013;13:128.

13 Fassaert T, De Wit MA, Tuinebreijer WC*, et al.* Acculturation and psychological distress among non-Western Muslim migrants-a population-based survey. *International Journal of Social Psychiatry* 2011;57:132-43.

14 Mckenzie SK, Gunasekara FI, Richardson K*, et al.* Do changes in socioeconomic factors lead to changes in mental health? Findings from three waves of a population based panel study. *Journal of epidemiology and community health* 2014;68:253-60.

15 Rios R, Aiken LS, Zautra AJ. Neighborhood contexts and the mediating role of neighborhood social cohesion on health and psychological distress among Hispanic and non-Hispanic residents. *Annals of behavioral medicine : a publication of the Society of Behavioral Medicine* 2012;43:50-61.

16 Reijneveld SA, Verheij RA, de Bakker DH. The impact of area deprivation on differences in health: does the choice of the geographical classification matter? *Journal of epidemiology and community health* 2000;54:306-13.

17 Völker B, Flap H, Lindenberg S. When are neighbourhoods communities? Community in Dutch neighbourhoods. *European Sociological Review* 2007;23:99-114.

18 Vervoort M, Dagevos J, Flap H. Ethnic concentration in the neighbourhood and majority and minority language: A study of first and second-generation immigrants. *Social Science Research* 2012;41:555-69.

19 Veldhuizen EM, Stronks K, Kunst AE. Assessing associations between socio-economic environment and self-reported health in Amsterdam using bespoke environments. *PloS one* 2013;8:e68790.

20 Veldhuizen EM, Ikram UZ, Vos S*, et al.* The relationship between ethnic composition of the residential environment and self-reported health among Turks and Moroccans in Amsterdam. *International journal of health geographics* 2017;16:12.

21 Veldhuizen EM, Musterd S, Dijkshoorn H*, et al.* Association between Self-Rated Health and the Ethnic Composition of the Residential Environment of Six Ethnic Groups in Amsterdam. *International journal of environmental research and public health* 2015;12:14382-99.

22 Propper C, Jones K, Bolster A*, et al.* Local neighbourhood and mental health: evidence from the UK. *Social Science & Medicine* 2005;61:2065-83.

23 de Vries S, ten Have M, van Dorsselaer S*, et al.* Local availability of green and blue space and prevalence of common mental disorders in the Netherlands. *British Journal of Psychiatry Open* 2016;2:366-72.

24 Maas J, Verheij RA, Spreeuwenberg P*, et al.* Physical activity as a possible mechanism behind the relationship between green space and health: a multilevel analysis. *BMC public health* 2008;8:206.

25 Stafford M, Duke-Williams O, Shelton N. Small area inequalities in health: are we underestimating them? *Social Science & Medicine* 2008;67:891-9.

26 Roux A-VD. Neighborhoods and health: where are we and were do we go from here? *Revue d'epidemiologie et de sante publique* 2007;55:13-21.

27 Mujahid MS, Diez Roux AV, Morenoff JD*, et al.* Assessing the measurement properties of neighborhood scales: from psychometrics to ecometrics. *American journal of epidemiology* 2007;165:858-67.

28 Raudenbusch SW, Sampson RJ. Ecometrics: toward a science of assessing ecological settings, with application to the systematic social observation of neighborhoods. *Sociological Methodology* 1999;29:1-41.

29 Mohnen SM, Groenewegen PP, Volker B*, et al.* Neighborhood social capital and individual health. *Social science & medicine (1982)* 2011;72:660-7.

30 Hox JJ. *Multilevel analysis: Techniques and applications*. Mahwah, NJ: Lawrence Erlbaum Associates 2002.

31 Kröger H, Pakpahan E, Hoffmann R. What causes health inequality? A systematic review on the relative importance of social causation and health selection. *The European Journal of Public Health* 2015;25:951-60.

32 Drukker M, Gunther N, Van Os J. Disentangling associations between poverty at various levels of aggregation and mental health. *Epidemiology and psychiatric sciences* 2007;16:3-9.

33 Generaal E, Timmermans EJ, Dekkers JE*, et al.* Not urbanization level but socioeconomic, physical and social neighbourhood characteristics are associated with presence and severity of depressive and anxiety disorders. *Psychological medicine* 2018:1-13.

34 O'Donoghue B, Roche E, Lane A. Neighbourhood level social deprivation and the risk of psychotic disorders: a systematic review. *Social psychiatry and psychiatric epidemiology* 2016;51:941-50.

35 Airaksinen J, Hakulinen C, Elovainio M*, et al.* Neighborhood effects in depressive symptoms, social support, and mistrust: Longitudinal analysis with repeated measurements. *Social Science & Medicine* 2015;136:10-6.

36 Mair C, Diez Roux AV, Galea S. Are neighbourhood characteristics associated with depressive symptoms? A review of evidence. *Journal of epidemiology and community health* 2008;62:940-6, 8 p following 6.

37 Kim D. Blues from the neighborhood? Neighborhood characteristics and depression. *Epidemiologic reviews* 2008;30:101-17.

38 Bassett E, Moore S. Gender Differences in the Social Pathways Linking Neighborhood Disadvantage to Depressive Symptoms in Adults. *PloS one* 2013;8:e76554.

39 Jokela M. Are neighborhood health associations causal? A 10-year prospective cohort study with repeated measurements. *American journal of epidemiology* 2014;180:776-84.

40 Jokela M. Does neighbourhood deprivation cause poor health? Within-individual analysis of movers in a prospective cohort study. *Journal of epidemiology and community health* 2015;69:899-904.

41 Green MA, Subramanian S, Vickers D*, et al.* Internal migration, area effects and health: Does where you move to impact upon your health? *Social Science & Medicine* 2015;136:27-34.

42 Mair C, Roux AD, Golden S*, et al.* Change in neighborhood environments and depressive symptoms in New York City: the multi-ethnic study of atherosclerosis. *Health & place* 2015;32:93-8.

43 Airaksinen J, Hakulinen C, Pulkki-Råback L*, et al.* Neighbourhood effects in health behaviours: a test of social causation with repeat-measurement longitudinal data. *The European Journal of Public Health* 2015;26:417-21.

