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Multivariate Analysis of Noise, Socioeconomic and Sociodemographic Factors and Their Association with Depression on Borough Level in the City State of Hamburg, Germany

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Abstract

The objective of this first part of our study was to investigate associations of road traffic noise, socioeconomic and -demographic risk factors, and health access on depression on borough level.

We investigated in a large metropolis associations between prevalence rates of depression per borough (n = 67 boroughs) in all age groups (excluding the age group of 0–17 years) using health claims data (year 2011) and the variables “social deprivation” and “number of family members”, which were obtained from a previously conducted principal component analysis, and by using multivariate regression model. Additionally, the proportion of borough area affected by noise > 65 db(A) and physician density used as a surrogate parameter for health access were considered as potentially associated factors for depression.

The results demonstrated that depression might be associated with increasing social borough deprivation. Additionally, the number of family members used as a proxy measure for positive family support showed decreasing prevalence rates the more family members were present. Furthermore, proportions of borough areas affected by noise > 65 db(A) was positively associated with depression.

Our ecological study design has the advantage that a large number of large-scale, population-based aggregated data could easily be obtained and analysed and first potential associations could be found and discussed. To improve our findings, future studies will use data from a survey and data from the Hamburg City Health Study, a local follow-up health study, to better elucidate the individual risk factors together with environmental living and working conditions.

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Introduction

Worldwide, major mental and behavioural disorders are increasing and account for approximately 7.5 % of disability-adjusted life years (DALYs) with major depressive disorder having the highest impact with 2.5 % within this group [1]. In Germany, where this study was conducted, major depressive disorder is the seventh most frequent cause for loss of healthy years of life among men and the third frequent cause for DALYs among women [1, 2].

Environmental noise in urban areas is suggested to be one of the major risk factors for adverse health effects and several studies mainly investigated and showed the link between different noise sources and cardiovascular outcomes such as hypertension [3–5]. However, fewer is known about the relationship between traffic noise [6, 7] or aircraft noise [8] and different mental disorders such as depression. Results from the Heinz Nixdorf Recall Study showed a relative risk (RR) of 1.29 (95 % confidence interval 1.03, 1.62) for participants classified as having high depressive symptoms for exposure to road traffic noise > 55 dB(A) compared to ≤ 55 dB(A) [6].

Furthermore, it is suggested that health access as well as social services might be associated with mental health outcomes and that there is a gradient of social and health services from urban to rural areas [9, 10].

Likewise, positive support from family was identified as a potential protective factor for the onset or the level of depressive symptoms. A follow-up study conducted in the USA revealed that patients recovered from depression by the time of the follow-up assessment reported higher perceived emotional support from family at baseline [11].

Additionally, a lower socioeconomic background is considered to be an important risk factor for poor mental health. Many studies investigated and showed the relationship between individual, educational and occupational background or income and different mental disorders such as depression and anxiety [12–15]. Weich and Lewis [15] for instance investigated in a cohort study associations between poverty, unemployment and common mental disorders and showed that the duration of episodes of common mental disorders but not the likelihood of their onset were associated with unemployment and poverty, even after adjustment for other individual indices such as educational background or marital status [15]. However, the use of single variables as potential risk indicators may lead to false conclusions because they only reflect parts of the general view.

Other studies have shown that local environmental and borough conditions may play an important role in the prevalence of psychiatric disorders as it has been investigated for instance in two studies conducted by Kirkbride et al. [16] in East London, United Kingdom and by Rejneveld and Schene [14] in the city of Amsterdam, the Netherlands.

Experimental Procedure

The aim of this first part of the study was to investigate associations between road traffic noise, socioeconomic and -demographic factors, and physician density on depressive disorder on borough level in the city of Hamburg. Particularly, by using the multivariate analysis of covariance (ANCOVA) model we assessed potential associations between prevalence rates of depression per borough in all age groups (excluding the age group of 0–17 years of age) and divided by sex using health claims data (year 2011) and the variables “social deprivation” and “number of family members”, which were obtained from a previously conducted principal component analysis (PCA). Furthermore, the proportion of borough area affected by noise > 65 db(A) and physician density used as a proxy measure for health access were considered as potentially associated factors for depression and entered the final model.

