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Relationship between country of birth and self-rated health: a cross-sectional study in primary health care patients

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Abstract

Objective The extent of association between self-rated health and country of birth among primary healthcare patients born outside and resettled in Sweden and born in Sweden.

Setting Two Academic Primary Healthcare centers in Stockholm County, Sweden

Participants 825 individuals with risks for prediabetes and diabetes attending academic healthcare centers, aged 18-74 years old, 56.8% born abroad and 43.2% born in Sweden. Persons with diabetes diagnosis were excluded.

Outcome Self-rated health (SRH) was dichotomized as optimal (very good/good) and suboptimal (fair/bad/very bad) and compared between born in Sweden and born outside Sweden.

Results The difference between two groups in SRH was statistically significant (p=0.008). Logistic regression analysis showed a crude OR for reduced SRH of 1.46 (95% CI 1.10-1.92) in patients born outside Sweden compared to Swedish-born patients. After controlling for education, employment and marital status, OR increased to 1.57 (95% CI 1.16-2.11) and after controlling for physical activity and smoking decreased to 1.41 (95% CI 1.03-1.92).

Conclusions Patients born outside Sweden reported lower SRH than their Swedish-born counterparts. Socioeconomic factors as well as lifestyle aspects influenced reporting of lower SRH. Future studies should further investigate the SRH of immigrants.

Article summary

Strengths and limitations of this study

- There are socioeconomic discrepancies between different parts of Sweden. Therefore, choosing subjects who live in the same socioeconomic neighborhood and from the same APHCC is important to avoid the influence of two neighborhoods.
- Another strength was the inclusion of different aspects of SES i.e. employment status and educational level, as well as lifestyle factors (smoking habits and physical activity) is a strength since it is shown in previous studies that these factors may influence SRH (13).
- One weakness is the fact that even if the translation of the questionnaire into different languages facilitates the understanding for non-Swedish speaking participants, it could represent a limitation. The wording of the response alternatives may differ from one language to another (translational bias). For instance, a translation of the category "fair" into other languages could give it a more negative or positive meaning which may eventually influence the results.
- Another limitation was the choice of countries. Syrian immigrants represent a large proportion of immigrants in Sweden but were not included in this study. Furthermore, SRH could be susceptible to response bias due to its subjectivity. However, this is balanced

by the fact that SRH has long been used as a valid measure of subjective health that predicts mortality.

- Because of the cross-sectional nature of the study, it is impossible to infer causality. This means that being an immigrant in Sweden does not necessarily cause low SRH.
- Another problem that may be generated by the study design is that these results reflect the time point at which the study was carried out. This means that the results may differ if another time-frame is to be chosen, which calls for prospective studies.

Key messages

- Immigrants with risks for prediabetes and diabetes have lower SRH in comparison with their Swedish-born counterparts.
- Differences in SRH could not be explained by differences in the objective health status.
- Inclusion of patients from the same neighborhood and factors influencing SRH such as different aspects of SES i.e. employment status and educational level, as well as lifestyle factors (smoking habits and physical activity) could not explain the differences in rating SRH between born abroad compare to those born in Sweden.

Background

For achievement of a good state of health, it is suggested by the World Health Organization (WHO) to find a balance between objective and subjective measures. While objective health focuses on diagnosing health diseases and measuring various clinical parameters (1), subjective health, on the other hand, combines the physical, mental and social well-being of the individual (2). Self-rated health (SRH) has emerged as a unified measure of subjective health status that can provide valuable information serving as a compliment to objective health measures (1) (3) (4). SRH is widely used as a reliable measure of subjective health status in the public health field. SRH has been used in national and international health surveys, as an important public health indicator (5). Patients reporting low self-rated health have been shown to be more likely to manifest an increased use of healthcare services (11).Prior studies have shown that SRH is an independent predictor of one of the major unfavorable health outcomes, namely mortality (6). SRH has been associated with higher rates of mortality of various diseases including cardiovascular diseases (CVD) (7) and diabetes (8), among others, as well as all-cause mortality (6). It was shown in a recently published meta-analysis that subjects reporting their health as fair or bad had a twofold higher risk of all-cause mortality compared to those with good SRH (6).