44 van Lenthe FJ, Martikainen P, Mackenbach JP. Neighbourhood inequalities in health and health-related behaviour: results of selective migration? *Health & place* 2007;13:123-37.

45 Jongeneel-Grimen B, Droomers M, Stronks K*, et al.* Migration does not enlarge inequalities in health between rich and poor neighbourhoods in The Netherlands. *Health & place* 2011;17:988-95.

46 Boschman S, Van Ham M. Neighbourhood selection of non-Western ethnic minorities: testing the own-group effects hypothesis using a conditional logit model. *Environment and Planning A* 2015;47:1155-74.

47 Grafova IB, Freedman VA, Lurie N*, et al.* The difference-in-difference method: Assessing the selection bias in the effects of neighborhood environment on health. *Economics & Human Biology* 2014;13:20-33.

48 Merlo J, Chaix B, Yang M*, et al.* A brief conceptual tutorial on multilevel analysis in social epidemiology: interpreting neighbourhood differences and the effect of neighbourhood characteristics on individual health. *Journal of epidemiology and community health* 2005;59:1022-9.

49 Twisk JW. *Applied multilevel analysis: a practical guide*: Cambridge University Press 2006.

50 Merlo J, Chaix B, Yang M*, et al.* A brief conceptual tutorial of multilevel analysis in social epidemiology: linking the statistical concept of clustering to the idea of contextual phenomenon. *Journal of Epidemiology & Community Health* 2005;59:443-9.

51 Fone D, Greene G, Farewell D*, et al.* Common mental disorders, neighbourhood income inequality and income deprivation: small-area multilevel analysis. *The British Journal of Psychiatry* 2013;202:286-93.

52 Wilkinson RG, Pickett KE. Income inequality and population health: a review and explanation of the evidence. *Social Science & Medicine* 2006;62:1768-84.

53 Layte R. The association between income inequality and mental health: testing status anxiety, social capital, and neo-materialist explanations. *European Sociological Review* 2011;28:498-511.

54 Chiavegatto Filho ADP, Kawachi I, Wang YP*, et al.* Does income inequality get under the skin? A multilevel analysis of depression, anxiety and mental disorders in Sao Paulo, Brazil. *Journal of epidemiology and community health* 2013:jech-2013-202626.

55 Ichida Y, Kondo K, Hirai H*, et al.* Social capital, income inequality and self-rated health in Chita peninsula, Japan: a multilevel analysis of older people in 25 communities. *Social Science & Medicine* 2009;69:489-99.

56 Vilhjalmsdottir A, Gardarsdottir RB, Bernburg JG*, et al.* Neighborhood income inequality, social capital and emotional distress among adolescents: A population-based study. *Journal of adolescence* 2016;51:92-102.

57 Bjornstrom EE. The neighborhood context of relative position, trust, and self-rated health. *Social Science & Medicine* 2011;73:42-9.

58 Hou F, Myles J. Neighbourhood inequality, neighbourhood affluence and population health. *Social Science & Medicine* 2005;60:1557-69.

59 Wen M, Browning CR, Cagney KA. Poverty, affluence, and income inequality: neighborhood economic structure and its implications for health. *Social Science & Medicine* 2003;57:843-60.

60 Wong IO, Cowling BJ, Lo S-V*, et al.* A multilevel analysis of the effects of neighbourhood income inequality on individual self-rated health in Hong Kong. *Social Science & Medicine* 2009;68:124-32.

61 Fernández-Niño JA, Manrique-Espinoza BS, Bojorquez-Chapela I*, et al.* Income inequality, socioeconomic deprivation and depressive symptoms among older adults in Mexico. *PloS one* 2014;9:e108127.

62 Marshall A, Jivraj S, Nazroo J*, et al.* Does the level of wealth inequality within an area influence the prevalence of depression amongst older people? *Health & place* 2014;27:194-204.

63 Chen Z, Crawford CAG. The role of geographic scale in testing the income inequality hypothesis as an explanation of health disparities. *Social Science & Medicine* 2012;75:1022-31.

64 Drukker M, Feron FJ, Van Os J. Income inequality at neighbourhood level and quality of life. *Social psychiatry and psychiatric epidemiology* 2004;39:457-63.

65 Rostila M, Kölegård ML, Fritzell J. Income inequality and self-rated health in Stockholm, Sweden: a test of the 'income inequality hypothesis' on two levels of aggregation. *Social Science & Medicine* 2012;74:1091-8.

66 de Graaf R, ten Have M, van Gool C*, et al.* Prevalence of mental disorders and trends from 1996 to 2009. Results from the Netherlands Mental Health Survey and Incidence Study-2. *Social psychiatry and psychiatric epidemiology* 2012;47:203-13.

67 de Wit MA, Tuinebreijer WC, Dekker J*, et al.* Depressive and anxiety disorders in different ethnic groups. *Social psychiatry and psychiatric epidemiology* 2008;43:905-12.

68 Beck AN, Finch BK, Lin S-F*, et al.* Racial disparities in self-rated health: Trends, explanatory factors, and the changing role of socio-demographics. *Social Science & Medicine* 2014;104:163-77.

69 Wiking E, Johansson S-E, Sundquist J. Ethnicity, acculturation, and self reported health. A population based study among immigrants from Poland, Turkey, and Iran in Sweden. *Journal of epidemiology and community health* 2004;58:574-82.

70 Ikram UZ, Snijder MB, Fassaert TJ*, et al.* The contribution of perceived ethnic discrimination to the prevalence of depression. *The European Journal of Public Health* 2015;25:243-8.

71 Williams DR, Neighbors HW, Jackson JS. Racial/ethnic discrimination and health: findings from community studies. *American journal of public health* 2003;93:200-8.

72 van Dijk TK, Agyemang C, de Wit M*, et al.* The relationship between perceived discrimination and depressive symptoms among young Turkish–Dutch and Moroccan–Dutch. *The European Journal of Public Health* 2010;21:477-83.

73 Ince BÜ, Fassaert T, de Wit MA*, et al.* The relationship between acculturation strategies and depressive and anxiety disorders in Turkish migrants in the Netherlands. *BMC psychiatry* 2014;14:252.