Material and Methods

Study area

This study was accomplished in the city of Hamburg, northern Germany, which is the second largest city in Germany, with approximately 1.8 million inhabitants (census data 2013) [17]. Even though Hamburg in general can be described as a prosperous city, great heterogeneity considering socioeconomic and sociodemographic indicators between the 104 boroughs can be found (data 2013) (Fig. 1) [17]. Due to low prevalence in some of the boroughs in Hamburg some of the adjacent boroughs with similar socioeconomic and -demographic background information were combined and from the former 104 urban boroughs, 67 were received and used for all analyses. No data were available for the borough “Hafencity” [18].

Prevalence rates of depression

Prevalence rates per borough for depression from the year 2011, which cover the 67 urban boroughs of Hamburg described above, were provided by the Ministry for Health and Consumer Protection of the Free and Hanseatic City of Hamburg considering the care claims data from the public health care system of all statutory health insured patients with at least one contact to a contract physician working in the ambulatory sector, including psychotherapists as the population (n = 203,172) [18].

The following ICD-10 codes were used for the health outcome: F32 depressive episode ("Depressive Episode"), F33 recurrent depressive disorder ("Rezidivierende depressive Störung") and F34.1 persistent depressive disorder ("Dysthymia"). Prevalence rates were divided by borough and

Figure 1. Map depicting the city of Hamburg. Detailed information about the boroughs can be obtained from Table 1 (Own depiction, according to [17, 18]).

Table 1. List of all boroughs and borough clusters considered in the analysis

ID	borough	ID	borough
1	Allermöhe and Bergedorf	35	Jenfeld
2	Alsterdorf	36	Langenhorn
3	Altona-Altstadt	37	Lohbrügge
4	Altona-Nord and Sternschanze	38	Lokstedt
5	Bahrenfeld	39	Lurup
6	Barmbek-Nord	40	Marienthal
7	Barmbek-Süd	41	Neuallermöhe
8	Bergstedt and Wohldorf-Ohlstedt	42	Neugraben-Fischbek
9	Billstedt	43	Niendorf
10	Blankenese	44	Nienstedten and Othmarschen
11	Borgfelde and St. Georg	45	Ohlsdorf
12	Bramfeld	46	Osdorf
13	Dulsberg	47	Ottensen
14	Duvenstedt and Lemsahl-Mellingstedt	48	Poppenbüttel
15	Eidelstedt	49	Rahlstedt
16	Eilbek	50	Rissen
17	Eimsbüttel	51	Rotherbaum
18	Eißendorf	52	Sasel
19	Eppendorf and Hoheluft-Ost	53	Schnelsen
20	Farmsen-Berne	54	St. Pauli
21	Fuhlsbüttel and Groß Borstel	55	Borough cluster around Kirchwerder (Kirchwerder, Altengamme, Billwerder, Curslack, Moorfleet, Neuengamme, Ochsenwerder, Reitbrook, Spadenland, Tatenberg)
22	Groß Flottbek	56	Borough cluster around Marmstorf (Marmstorf, Langenbek, Neuland and Gut Moor, Rönneburg, Sinstorf)
23	Hafencity*	57	Borough cluster around Neuenfelde (Neuenfelde, Cranz, Francop,
24	Hamburg-Altstadt and -Neustadt	58	Borough cluster around Rothenburgsort (Rothenburgsort, Billbrook, Hammerbrook)
25	Hamm	59	Borough cluster around Wilhelmsburg (Wilhelmsburg, Kleiner Grasbrook and Steinwerder, Veddel)
26	Harburg	60	Steilshoop
27	Harvestehude	61	Stellingen
28	Hausbruch	62	Tonndorf
29	Heimfeld	63	Volksdorf
30	Hoheluft-West	64	Waltershof and Finkenwerder
31	Hohenfelde and Uhlenhorst	65	Wandsbek
32	Horn	66	Wellingsbüttel
33	Hummelsbüttel	67	Wilstorf
34	Iserbrook and Sülldorf	68	Winterhude

* no data for the borough “Hafencity” was available

sex and grouped by age (five groups: 0–17, 18–64, 65–79, 80+, and total) [18]. Due to very low depression prevalence rates in the age group of 0–17 in both sex and hence, possible biased results, we excluded this age group and used the respective borough prevalence rates for the remaining summarized age groups.