SRH has been shown to be influenced by many factors such as gender (12), socioeconomic status (SES) (13) and age (14). Women, people

with low SES, and older adults are more likely to report poor SRH. Other crucial elements related to poor SRH are lifestyle factors such as obesity, physical inactivity and smoking (13,15). Furthermore, in a study by Bardage et al SRH was rated significantly different in relation to self-reported diseases or functional ability in Finland, Sweden, Spain, The Netherlands and Israel (16). However, regardless of which country of origin, such indicators of medical and functional health as marital status, hypertension, stroke, diabetes, cancer, musculoskeletal diseases and ADL were significantly associated with SRH (16).

It has been found that people tend to interpret SRH differently and that the factors that may potentially influence health rating differ from one individual to another. Individuals with similar levels of objective ill health could perceive their SRH differently. A study on young people with type 1 diabetes mellitus found that participants varied in their SRH even after adjusting for multiple risk factors (17). Similarly, another study found a discrepancy in SRH among subjects with hypertension (18). Additionally, a study comprising 181 patients with advanced cancer showed differences in reported SRH (19).

The percentage of foreign-born individuals in Sweden now exceeds 20% according to Statistics Sweden (20). In 2016, almost 80% of the population growth resulted from migration movement.

Prior studies in this field have yielded results suggesting that immigrants in general have lower SRH in comparison with their

Swedish-born counterparts (24). Immigrants in general are more vulnerable to diseases than the native-born population (25,26). This raises the question whether the differences in SRH could be explained by differences in the objective health status. However, including some diseases in previous studies did not eliminate the differences in SRH observed between foreign-born and native-born population. For instance, a Swedish study on the role of country of birth and parental background in reported health among adolescents found that boys born outside of Europe were almost twice as likely as their Swedish counterparts to rate their health as low, but the percentage of subjects with asthma did not differ significantly (27). In addition, a study by Taloyan et al. comparing Kurdish immigrants to Swedish subjects found that Kurdish immigrants were more likely to report lower SRH. However, the two groups had comparable objective health condition in terms of chronic diseases, eczema, psoriasis, urinary tracts complaints and diabetes (28).

When it comes to studying specific immigrant groups in Sweden, there has been a clear interest in Finnish immigrants (29,30). This is not surprising since they constitute one of the largest groups in Sweden. Similarly, studies have been conducted on immigrants from other European countries (31,24). A published study by Sundquist et al on immigrants from Turkey, Iran and Poland demonstrated that they reported lower SRH compared with Swedish-born individuals (32). Furthermore, Taloyan et al investigated SRH in Assyrians with diabetes in the town of Södertälje in Sweden. They found that this group had

lower SRH compared with Swedes. This association could not entirely be explained by gender, age or socioeconomic status, which called for further studies (33).

Differences in targeted populations and methodological approaches applied for SRH as well as other variables of interest is a problem that hinders the comparison between different studies involving subjects of non-Swedish origin. One of the encountered issues is that previous studies were limited in sample representativeness as they focused on middle-aged and older adults. According to Statistics Sweden, younger immigrant adults aged under 35 represent around 20% of the total immigrant population (34). Therefore, this group needs to be included when studying immigrant's health. Additionally, there should be more focus on lifestyle factors as an important determinant of SRH.

Overall there is a gap in knowledge when it comes to studying SRH in subjects born outside Sweden resettled in Sweden. The acquisition of more knowledge is therefore important in order to provide them with suitable health care services.

Aims

The first aim of the current study was to determine the extent of relationship between country of birth and self-rated health among primary healthcare patients in Sweden. The second aim of the study was

to investigate if these differences were explained by socioeconomic and lifestyle factors.

Methods

Data source

Data were drawn from a large study: 4D diabetes project" screening and treatment of prediabetes and diabetes in primary care: a pilot study", initiated by a collaboration between Karolinska Institutet and Stockholm County Council. The 4D diabetes project aims to identify subjects at a high risk for developing diabetes and prediabetes at APHCC in Flemingsberg and Jakobsberg (35). Either patients or public were involved in the design of the study. Study was aimed start recruitment of patients consecutively attending Flemingsberg and/or Jakobsberg health care centres during study period. Eligibility criteria for the 4D diabetes project were as follows: attending APHCC in Flemingsberg or Jakobsberg during the period 2013-2015, as well as being ethnic Swede or being first- or second generation immigrant from Asia including Middle East and Africa. An ethnic Swede was defined as being born in Sweden with both parents born in Sweden.