74 Nap A, van Loon A, Peen J*, et al.* The influence of acculturation on mental health and specialized mental healthcare for non-western migrants. *International Journal of Social Psychiatry* 2015;61:530-8.

75 Alcántara C, Chen C-N, Alegría M. Do post-migration perceptions of social mobility matter for Latino immigrant health? *Social Science & Medicine* 2014;101:94-106.

76 Bhugra D, Becker MA. Migration, cultural bereavement and cultural identity. *World Psychiatry* 2005;4:18.

77 Brodersen NH, Steptoe A, Boniface DR*, et al.* Trends in physical activity and sedentary behaviour in adolescence: ethnic and socioeconomic differences. *British Journal of Sports Medicine* 2007;41:140-4.

78 Karlsen S, Millward D, Sandford A. Investigating ethnic differences in current cigarette smoking over time using the health surveys for England. *The European Journal of Public Health* 2011:ckr097.

79 Fujiwara T, Kawachi I. Social capital and health: a study of adult twins in the US. *American journal of preventive medicine* 2008;35:139-44.

80 Cohen-Cline H, Beresford SA, Barrington WE*, et al.* Associations between neighbourhood characteristics and depression: a twin study. *Journal of epidemiology and community health* 2018;72:202-7.

81 Fujiwara T, Kawachi I. A prospective study of individual-level social capital and major depression in the United States. *Journal of Epidemiology & Community Health* 2008;62:627-33.

82 Daoud N, Haque N, Gao M*, et al.* Neighborhood settings, types of social capital and depression among immigrants in Toronto. *Social psychiatry and psychiatric epidemiology* 2016;51:529-38.

83 Ehsan AM, De Silva MJ. Social capital and common mental disorder: a systematic review. *Journal of epidemiology and community health* 2015:jech-2015-205868.

84 Pabayo R, Dunn EC, Gilman SE*, et al.* Income inequality within urban settings and depressive symptoms among adolescents. *Journal of epidemiology and community health* 2016;70:997-1003.

85 Erdem Ö, Van Lenthe FJ, Prins RG*, et al.* Socioeconomic inequalities in psychological distress among urban adults: the moderating role of neighborhood social cohesion. *PloS one* 2016;11:e0157119.

86 Coll-Planas L, Nyqvist F, Puig T*, et al.* Social capital interventions targeting older people and their impact on health: a systematic review. *Journal of epidemiology and community health* 2016:jech-2016-208131.

87 Flores EC, Fuhr DC, Bayer AM*, et al.* Mental health impact of social capital interventions: a systematic review. *Social psychiatry and psychiatric epidemiology* 2017:1-13.

SUMMARY

Current evidence suggests that the places where people live affect their health and contribute to health inequalities between the individuals. Neighbourhood conditions affect people's health over and above individual factors, such as socioeconomic position. Although studies have shown that the role of neighbourhood factors for health is relatively small compared to individual socio-demographic and socioeconomic factors, changing them has the potential to influence many people living in a neighbourhood and therefore to contribute to the reduction of social and ethnic inequalities in health. Despite the considerable geographical differences in mental health outcomes, such as common mental disorders, mood and anxiety disorders and depression, the impact of neighbourhoods on individual mental health has been understudied. Understanding the role and impact of neighbourhoods on depression might be important for prevention of disease burden of mental health. Accordingly, the following research questions were addressed in this thesis.

1. Are neighbourhood factors associated with depression and does neighbourhood social cohesion mediate these associations?
2. Do neighbourhood factors moderate the associations of neighbourhood and individual socioeconomic factors or individual ethnicity with depression?
3. Do health-related behaviours mediate the association between individual ethnicity and depression?

The population health survey *(G4 Gezondheidsenquête 2008)* and the national public health survey *(Gezondheidsmonitor Volwassenen GGD-en, CBS en RIVM 2012)* were linked with information at the neighbourhood level to answer these research questions.

Are neighbourhood factors associated with depression and does neighbourhood social cohesion mediate these associations?

In chapter 2 we investigated which neighbourhood factors are important as population determinants of depression. Of the neighbourhood factors studied (neighbourhood SES, amount of green area, home maintenance, social cohesion and urbanity) both a high neighbourhood social cohesion and high neighbourhood SES were associated with less psychological distress. Neighbourhood social cohesion had the strongest (inverse) association with psychological distress. The association between neighbourhood SES and psychological distress was mediated partly by neighbourhood social cohesion. In other words, adults living in neighbourhoods with lower SES or lower social cohesion were more likely to experience psychological distress and neighbourhood SES shaped psychological

distress through neighbourhood social cohesion. We found no evidence for associations of amount of green, urbanity and home maintenance with psychological distress.

Do neighbourhood factors moderate the associations of neighbourhood and individual socioeconomic factors or individual ethnicity with depression?

In chapters 3 and 4 we found inequalities in psychological distress among urban residents by employment status, levels of financial deprivation and ethnicity. Recipients of disability, social assistance or unemployment benefits reported higher psychological distress than those in paid employment. Persons with some or great financial difficulties reported higher psychological distress than those with little or no financial problems. Compared to native Dutch, Turkish and Moroccans residents reported higher psychological distress. Gender, age, marital status, years of residence in place and education were also associated with psychological distress, albeit less strong.

Residing in a neighbourhood with high social cohesion was significantly associated with lower psychological distress among urban residents. Neighbourhood social cohesion moderated the associations between employment status or financial deprivation and psychological distress. Living in a neighbourhood with a high social cohesion instead of a low social cohesion was associated with a lower psychological distress among recipients of disability, social assistance or unemployment benefits and among citizens with financial difficulties. A high neighbourhood social cohesion did not modify the associations between gender, age, ethnicity, marital status, education and, years of residence and psychological distress. Hence, neighbourhood social cohesion does not affect all urban residents equally. It may partly buffer the adverse effects of being poor, unemployed and disabled on depression.