Mapping (grid width: 10 m x 10 m; immission height: 4 m above ground level) depicting the noise level of L_{den} (Level day-evening-night) > 65 db(A) as a threshold for high exposure to noise was performed and obtained from the State Ministry for Urban Development and the Environment by using the software Predictor-LimA, version 11.1 [19, 20]. Additionally, population census data (data from 2013) were obtained from the Statistical Office for Hamburg and Schleswig-Holstein [17] and the road traffic noise map was overlayed with the population map by using the Geographical Information System ArcGIS 10.3.1. Afterwards, the resulting fractions were subsequently transferred to the number of potentially affected residents per building block by multiplying the area fraction with the total amount of inhabitants. Finally, the population data and the number of potentially affected residents by L_{den} > 65 db(A) were aggregated to the 67 boroughs, scaled in % per borough and used for further analysis.

Socioeconomic and sociodemographic borough characteristics

Information on social indicators on borough level were provided by the Statistical Office for Hamburg and Schleswig-Holstein [17]. To classify a borough's economic and demographic situation, several socioeconomic and -demographic variables were considered to enter a PCA, which was previously conducted by Erhart et al. [18, 21]. The following data (data from 2012) indicating the socioeconomic and -demographic borough characteristics were considered in the PCA (Table 2 on Page 34).

The first factor of the PCA was used as the indicator, which might adequately describe the social deprivation of a borough and interpreted and titled as “social deprivation”. The respective factor scores were categorized in subgroups where the lowest 25 % of the boroughs pursuant to the social deprivation were classified as low social deprivation, the median 50 % as average social deprivation and the upper 25 % of the boroughs as high social deprivation.

The second factor which was identified by the PCA described the household size and number of children per family. This variable “number of family members” was used as a proxy measure for family support where high number of family members were interpreted as high positive family support and low number of family members as low positive family support. Likewise, the respective factor scores were categorized in subgroups where the lowest 25 % of all boroughs were classified as low number of family members, the highest 25 % as high number of family members, and the rest as average number of family members [18, 21].

Additionally, data about the physician density (general practitioner) per 1,000 inhabitants per borough used as a surrogate parameter for health access for people diagnosed with mental disorder were obtained from the Statistical Office for Hamburg and Schleswig-Holstein [17] and were considered as a further potential co-factor for the statistical analysis.

Statistical Modelling

All analyses were conducted using a borough´s respective overall prevalence rate for depression excluding the age group of 0–17 years of age and for both sex, separately. A multivariate ANCOVA (Analysis of Covariance) model was applied to quantitatively assess the associations between the socioeconomic and sociodemographic factors, as well as noise and physician density, and the borough prevalence rates of depression, using IBM SPSS Statistics, version 23. The independent variables “proportion of borough area affected by noise > 65 db(A)” and “physician density” were analysed as continuous variables and scaled at a unit of per 5 % increase in borough area. For the categorical variables “social deprivation” and “number of family members” a scaling unit of three groups (low, average, and high) was used, respectively. The covariates in the ANCOVA

Table 2 Indicators considered for the Principal Component Analysis

Item	unit	year
SGB II benefit recipients	Proportion of the total population (%)	2012
SGB II benefit recipients below 15 years of age	Proportion of the population below 15 years of age (%)	2012
Households receiving benefits	Proportion of all households (%)	2012
Average income in €	Per taxable person	2007
High school students	Proportion of all school students (%)	2012/2013
Employees	Proportion of all working age population (15 to 64 years of age) (%))	2012
Unemployed	Proportion of all working age population (15 to 64 years of age) (%)	2012
Younger unemployed (15 to < 25 years of age)	Proportion of the younger working age population (15 to < 25 years of age) (%)	2012
Older unemployed (55 to < 65 years of age)	Proportion of the older working age population (55 to < 65 years of age) (%)	2012
Unemployed under the SGB II	Proportion of all working age population (15 to 64 years of age) (%)	2012
Premature deaths	Per 1,000 inhabitants	2012
Children and adolescents < 18 years of age	Proportion of the total population (%)	2012
Inhabitants > 64 years of age	Proportion of the total population (%)	2012
Foreign inhabitants	Proportion of the total population (%)	2012
Inhabitants with migration background	Proportion of the total population	2012
Children and adolescents < 18 years of age with migration background	Proportion of the total population < 18 years of age	2012
Mean number of people	Per household	2012
Single-person household	Proportion of all households (%)	2012
Households with children	Proportion of all households (%)	2012
Households with single-parents	Proportion of all households (%)	2012
Human population density	Per km^2	2012
In-migrations beyond the border of the city	In total	2012
Out-migrations beyond the border of the city	In total	2012
Difference between the in- and out-migrations	In total	2012
Living space	Per inhabitant per m^2	2012
Social housing	Proportion of all flats (%)	2012