All patients, aged between 18 and 74 years were asked whether or not they wished to take part in the study. Patients with known diabetes were excluded. A total of 830 patients (389 individuals from Flemingsberg and 441 from Jakobsberg) from 69 countries (including Sweden) agreed and were included in the 4D diabetes project. Of the 830 individuals included in the 4D project, were 42,1 % (n=356) born in Sweden and 56,9 % (n=469) - abroad. The biggest groups were from Turkey (n=86), Iran (n=52), Iraq (n=48), Finland (n=39) and Bangladesh (n=24).The final sample size was 825.

Data collection

The data were collected via direct personal face-to-face interviews at the APHCCs in Flemingsberg and Jakobsberg. The interviews lasted approximately 15 to 20 minutes and were conducted at a separate room at the APHCCs in order to maintain privacy for the participants. The questionnaire was translated into several languages including Arabic, Persian and Turkish.

Outcome variable

Self-rated health (SRH) was assessed using a single question "How would you rate your general state of health?" with five response alternatives ranging from "very good" to "very bad". This five-point

scale used for SRH is the one that has been recommended by the WHO (5). For analysis, we considered a dichotomization into two groups: response alternatives "very good" or "good" were considered as having an optimal SRH, whereas "fair", "bad" or "very bad" were grouped under suboptimal SRH. This classification of different categories of SRH has been previously applied in many studies (28,37).

Explanatory variables

The variables included were **sex** (male or female); **age** (18-44 and 45-74 years); **country of birth** (born in Sweden with parents born in Sweden and individuals born abroad); **socioeconomic status** (SES): *educational level* (9 years or less, 10 to 12 years, more than 12 years), e*mployment status* (employed and unemployed/retired/student) and *marital status* (married/living with a partner and single/divorced or separated/widowed) and finally, **lifestyle factors**: *physical activity* (exercised or not exercised) and *smoking* (non-smokers, former smokers and current smokers).

Statistical analysis

Descriptive statistics were used to assess the population's characteristics, according to the country of birth. For the categorical variables, i.e. sex, educational level, employment status, marital status, physical activity, and smoking, the differences in percentages were compared using chi-squared test. The relationship between SRH and

country of birth was examined using chi-squared test. A p-value <0.05 was considered significant. Logistic regression was performed to determine the association between low SRH in individuals born outside Sweden and the explanatory variables, with Swedish-born persons as a reference. The results are presented as odds ratios (OR) with 95% confidence interval (95% CI). The statistical analysis was performed using STATA version 14 (StataCorp LP, Texas, USA).

Ethical considerations

Giving the cross-sectional nature of this study, the ethical problems that potentially may be encountered were limited. No interventions possibly resulted in any psychological or physical harm to the participants were made. The respect of the individuals' integrity when taking part of the provided data were taken into consideration. This was easily surmounted by de-identifying the replies prior to initiation of this study. The subjects were informed that the participation was voluntary and that they had the right to withdraw from the study whenever they wished without facing any consequences.

Since the majority of our participants were born abroad, with limited or no knowledge of the Swedish language, they were provided with written information about the study purpose as well as the questionnaires in Arabic, Persian and Turkish. The results of this study could benefit more patients in the future, including our study participants and may lay basis for future studies to deepen our understanding of SRH. The present study was approved by the Ethical

Review Board in Stockholm (reference number for 4D diabetes project: 2013/2303-31/3).

Results

Demographic characteristics

Demographic characteristics of the study population by country of birth are displayed in Table 1. There were in total 825 individuals, of which persons born in Sweden constituted 43.2 % and 56.8% were born in other countries. No significant differences were found between the two groups with regard to sex and marital status. Born outside Sweden were significantly younger, had higher education and were less physically active. On the other hand they smoked to significantly higher extent compared to Swedish-born patients. The mean age of the study population was 49, 5 years for Swedish-born and 46 years for born outside Sweden. More than half of the participants attended more than 12 years of education (54.0%). More than two-thirds of the subjects were married/cohabiting (70.0%). The majority of the participants reported being physically active (63.3%). More than half of the participants were employed (53.5%). The percentage of people

born outside Sweden with optimal SRH was lower than in ethnic Swedes.