Further, we found that neighbourhood ethnic diversity seems to have ethnic-specific effects on depression. Although residing in a high ethnic diverse neighbourhood was associated with more psychological distress among urban residents, the moderation analysis showed that Turkish residents in high ethnic diverse neighbourhoods reported less psychological distress than Turkish residents in low ethnic diverse neighbourhoods. This moderation effect was not observed for other ethnic minorities (Moroccan and Surinamese residents).

In chapter 5 we examined the associations between income inequality at neighbourhood and municipality level and psychological distress in the context of the relatively low income inequality in the Netherlands. Also, we examined whether the association between neighbourhood income inequality and psychological distress differed between low-income and high-income neighbourhoods. The same question was examined at the municipality level as well. Our study showed that the mean Gini coefficient across all municipalities and neighbourhoods was 0.26, with smaller variation between municipalities

(range 0.21-0.44) than between neighbourhoods (0.11-0.51). We found no significant association between neighbourhood income inequality and psychological distress, after adjustment for individual and neighbourhood level factors. However, we found a significant interaction between neighbourhood income inequality and neighbourhood income in relation to psychological distress. A higher neighbourhood income inequality in neighbourhoods with the middle to highest mean neighbourhood incomes was associated with more psychological distress, whereas no such effect was found in neighbourhoods with the lowest mean income levels. Among individuals living in neighbourhoods with the highest mean income, those living in neighbourhoods with the highest income inequality reported more psychological distress compared to those living in neighbourhoods with the lowest income inequality.

At the municipality level, we found a significant association between municipal income inequality and psychological distress, after adjustment for individual and municipal level factors. Individuals living in municipalities with the highest income inequality reported more psychological distress compared to those living in municipalities with the lowest income inequality. We found no significant interaction between municipal income and municipal income inequality in relation to psychological distress. Our results suggest that income inequality at the municipality level is more important as a risk factor for mental health than municipal mean income, while at the neighbourhood level, mean income is more important than income inequality.

Do health-related behaviours mediate the association between individual ethnicity and depression?

In chapter 6 we investigated the mediating effect of a lack of physical activity and smoking on ethnic inequalities in (mental) health. Based on data from the national public health survey carried out in 2012, it appeared that Turks, Moroccans and Surinamese in the Netherlands experienced higher levels of psychological distress and poorer self-rated health than Dutch natives. These results support the findings reported in chapter 4 that Turks and Moroccans experienced higher levels of psychological distress compared to native Dutch, which was based on data from the national public health survey carried out in 2008.

Moroccans and Turks were the least physically active, and Turks smoked the most. Lower physical activity amongst Turks and Moroccan, and smoking more cigarettes amongst Turks explained a small part of the association between ethnicity and psychological distress and self-rated health. For Turks and Moroccans lack of physical activity mediated respectively 6% and 13% of the association between ethnicity and psychological distress, and respectively 11% and 9% of the association between ethnicity and self-rated health. Additionally, among Turks smoking mediated 3% of both associations. Even though the proportion mediated was small, there was a significant indirect effect which means that the

mediators play a weak to moderate role in the association between individual ethnicity and the health outcomes under study. Moreover, the consequences of lack of physical activity and smoking may become increasingly important given the rising levels of physical inactivity and the higher rates of smoking among ethnic minorities.

Conclusions

In chapter 7 a summary of the main findings was presented, methodological considerations and new insights were discussed, and recommendations for public health professionals and researchers were presented. Based on the study results in this thesis the following is concluded and can be recommended:

- Living in neighbourhoods with higher social cohesion or higher SES was associated with better mental health.
- Inequalities are found in mental health among urban residents by employment status, levels of financial deprivation and ethnicity.
- Living in neighbourhoods with high social cohesion was more beneficial for persons in financial difficulties and for unemployed or disabled than other groups in relation to mental health.
- Neighbourhood ethnic diversity seems to have ethnic-specific effects on mental health. Although residing in a high ethnic diverse neighbourhood was associated with poorer mental health among urban residents, Turkish residents in high ethnic diverse neighbourhoods reported better mental health than Turkish residents in low ethnic diverse neighbourhoods.
- Income inequality in municipalities and affluent neighbourhoods was a risk factor for mental health.
- Lower physical activity and smoking more cigarettes partly explained ethnic (mental) health inequalities.

Recommendations for researchers

- Use advanced statistical modelling approaches and alternative study designs (e.g. longitudinal data with repeated measurement or twin study designs) in order to confirm the causality of the associations found in cross-sectional studies.
- Investigate simultaneously the association between individual- and neighbourhood-level social cohesion with mental health. Further research is needed to disentangle the associations of social cohesion at two different levels with individual mental health.

- Further research is needed to understand whose health is affected by income inequality in small areas. For example, little is known on the association between the income inequality in small areas and mental health among adolescents, the elderly and those with low SES.

Recommendations for public health professionals

- Promote neighbourhood social cohesion as this contributes to better mental health in the communities. Policymakers need to be aware of the existence of financial disadvantaged groups who are at higher risk of depression as a result of residing in low social cohesion neighbourhoods.
- Reduce income inequality within municipalities and affluent neighbourhoods, and improve the welfare level (mean income) in poor neighbourhoods as this may foster the mental health of the residents. At the national level, socioeconomic policies that promote the fair distribution of income can ensure a more egalitarian distribution of income in the society. At the local level, public health policies and efforts aimed at reducing depression should focus on the social and economic determinants of depression.
- Promote engagement in healthy behaviours among ethnic minorities. The findings suggest that intervening and facilitating certain ethnic groups (i.e. Turks and Moroccans) in engaging in health behaviours (i.e. more physical activity and less smoking) could contribute to improving their mental health and reduce ethnic health inequalities.