SGB II: Social Security Code (Sozialgesetzbuch, Buch II)

model were examined for interactions, but none could be confirmed.

Criterion for significance and therefore inclusion of an independent determinant in the final model was $p \leq 0.05$. The measure of association between a co-variable and the respective depression prevalence rate was defined as the regression coefficient (B) adjusted for all other co-variables. All estimates of the regression coefficient were complemented by a 95 % confidence interval (CI) and a p value. The adjusted R-squared (R^2) was provided as a measure of overall goodness-of-fit of the estimated statistical model.

Results

Prevalence rates of depression

The overall treatment prevalence rates of depression (year 2011), excluding the age group of 0–17 years of age, varied from 7.8 % to 18.5 % among males and from 16.8 % to 26.1 % among females (data not shown). The median value among females nearly doubled compared to males (21.7 and 12.6, respectively) (data not shown). Fig. 2 illustrates the considered overall prevalence for depression per urban borough and showed highest prevalence rates in the boroughs clustered within the Hamburg-Mitte district and in some urban boroughs in the Wandsbek district. Lowest prevalence rates for depression could be detected in the outer parts of Hamburg. No major sex-specific differences could be detected.

Socioeconomic and sociodemographic borough characteristics

Mapping of the spatial results of the social deprivation per urban borough, which was obtained from the PCA showed mainly comparable patterns to the depression prevalence rates and depicted for instance also highest social deprivation in the district of Hamburg-Mitte. This factor is characterised by indicators showing high positive correlations on the proportion of unemployment and the proportion of SGB II benefit recipients (SGB II: Social Security Code [Sozialgesetzbuch, Buch II]). Accordingly, these boroughs

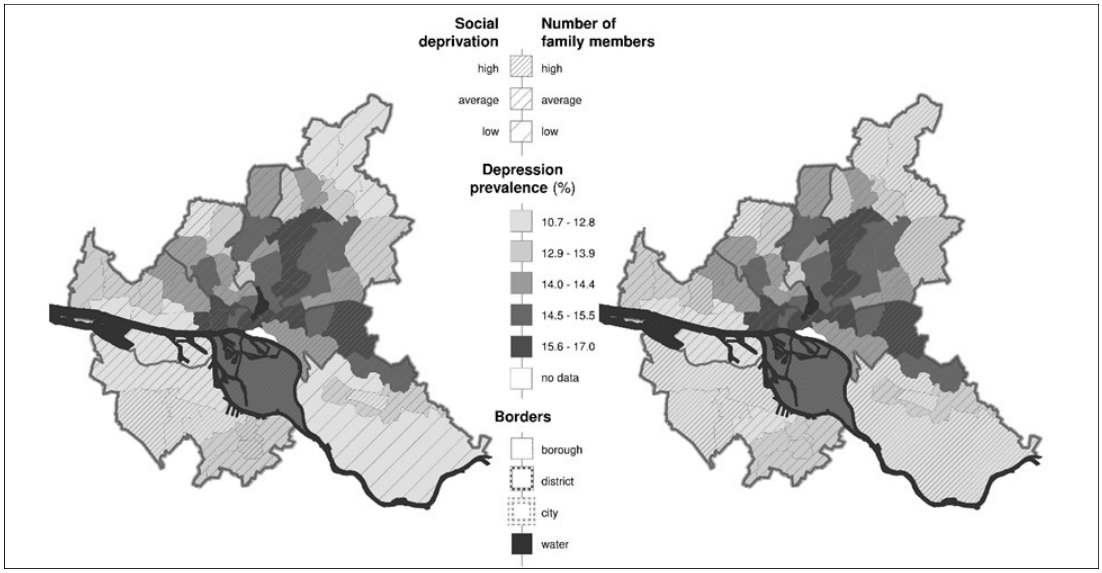

Figure 2. Prevalence rates of depression and spatial distribution of the variables "social deprivation" and "number of family members" per borough, Hamburg, Germany, 2011. Overall treatment prevalence, excluding the age group of 0–17 years of age, both sex. Population are all statutory health insured patients with at least one contact to a contract physician working in the ambulatory sector, including psychotherapists per year. Classification of prevalence rates was conducted using quantiles. The variables "social deprivation" and "number of family members" were obtained from a previously conducted PCA [17, 21].