Table 1: Characteristics of the study population according to different countries of birth

Variables	Category	Total	Swedish-born	Born outside Sweden	p-value
Sample size, n (%)		825 (100)	356 (43.2)	469 (56.8)	
Age					
Mean (SD)		49 (0.5)	52 (16.4)	46 (12.8)	**<0.0001[ab]**
	18-44 years	323 (39.0)	111 (31.3)	209 (44.6)	**<0.0001[b]**
	45-74 years	506 (61.0)	244 (68.7)	260 (55.4)	
Sex, n (%)	Female	475 (57.2)	203 (57.0)	269 (57.4)	0.924[a]
	Male	355 (42.8)	153 (43.0)	200 (42.6)	
SRH, n (%)	Optimal	430 (52.3)	204 (57.6)	242 (51.7)	**0.008[a]**
	Suboptimal				

		392 (47.7)	150 (42.4)	226 (48.3)	
SES, n (%)	*Educational level*				**<0.0001[a]**
	9 or less	148 (18.0)	51 (14.3)	97 (20.8)	
	10 to 12	230 (28.0)	132 (37.1)	98 (21.0)	
	Over 12	445 (54.0)	173 (48.6)	272 (58.2)	
	Employment status				**0.050[a]**
	Employed	433 (53.5)	173 (49.6)	260 (56.5)	
	Unemployed	376 (46.5)	176 (50.4)	200 (43.5)	
	Marital status:				0.066[a]
	Single	248 (30.1)	119 (33.4)	129 (27.5)	
	Married/cohabiting	577 (69.9)	237 (66.6)	340 (72.5)	
Lifestyle factors, n (%)	*Physical activity*				**<0.0001[a]**
	< 30 min	103 (12.5)	23 (6.5)	80 (17.1)	
	30-60 min	105 (12.7)	29 (8.1)	76 (16.2)	
	60-90 min		37 (10.4)		
	> 90 min		267 (75.0)		

	95 (11.5)		58 (12.4)	
	521 (63.3)		254 (54.3)	
Smoking				**<0.0001[a]**
Non-smoker	412 (50.1)	167 (47.0)	245 (52.4)	
Former smoker	248 (30.1)	133 (37.5)	115 (24.6)	
Current smoker	163 (19.8)	55 (15.5)	108 (23.0)	

a Bold numbers are significant

b Chi-squared test

Logistic regression

Odds ratios of low SRH in patients born outside Sweden compared to Swedish-born subjects with adjustment for age and sex (model one), SES i.e. employment status, educational level and marital status (model two) and lifestyle factors in terms of physical activity and smoking (model three), are presented in Table 2. The crude OR of reporting suboptimal health was 1.46 (95% CI 1.10-1.92) for born outside Sweden compared to Swedish-born patients. This relationship

increased after controlling for educational level, employment and marital status (OR=1.57 95% CI 1.17-2.10) and decreased to 1.41 after adjustment for smoking habits (1.03-1.92) still significant level.

Table 2. The odds ratios (OR) with 95% confidence interval (CI) of suboptimal SRH (self-rated health) in individuals born outside Sweden with Swedish-born patients as reference group, by stepwise inclusion of the explanatory variables (Crude Model – Model 3).

Variable	Crude OR	Model 1: + age, sex	Model 2: +educ. level, employment, marital status	Model 3: + physical activity, smoking
Swedish-born	Ref	Ref	Ref	Ref
Born outside Sweden	**1.46** 1.10-1.92	**1.48** 1.12-1.97	**1.57** 1.16-2.11	**1.41** 1.03-1.92
Age				
18-44 years		Ref	Ref	Ref
45-74 years		1.10 0.80-1.42	0.94 0.69-1.27	1.02 0.74-1.40
Sex				
Female		Ref	Ref	Ref
Male		**0.74** 0.56-0.98	0.86 0.65-1.15	0.85 0.63-1.14
Educational level				
Low			Ref	Ref
Medium			0.72 0.47-1.12	0.78 0.50-1.22
High			**0.63** 0.42-0.93	0.68 0.45-1.02

Employment status	Ref	Ref
Employed	**1.51**	**1.53**
Unemployed	1.13-2.01	1.14-2.10
Marital Status	Ref	Ref
Married	**1.63**	**1.60**
Single	1.20-2.23	1.15-2.20
Physical activity		Ref
<30 min		**0.51** 0.28-0.92
30-60 min		**0.48** 0.27-0.88
60-90 min		**0.36** 0.22-0.57
>90 min		
Smoking		
Non-smoker		Ref
Former		0.98 0.70-1.39
Current		1.01 0.68-1.52

Discussion

In this study, we aimed to assess the association between SRH and country of birth among primary health care patients born abroad compared to Swedish-born patients. The results showed that those born outside Sweden had significantly lower SRH in comparison with

Swedish-born counterparts. This result agrees with previous studies investigating SRH in patients born outside Sweden, especially those born in a middle-eastern country (31,33).