SAMENVATTING

Recent bewijs suggereert dat de sociale leefomgeving waarin mensen in grote steden wonen, de gezondheid beïnvloedt en bijdraagt aan gezondheidsongelijkheden tussen mensen. In aanvulling op individuele factoren, zoals de sociaaleconomische positie, dragen buurtkenmerken bij aan de verklaring van verschillen in gezondheid tussen mensen. Hoewel studies hebben aangetoond dat de rol van buurtkenmerken voor de gezondheid relatief klein is in vergelijking met individuele sociaal-demografische en sociaaleconomische factoren, heeft het veranderen ervan mogelijk gevolgen voor veel mensen die in de buurt wonen. Ondanks de aanzienlijke geografische verschillen in diverse uitkomsten van psychische gezondheid, zoals veelvoorkomende psychische aandoeningen, stemmings- en angststoornissen en depressie, is de invloed van sociale buurtkenmerken op individuele psychische gezondheid tot nu toe onvoldoende onderzocht. Het begrijpen van de rol en impact van specifieke buurtkenmerken op depressie kan belangrijk zijn voor het voorkómen van ziektelast als gevolg van psychische ongezondheid. De volgende onderzoeksvragen zijn in dit proefschrift behandeld.

1. Is er een relatie tussen buurtkenmerken en depressie, en in welke mate verklaart sociale cohesie in de buurt deze relaties?
2. Modificeren buurtkenmerken de relaties tussen buurt- en individuele sociaaleconomische kenmerken of individuele etniciteit enerzijds en depressie anderzijds?
3. In welke mate verklaart gezond gedrag de relatie tussen individuele etniciteit en depressie?

Statistische gegevens op buurtniveau zijn gekoppeld aan de G4 Gezondheidsenquête (2008) en de Gezondheidsmonitor Volwassenen GGD-en, CBS en RIVM (2012) om deze onderzoeksvragen te beantwoorden.

Is er een relatie tussen buurtkenmerken en depressie, en in welke mate verklaart sociale cohesie in de buurt deze relaties?

In **hoofdstuk 2** hebben we onderzocht welke buurtkenmerken belangrijk zijn voor de psychische gezondheid van inwoners van grote steden in Nederland. Van de onderzochte buurtkenmerken (sociaaleconomische status (SES), hoeveelheid groen, woningonderhoud, sociale cohesie en stedelijkheid) associeerden zowel een hoge sociale cohesie in de buurt als een hoge buurt SES met minder psychische klachten. Sociale cohesie in de buurt had de sterkste (omgekeerde) associatie met psychische stress. Met andere woorden, volwassen inwoners in buurten met een lage SES of lage sociale cohesie hadden meer kans op

psychische stress. Verder bleek dat de associatie tussen buurt SES en psychische stress deels werd verklaard door sociale cohesie in de buurt. Volwassen inwoners in buurten met een lage SES hebben een grotere kans dat in hun buurt weinig sociale cohesie is, en deze geringe sociale cohesie was geassocieerd met meer psychische klachten. We vonden geen bewijs voor de relaties tussen hoeveelheid groen, mate van stedelijkheid en woningonderhoud en psychische stress.

Modificeren buurtkenmerken de relaties tussen buurt- en individuele sociaaleconomische kenmerken of etniciteit enerzijds en depressie anderzijds?

In **hoofdstukken 3 en 4** vonden we ongelijkheden in psychische gezondheid bij stedelijke bewoners op basis van hun werkstatus, financiële deprivatie en etniciteit. Uitkeringsontvangers (arbeidsongeschikten of bijstandsgerechtigden) rapporteerden meer psychische klachten dan werkenden met betaalde banen. Mensen die enige of grote moeite hadden met rondkomen van het inkomen rapporteerden meer psychische klachten dan mensen die geen of nauwelijks moeite hadden financieel rond te komen. Turken en Marokkanen meldden meer psychische klachten dan Nederlanders. Andere factoren, zoals geslacht, leeftijd, burgerlijke staat, woonduur en opleidingsniveau, waren ook (maar minde sterk) geassocieerd met psychische stress.

Wonen in een buurt met een grote sociale cohesie was geassocieerd met minder psychische klachten onder stedelijke bewoners. Sociale cohesie in een buurt modereerde de relaties tussen werkstatus of financiële deprivatie en psychische stress. Wonen in een buurt met een grote sociale cohesie ging gepaard met minder psychische klachten onder uitkeringsontvangers (arbeidsongeschikten of bijstandsgerechtigden) en onder mensen die moeite hadden rond te komen van hun inkomen. Er was geen bewijs voor zo'n modererende rol van sociale cohesie voor het verband tussen geslacht, leeftijd, etniciteit, burgerlijke staat, opleidingsniveau en woonduur en psychische stress. Concluderend, sociale cohesie in de buurt heeft niet dezelfde invloed op alle buurtbewoners; sociale cohesie werkt als een buffer die de negatieve gevolgen van armoede en uitkeringsafhankelijkheid op de psychische gezondheid enigszins verzacht.

De etnische diversiteit in buurten lijkt etnisch-specifieke effecten te hebben op de psychische gezondheid van buurtbewoners. Hoewel wonen in buurten met een hoge mate van etnische diversiteit geassocieerd was met meer psychische klachten bij buurtbewoners, toonden we aan dat Turken in buurten met meer etnische diversiteit minder psychische klachten rapporteerden dan Turken in buurten met minder etnische diversiteit. Dit modererende effect werd niet waargenomen voor andere etnische minderheden (Marokkanen en Surinamers).

In **hoofdstuk 5** onderzochten we de associaties tussen inkomensongelijkheid op buurt- en gemeentelijk niveau en psychische gezondheid in Nederland, een land met een internationaal gezien relatief lage inkomensongelijkheid. We onderzochten ook of de relatie tussen inkomensongelijkheid op buurtniveau en psychische gezondheid verschilde tussen buurten met een gemiddeld laag en een hoog inkomen. Dezelfde vraag werd ook op gemeentelijk niveau onderzocht. Onze studie toonde aan dat de gemiddelde Gini-coëfficiënt, als maat van inkomensongelijkheid, in alle gemeenten en buurten 0,26 was, met een kleinere variatie tussen gemeenten (range: 0,21-0,44) dan tussen buurten (range: 0,11-0,51). We vonden geen significante associatie tussen inkomensongelijkheid op buurtniveau en psychische gezondheid na correctie voor individuele- en buurtkenmerken. Maar we vonden wel een interactie tussen buurtinkomen en inkomensongelijkheid op buurtniveau in relatie tot psychische stress: een hogere inkomensongelijkheid op buurtniveau was geassocieerd met meer psychische klachten, vooral in buurten met de middelste tot de hoogste gemiddelde buurtinkomens. Met andere woorden: binnen de groep mensen die in buurten met het hoogste gemiddelde inkomen wonen, rapporteerden degenen die in de buurten met de hoogste inkomensongelijkheid woonden meer psychische klachten dan degenen die in de buurten met de laagste inkomensongelijkheid wonen. Op het gemeenteniveau vonden we een significante associatie tussen inkomensongelijkheid op gemeenteniveau en psychische gezondheid na correctie voor individuele- en gemeentekenmerken. Mensen die in gemeenten woonden met de hoogste inkomensongelijkheid rapporteerden meer psychische klachten dan mensen woonachtig in de gemeenten met de laagste inkomensongelijkheid. Er is geen interactie gevonden tussen het gemiddelde inkomen op gemeenteniveau en inkomensongelijkheid op gemeenteniveau in relatie tot psychische stress.