record high unemployment rates and a high proportion of SGB II benefit recipients. On contrary, boroughs with the lowest social deprivation and hence, amongst others, low unemployment rates, were located in the most north-eastern boroughs and in the most western boroughs of Hamburg (Fig.2). This pattern again predominantly coincided with low prevalence rates of depression. The second factor which was used as a surrogate parameter for positive family support had highest values in the peripheral boroughs. Smallest household sizes and hence, lowest positive family support could be found in the centrally located boroughs. Again spatially similarities to a borough´s depression prevalence rate could be mainly found (Fig. 2).

Physician density

Physician density considering all general practitioners ranged from 0.2 physicians per 1,000 inhabitants in most borough-clusters in the southern parts of Hamburg to 10.4 physicians per 1,000 inhabitants in the centrally located boroughs of Hamburg (data not shown).

Proportion of road traffic noise > 65 db(A)

Additionally, the centrally located boroughs showed the lowest percentage of borough area affected by noise > 65 db(A) with 0.7 %. Highest percentage of borough area affected by road traffic noise level > 65 db(A) with up to 10.1 % could be found within the highly industrialised borough-cluster in Hamburg-Mitte (data not shown).

Multivariate regression analyses

The results of our analysis (Table 3) showed a significantly higher association of depression prevalence rates with an environment characterised by a fractional area increase (5 %) of road traffic noise > 65 db(A) per borough (males 2.38 %; 95 % CI 1.39, 3.36; females 1.44 %; 95 % CI 0.22, 2.65), but no significant results for the considered variable "physician density" (males 0.48; 95 % CI -0.48, 1.43; females 0.80; 95 % CI -0.38, 1.98). The prevalence rate for depression per borough was significantly associated with social deprivation showing an increase from low social deprivation to high social deprivation with 2.21 % (95 % CI 1.10, 3.31) among males. Living in a deprived

Table 3 Associations of determinants on depression, Hamburg, Germany[a]

	Depression male			Depression female		
Determinant	Coefficient B[b]	95 % CI	p value	Coefficient B[b]	95 % CI	p value
Physician density[c,d]	0.48	-0.48,1.43	0.324	0.8	-0.38,1.98	0.18
Proportion of borough area affected by noise > 65 dB(A)[c]	2.38	1.39,3.36	<0.0001	1.44	0.22,2.65	0.021
Low social deprivation[e]	NA	NA	NA	NA	NA	NA
Average social deprivation[e]	0.7	-0.24,1.63	0.141	0.14	-1.01,1.29	0.809
High social deprivation[e]	2.21	1.10,3.31	<0.0001	1.41	0.06,2.77	0.041
Low number of family members[f]	NA	NA	NA	NA	NA	NA
Average number of family members[f]	-0.31	-1.28,0.65	0.519	-0.94	-2.13,0.25	0.119
High number of family members[f]	-1.29	-2.49,0.10	0.034	-2.39	-3.84,-0.92	0.002

NA - not applicable

[a] ANCOVA model, all age groups excluding the age group of 0–17 years of age

[b] Mutually adjusted

[c] Unit = 5 %

[d] per 1,000 inhabitants

[e] Social deprivation classified by PCA: 3 categories: low social deprivation = the lowest 25 % of boroughs, average social deprivation = 26 % –74 % of boroughs, high social deprivation = the upper 25 % of boroughs

[f] Number of family members classified by PCA: 3 categories: low number of family members = the lowest 25 % of boroughs, average number of family members = 26–74 % of boroughs, high number of family members = the upper 25 % of boroughs

borough was associated with higher depression rates of 1.41 % (95 % CI 0.06, 2.77) among females. Additionally, the variable "number of family members" used as a proxy measure for positive family support showed a significant decrease in depression from low positive family support to high positive family support with -1.29 % (95 % CI -2.49, -0.10) among men and with -2.39 % (95 % CI -3.86, 0.92) among women. However, an overall model fit of $R^2 = 0.46$ (males) and $R^2 = 0.31$ (females) indicates that more than 50 % of the variation of the observed prevalence rates cannot be explained by the independent variables of the model.

Discussion

The current study was conducted in order to get insight into the potential association of depression with environmental and socioeconomic and sociodemographic factors. This topic is of particular importance since there is a marked increase in depression among the German population [2]. This increase has led to a significantly increasing volume of health care expenses and still rising losses of productivity, both resulting in high direct and indirect costs [22]. The first results of our study indicate that factors related to the socioeconomic and sociodemographic borough background as well as road traffic noise may be associated with the occurrence of depression in the city of Hamburg. Highest prevalence for depression could be found in most deprived areas, compared to boroughs with low social deprivation. Additionally, the proportion of depression was lower in boroughs where more family members, interpreted as positive family support, were present. Another independent factor was road traffic noise, showing higher prevalence rates of depression in boroughs with higher percentage of borough areas affected by noise > 65 db(A). Physician density used as a surrogate parameter for health access did not show any significant effect on depression rates on borough level.

Several studies have shown that local environmental conditions may play an important role in the prevalence of psychiatric disorders [12, 14, 16, 23]. For instance, a study conducted in the city of Maastricht, the Netherlands, found significantly higher incidences and severity of psychiatric disorders in deprived neighbourhoods [24].

A PCA is a multivariate statistical technique used to reduce the complexity and dimensionality of correlated variables to one or more uncorrelated single indicator variables. Interpretation and comparison across settings such as urban boroughs as provided herein in this study are easier. On the other hand, the principal components are artificially constructed indices and the number of selected variables included and the number of components is arbitrary [25]. However, the indicators which entered the PCA and were used in our study should be reliable and hence, should approximately reflect the socioeconomic and -demographic background of a borough.

Nevertheless, single socioeconomic indicators such as unemployment or income have also been shown to potentially be associated with mental disorder and many studies, reviews or meta-analyses have been published investigating or summarizing the socioeconomic effects on mental health such as depression or anxiety [13, 15, 26].

Number of family members, used as a proxy measure for positive family support, was an independent factor on depression. These results are consistent with other studies, investigating objective and subjective aspects of support from family [11, 27–29]. However, even though we used a high number of family members as a surrogate parameter for positive family support, it could contrarily have a negative effect on depression when for instance family conflicts are present [28, 29]. Therefore, our results have to be interpreted with caution.

Furthermore, the proportion of borough areas affected by road traffic noise > 65 db(A) indicated associations with depression prevalence rates. Likewise, an impact of residential road traffic noise > 55 db(A) on high depressive symptoms has been suggested from the Heinz Nixdorf Recall study, conducted in three adjacent cities in western Germany [6]. Same results could be found in a study

conducted in the city of Tokyo showing associations between road traffic noise above a threshold of > 65 db(A) with sleep disturbance and depression [7]. Nevertheless, a limitation of our study is that road traffic noise was transferred to the number of potentially affected residents per building block. Certainly this does not reflect the real environment or covers the real circumstances of noise exposure. Instead, other individual co-factors describing location of rooms, subjective noise annoyance or duration of residence should be taken into consideration [7, 8, 30, 31]. Additionally, noise at workplace [32, 33] or other sources of noise such as aircraft or industrial noise [8, 31, 34] are suggested to affect psychological disorders. Additionally, exposure to gaseous and particulate air pollutants, which is generally higher in cities than in non-urban areas, has been associated with depression [31] or anxiety [35]. However, no data on further noise sources or air pollutants in the city of Hamburg were available and so far, could not be considered in our study.

Physician density applied as a surrogate parameter for health access did not show any significant association with depression. Only data from general practitioners and not from psychotherapists were used to calculate the physician density per 1,000 inhabitants. In the German health care system people potentially suffering from mental disorder first have to see a general physician or practitioner for referrals to a specialist such as psychologists. Hence, only using the physician density as a proxy measure for health access for people diagnosed with several mental diseases should mostly represent the health care for mental disorder. However, in general people do not always seek medical care adjacent to their home-address. Instead, they seek help at a general practitioner or even specialist in a borough further away or go directly to the hospital. Hence, depression prevalence rates might be underdiagnosed and skewed in some particular groups of the population due to differences in seeking health care behaviour.