Op gemeenteniveau is inkomensongelijkheid als risicofactor voor de psychische gezondheid van de inwoners belangrijker dan het gemiddelde inkomen, terwijl op buurtniveau het gemiddelde inkomen belangrijker is dan inkomensongelijkheid.

In welke mate verklaart gezond gedrag de relatie tussen individuele etniciteit en depressie?

In **hoofdstuk 6** onderzochten we de mediërende rol van lichamelijke inactiviteit en roken voor de relatie etniciteit en (psychische) gezondheid. Op basis van nieuwe gezondheidsgegevens *(Gezondheidsmonitor Volwassenen GGD-en, CBS en RIVM 2012)* bleek dat Turken, Marokkanen en Surinamers in Nederland meer psychische klachten ervaren en zich vaker minder gezond voelen dan autochtonen. Deze resultaten ondersteunen de in hoofdstuk 4 gerapporteerde bevindingen, die gebaseerd waren op een eerdere dataverzameling: *G4 Gezondheidsenquête 2008*.

In vergelijking met Nederlanders waren Marokkanen en Turken het minst lichamelijk actief, en Turken rookten het meest. Minder lichaamsbeweging onder Turken en Marokkanen, en meer sigaretten roken onder Turken verklaarde een klein deel van de relatie tussen etniciteit en psychische stress, en ervaren gezondheid. Minder lichaamsbeweging onder Turken en Marokkanen verklaarde respectievelijk 6% en 13% van de relatie tussen etniciteit en psychische stress, en respectievelijk 11% en 9% van de relatie tussen etniciteit en ervaren gezondheid. Daarnaast verklaarde roken onder Turken 3% van beide relaties. Het verklaarde percentage van beide relaties was klein. De potentieel verklarende variabelen speelden een zwakke tot matige rol in het verklaren van de relaties tussen de etniciteit en de uitkomstmaten. Echter, gezien het toenemende aantal mensen uit etnische minderheden dat weinig beweegt en dat meer rookt, gaan de gevolgen van minder lichaamsbeweging en meer roken een belangrijker rol spelen bij het verminderen van etnische ongelijkheden in (mentale) gezondheid.

Conclusies

In **hoofdstuk 7** werd een samenvatting van de belangrijkste bevindingen gepresenteerd, werden methodologische overwegingen en nieuwe inzichten besproken en werden aanbevelingen voor professionals en onderzoekers voor de volksgezondheid gepresenteerd. Op basis van de studieresultaten in dit proefschrift wordt het volgende geconcludeerd en kan worden aanbevolen:

- Wonen in buurten met een hogere sociale cohesie of hogere SES is geassocieerd met een betere geestelijke gezondheid.
- Er zijn ongelijkheden in psychische gezondheid tussen werkenden en niet-werkenden; tussen mensen die geen en die wel financiële problemen ervaren, en tussen de etnische groepen.
- Wonen in buurten met een grote sociale cohesie is gunstiger voor mensen die financiële problemen ervaren en voor werklozen of arbeidsongeschikten dan voor andere groepen met betrekking tot psychische gezondheid.
- De etnische diversiteit van buurten lijkt etnisch-specifieke effecten te hebben op psychische gezondheid van de inwoners.
- Hoewel wonen in buurten met een hoge mate van etnische diversiteit geassocieerd is met een slechtere psychische gezondheid onder inwoners, rapporteerden Turkse inwoners in etnisch heterogene buurten een betere psychische gezondheid dan Turkse inwoners in etnisch homogene buurten.

- Inkomensongelijkheid in gemeenten en welgestelde buurten is een risicofactor voor de psychische gezondheid van de inwoners.
- Minder lichaamsbeweging en meer sigaretten roken verklaren een klein deel van de etnische ongelijkheden in (psychische) gezondheid.

Aanbevelingen voor onderzoekers

- Geavanceerde statistische modellen en alternatieve onderzoeksdesign (bijvoorbeeld herhaalde metingen of tweelingstudies) moeten worden gebruikt om de causaliteit van de gevonden associaties in cross-sectionele studies te bevestigen.
- De associaties tussen sociale cohesie op individueel én buurtniveau met psychische gezondheid moeten tegelijkertijd worden onderzocht. Er is meer onderzoek nodig om de associaties van sociale cohesie op twee verschillende niveaus met psychische gezondheid te ontrafelen.
- Er is meer onderzoek nodig om te begrijpen wiens gezondheid wordt beïnvloed door inkomensongelijkheid op buurtniveau. Er is weinig bekend over de associaties tussen inkomensongelijkheid op buurtniveau en psychische gezondheid van adolescenten, ouderen en mensen met een lage SES.

Aanbevelingen voor beleidsmakers en professionals in de publieke gezondheidszorg

- Bevordering van de sociale cohesie in de buurt kan bijdragen aan een betere psychische gezondheid van de buurtbewoners. Beleidsmakers moeten zich bewust zijn van het bestaan van een groep mensen met financiële problemen, die een hoger risico op een depressie lopen als gevolg van het wonen in buurten met weinig sociale cohesie.
- Vermindering van de inkomensongelijkheid in gemeenten en welgestelde buurten, en het verbeteren van het welvaartsniveau (gemiddelde inkomen) van de arme buurten, kan de psychische gezondheid van buurtbewoners bevorderen. Landelijk sociaal-economisch beleid dat een eerlijke en egalitaire inkomensverdeling bevordert is daarom van groot belang. Op lokaal niveau moeten het volksgezondheidsbeleid en de inspanningen die als doel hebben om depressie te bestrijden, zich meer richten op de sociale en economische determinanten van depressie.
- Bevordering van gezond gedrag (meer lichamelijke activiteit en minder roken) bij etnische minderheden (Turken en Marokkanen) kan bijdragen aan het verbeteren van hun psychische gezondheid en het verminderen van etnische ongelijkheden in psychische gezondheid.

DANKWOORD

Dit is een bijzonder onderdeel van het proefschrift omdat hier niet de ratio overheerst, maar de gevoelens van de promovendus tot uitdrukking komen. Allereerst wil ik zeggen dat ik mijn promotietraject zeer uitdagend en leerzaam heb ervaren. Het is een lang proces geweest waarin ik mezelf beter heb leren kennen en ik kijk hier heel positief op terug. Dit proefschrift heb ik niet in mijn eentje geschreven. Het is tot stand gekomen dankzij een waardevolle samenwerking met mijn promotors en collega-onderzoekers.

Allereerst bedank ik mijn promotor, Lex, voor de goede begeleiding en prettige samenwerking in de afgelopen 7 jaar. Lex, ik waardeer enorm je daadkrachtige aanpak, enthousiasme, kritische blik op de onderzoeksmaterie en methodologische expertise. De discussies zijn heel leerzaam geweest en hebben mij geholpen om van het kaf het koren te scheiden. Je gaf mij het vertrouwen om mijn eigen route te wandelen en dit promotietraject tot een goed einde te brengen.

Mijn andere promotor, Frank, bedank ik voor de fijne samenwerking, goede inhoudelijke begeleiding, interessante discussies en waardevolle feedback en adviezen. Frank, je bent als copromotor gestart aan dit promotietraject en geëindigd als promotor. Van jou en Lex heb ik de kunst van het schrijven van een artikel geleerd. Minder woorden gebruiken en scherper formuleren! Ik stond helemaal perplex toen jij het aantal woorden van het eerste manuscript, dat meer dan 5.000 woorden telde, terugbracht tot minder dan 3.000 woorden! Inhoudelijk gezien was er nauwelijks iets gewijzigd, maar het stuk was zoveel beter leesbaar.

Leden van de leescommissie, Semiha Denktaş, Martijn Huisman en Niels Mulder, hartelijk bedankt voor uw bereidheid om mijn proefschrift te beoordelen. Ook de overige commissieleden, ook jullie wil ik heel erg bedanken voor het lezen van mijn proefschrift en de aanwezigheid tijdens de verdediging van mijn proefschrift om met mij van gedachten te wisselen.

Ook mijn leidinggevende bij de gemeente Rotterdam, Wilma, wil ik van harte bedanken. In 2009 heb jij me aangenomen als onderzoeker bij de GGD Rotterdam-Rijnmond en de mogelijkheid gegeven om in deeltijd bij het Erasmus MC te promoveren. Ik ben erg blij dat ik deze kans heb gekregen.

In het bijzonder wil ik mijn GGD-collega Gea bedanken voor haar expliciete bijdrage aan dit proefschrift. Gea, ik ben erg blij met jou als collega. Zonder jouw inzet voor de

dataverzameling van de Gezondheidsmonitor zou dit proefschrift nooit tot stand zijn gekomen. Bij jou kon ik altijd terecht bij vragen over de vragenlijsten, syntaxen en databestanden. Je bent een hele fijne collega. Addi, ook jij bedankt voor het beschikbaar stellen van het G4 databestand. Je hebt mijn werk heel wat makkelijker gemaakt.

Ik ben Rick dankbaar voor zijn scherpe opmerkingen en voor het meeschrijven aan drie hoofdstukken van dit proefschrift. Rick, zonder jouw hulp hadden deze hoofdstukken er heel anders uitgezien. En ook bedankt voor het leren van mediatieanalyse. Ook ben ik Toon dankbaar voor zijn kritische blik en verrassende perspectieven op de onderzoeksmaterie. Toon, ik waardeer je enthousiasme voor het vak gezondheid, je begeleiding en je luisterende oor.

Elisa en Margot, hartelijk dank voor het meedenken en meeschrijven van hoofdstuk 6. Elisa, wat begon als jouw scriptie-onderzoek bij de GGD Rotterdam-Rijnmond is geëindigd als een artikel in dit proefschrift. Het was heel fijn om met jou samen te werken.

Graag wil ik mijn collega's van de onderzoeksafdeling van de gemeente Rotterdam bedanken voor hun interesse in mijn proefschrift. In het bijzonder bedank ik Cüneyt, Sarah, Tamara, Bianca, Cathelijne, Matthieu, Ineke en Petra voor hun adviezen en fijne gesprekken. Daarnaast wil ik mijn collega's van beleid, Pascal en Ralda bedanken voor jullie interesse en alles wat jullie voor me geregeld hebben.

Lieve vrienden en (schoon)familie, hartelijk bedankt voor jullie steun, betrokkenheid en liefde.

Lieve moeder en vader, ook al hebben jullie dit proefschrift niet gezien, jullie hebben de basis gelegd voor mijn ontwikkeling en mijn interesse gewekt in het onderwijs en de wetenschap. Ik kan jullie niet genoeg bedanken.

Lieve Sevim, Erva en Mert, bedankt voor jullie begrip en steun de afgelopen jaren. Nu heb ik meer tijd voor jullie….

ABOUT THE AUTHOR

Özcan Erdem was born on the 10th of July 1971 in Taşlık, Kayseri, Turkey and partly grew up in Rotterdam, the Netherlands. In 1990 after graduating from secondary school in Kayseri, he started in 1993 studying Sociology at Erasmus University Rotterdam where he obtained his Master of Arts degree in Sociology in 1997. He worked for a year at the Ministry of Justice and 10 years at the Ministry of Social Affairs and Employment (mainly at the Labour Inspection). Here he carried out nationwide studies on working conditions and labour relations, such as pay differences between men and women in business and government. Since September 2009 Özcan is working as a researcher at the Municipality of Rotterdam, first at the Public Health Service (GGD Rotterdam-Rijnmond) and later at the Research Department (O&BI). His research activities focus on subjects in public health.