Another limitation of our study is, that only data from statutory health insurance patients with at least one contact to a contract physician working in the ambulatory sector, including psychotherapists were available. Data regarding the amount and distribution of privately insured patients or data from private practice were not available. However, it is suggested that roughly 10 to 20 % of all inhabitants in Hamburg are privately insured [18, 21], therefore the prevalence rates used here in our analyses should cover the largest proportion of diagnosed cases. Nevertheless, due to the high costs of the private insurance, mostly people above a certain income level can afford this status. Hence, our results might be skewed in low deprived boroughs due to the lack of data from the privately insured individuals.

Furthermore, it is suggested, that the insurance status might be associated with the treatment and hence, the health outcomes of individuals. For instance, two studies in the USA investigated the influence of insurance status on the access to mental health care. Both studies found associations between the insurance status and unmet need for mental health care or the acceptance rates [36, 37]. Additionally, a higher number of unreported cases might not be considered in our study, because not all people showing depressive symptoms do seek help at a psychotherapist. Additionally, differences in motivation for psychotherapy and illness beliefs might be one reason for underestimation of cases as shown in a study conducted among Turkish Immigrant inpatients in Germany [38]. Furthermore, not all ICD-codes for depressive disorders such as F48.0 describing Neurasthenia or F92.0 describing depressive conduct disorder, were considered for our health outcome depression. Therefore, the data used in our study only capture a fraction of the estimated prevalence and hence, might have an underestimation bias in their acquisition.

Due to very low borough prevalence rates among the age group of 0 to 17 years of age in both sex (approximately 0–2 %) and hence, a possible false estimation of the respective effects, we excluded this group in the final model. Prevalence rates among the remaining age groups

were approximately evenly distributed (among males range between approximately 10–20 %, among females range between approximately 15–25 %) and were chosen as one group for the analysis. Nevertheless, to check stability of the observed results, we repeated the ANCOVA model with the age group 0 to 17 years of age included. “Number of family members” as well as “social deprivation” had somewhat higher significant estimates of the coefficient B, instead “proportion of borough area affected by noise > 65 db(A)” indicated a halving of the depression prevalence (data not shown). Reversely, this result might underline the possible association of long-term effects of noise above a certain threshold and additionally the importance of duration of residence on mental disorder.

An advantage of our cross-sectional ecological study design is, that a number of large-scaled, population-based data could easily be obtained for the city of Hamburg and first theoretical associations might be analysed and discussed. Our results obtained here on borough level show similar association as demonstrated in other studies underlying the potential importance of social depravity of a borough in relation to specific disease outcomes, even though the study design used so far makes the results of this study difficult to interpret and potentially misleading.

In a next step we will conduct a case-control study with hypertensive patients as cases to get a better insight into the potential individual risk factors together with environmental living and working conditions. Participants from the Hamburg City Health Study (HCHS), the largest local follow-up health study, which just started spring 2016 and with follow-ups for the next 12 years will be matched and used as a control group. Additionally, data about noise (traffic noise, aircraft noise as well as industrial noise) and data about air pollution will be selectively collected close to the residents of participants and considered in the upcoming studies to account for the above discussed limitations and hence, to better analyse and understand potential individual and environmental co-factors of depression.

Conclusion

Our first results presented herein suggest that the socioeconomic and sociodemographic background of an urban borough could have a considerable effect on depressive disorder. A significantly higher prevalence for depression was detected for highly deprived boroughs. Furthermore, road traffic noise > 65 db(A) indicated a significant association with depression in the city of Hamburg. Our results suggest that large-scale socioeconomic and -demographic borough data together with noise, which could easily be obtained might be useful to pose potential associations between a borough´s socioeconomic and sociodemographic background, noise and different health outcomes such as depression. However, to regard the limitations of our study future studies will focus on collecting information on individual level and the environmental living and working conditions together with data on noise and air pollution in the near living environments of participants. These are prerequisites to assess the validity of our model and to develop strategies to reduce the increasing prevalence of depressive disorder.

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