This book is the result of his part-time PhD research carried out in the context of CEPHIR (Centre for Effective Public Health In the larger Rotterdam area) in Rotterdam.

LIST OF PUBLICATIONS

THIS THESIS

Erdem, Ö., Van Lenthe, F.J., & Burdorf, A. *Income inequality and psychological distress at neighbourhood and municipality level: An analysis in the Netherlands.* Health & Place. 2019;56:1-8.

Erdem, Ö., Burdorf, A., & Van Lenthe, F.J. *Ethnic inequalities in psychological distress among urban residents in the Netherlands: A moderating role of neighbourhood ethnic diversity?* Health & place. 2017;46:175-182.

Erdem, Ö., Riva, E., Prins, R.G., Burdorf, A., & Van der Doef, M. *Health-related behaviours mediate the relation between ethnicity and (mental) health in the Netherlands.* Ethnicity & health. 2017;1-14.

Erdem, Ö., Van Lenthe, F.J., Prins, R.G., Voorham, T.A., & Burdorf, A. *Socioeconomic inequalities in psychological distress among urban adults: the moderating role of neighbourhood social cohesion.* PloS one. 2016;11(6).

Erdem, Ö., Prins, R.G., Voorham, T.A., Van Lenthe, F.J., & Burdorf, A. *Structural neighbourhood conditions, social cohesion and psychological distress in the Netherlands.* European Journal of Public Health. 2015;25:995-1001.

OTHER PUBLICATIONS

Temel, S., Erdem, Ö., Voorham, T.A., Bonsel, G.J., Steegers, E.A., & Denktaş, S. *Knowledge on preconceptional folic acid supplementation and intention to seek for preconception care among men and women in an urban city: a population-based cross-sectional study.* BMC pregnancy and childbirth. 2015;15(1),340.

Schölmerich, V. L., Erdem, Ö., Borsboom, G., Ghorashi, H., Groenewegen, P., Steegers, E.A., Kawachi, I., & Denktaş, S. *The association of neighbourhood social capital and ethnic (minority) density with pregnancy outcomes in the Netherlands.* PloS one. 2014;9(5).

Schrier, A.C., Peen, J., de Wit, M.A., van Ameijden, E.J., Erdem, Ö., Verhoeff, A.P., Dekker, J.J.M., & Beekman, A.T. *Ethnic density is not associated with psychological distress in Turkish-Dutch, Moroccan-Dutch and Surinamese-Dutch ethnic minorities in the Netherlands.* Social psychiatry and psychiatric epidemiology. 2014;49(10),1557-1567.

PHD PORTFOLIO

Name:	Özcan Erdem
Erasmus MC Department:	Public Health
PhD period:	November 2011 - November 2018
Promotors:	Prof.dr. A. Burdorf, Prof.dr. F.J. van Lenthe

	Year	Workload (ECTS)
PhD Training		
General academic skills		
The biomedical English writing and communication course	2012	1.1
Presentation course	2017	0.6
Research integrity for PhD students	2018	0.3
In-depth courses		
Multilevel analyse EpidM, afdeling epidemiologie & biostatistiek, VU medisch centrum	2013	2.0
Missing data: consequences and solutions EpidM, afdeling epidemiologie & biostatistiek, VU medisch centrum	2014	2.0
Longitudinale data-analyse EpidM, afdeling epidemiologie & biostatistiek, VU medisch centrum	2015	3.0
Presentations		
Seminar CEPHIR, Rotterdam: oral presentation 'De relatie tussen buurt sociale cohesie en depressie in de vier grote steden in Nederland'.	2013	0.3
Meeting CEPHIR, Rotterdam: oral presentation 'De invloed van sociale cohesie in de buurt op mentale gezondheid'.	2017	0.3
Meeting Municipality of Rotterdam, Rotterdam: oral presentation 'Ses verschillen in depressie en de rol van buurt sociale cohesie'.	2017	0.3
Kennisfestival Municipality of Rotterdam, Rotterdam: oral presentation 'Worden Rotterdammers depressiever?'	2018	0.3
Expert meeting Municipality of Rotterdam, Rotterdam: oral presentation 'De epidemiologie van depressie in Rotterdam'.	2018	0.3

Supervising master's theses		
Supervision of student Health Psychology, Faculty of Social Sciences, Leiden University. Thesis title 'Ethnic differences in self-rated health in the Netherlands: a decomposition analysis'.	2013	3.0
Supervision of student Health Psychology, Faculty of Social Sciences, Leiden University. Thesis title 'Do health-related behaviours mediate the relation between ethnicity and (mental) health in the Netherlands?'	2015	3.0
Supervision of student Master Programme Health Sciences, VU University Amsterdam. Thesis title 'Depressive symptoms as a mediator on the association between ethnicity and loneliness in an urban context'.	2015	3.0
Supervision of student Health Psychology, Faculty of Social Sciences, Leiden University. Thesis title 'Social support buffers insufficient mastery in chronic disease and low socioeconomic status'.	2016	3.0
Supervision of student Health Psychology, Faculty of Social Sciences, Leiden University. Thesis title 'A cross-sectional study on the association between employment status and the sense of mastery in relation to BMI'.	2017	3.0
Supervision of student Urban Geography, Faculty of Geosciences, Utrecht University. Thesis title 'Woonomgeving en psychosociale gezondheid: over de samenhang tussen buurtfactoren en de psychosociale gezondheid van kinderen'.	2017	3.0
Supervising bachelor's thesis		
Supervision of student Mathematical Engineering, The Hague University of Applied Sciences. Thesis title 'In hoeverre draagt een stabiele gezinssituatie bij aan een goede gezondheid onder de jongeren in de regio Rotterdam-Rijnmond?'.	2017	1.5
Other		
Supervision of third year medical students' 'community projects'.	2017	0.6
TOTAL		30.6