It is well-known that chronic diseases are more prevalent in non-European immigrants compared to Europeans (39).The presence of chronic diseases could alter the quality of life which eventually could have a negative impact on SRH. However, we were unable to explore this issue because of the limited data. Additionally, psychological status is an important factor that could affect SRH (28). Psychological distress could be triggered by various situations; Migration per se is considered as a stressful process (40). Arriving at a new country, immigrants may face many challenges to adjust to a new society. The lack of knowledge on the language of the host country could serve as a barrier against the integration into the society. Discrimination in the host country could impair the psychological well-being of the individual. Also, many immigrants have left members of their families in a home country at war.

The finding that SRH statistically differs between immigrants in general and their Swedish-born counterparts agrees with results from some previous Swedish studies (28,32,33). However, these studies differ from our present study in certain ways. A large cross sectional study on immigrants from Turkey, Iran and Poland in Sweden showed that the differences in reporting significantly lower health than Swedish individuals disappeared when accounting for socio-economic status,

knowledge of the Swedish language and discrimination (32). In our study these differences in SRH between studied groups were still statistically significant even after adjustment for socioeconomic status.

We included both younger and older adults as opposed to a study by Pudaric et al. on 8959 individuals with different ethnic backgrounds that focused only on older adults (55-74 years old) (31) which may explain the difference they found in SRH between older immigrants and older Swedish subjects. Although they share the status of being immigrants in a foreign country, there are some discrepancies between different ethnic groups that should be taken into consideration. Thus, it would be better to study each ethnic group separately.

When studying whether ethnicity is associated with low SRH in Assyrians living in the town of Södertälje, Taloyan et al. focused on diabetic subjects only (33). Furthermore, as pointed out by the author of this article, one limitation was that they did not include lifestyle factors as a possible confounder (33). Another difference is in data collection methods; our study was carried out in APHCC using face-to-face interviews with questionnaires that were translated to the subjects' native languages. On the other hand, a study by Lindström et al. on immigrants living in Malmö that found lower SRH in these subjects compared to the native population, used mailed questionnaires with no translation help (24). The method applied for data collection may have an impact on the answers given by the subjects.

Lastly, our study compared immigrants to Swedes living in the same neighborhood as opposed to another larger study that compared immigrants to native Swedes in general and found that these immigrants reported lower SRH (32). On the other hand, Danish study done in the same neighborhood of Korskærparken showed that limited number of life resources rather than ethnicity could explain differences in self-rated health between immigrants with European and non-European backgrounds compared to native Danes (41). This suggests that differences in SRH observed in some other larger studies between immigrants and native population may be a result of differences in neighborhood rather than country of birth. In a case-control study on recent immigrants in Sweden was found that non-European immigrants, mainly from Somalia and Iraq with recent permanent permits to stay did not have inferior health to that of Swedish age- and sex-matched controls (42). One contributory cause as suggested by the author was the good environmental factors in the county of Västmanland where these newly arrived immigrants reside, which could be the case with our study as well (42). Also, it was suggested that men born in Iraq were well-educated and therefore had higher expectations in life that may explain that they did not have lower SRH than Swedes. Likewise, more than half of born abroad in our study had high educational level (58, 2%), however unemployment was significantly related to lower SRH than employment instead of high educational level.

Primary care implications

The number of immigrants in Sweden increases every year therefore, it is important to study immigrant population's health. An increased awareness of the lower SRH among immigrants is needed to plan and allocate primary health care services for this group. SRH is an easy item to collect since it is assessed through a single question. Despite that, it has an impact on a major heath outcome (mortality). Efforts to understand SRH and the factors related to it would be beneficial to the health care system on many levels including financials. Future studies should further investigate the health of immigrant patients.

Author Contributions

MT, AA and HS designed the study. CGÖ, KS, FL and MT was responsible for data collection. MT, AA and HS wrote the first draft of the manuscript and conducted analyses. CGÖ, KS and FL contributed with materials/analysis tools. MT extracted the data. MT and AA conducted analyses and interpretation of the results. All authors contributed to the analyses and editing of the manuscript, and approval the final manuscript.

All authors have declared that no competing interest exist. This work was supported by Stockholm County Council and Karolinska Institutet. The datasets generated and/or analyzed during the current study are not publicly available due to patient's integrity and ethical consideration. Only authors have access to the dataset.

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The extent of the association between self-rated health and place of birth: a cross-sectional study among people at high risk of developing pre-diabetes and diabetes in Sweden

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The extent of the association between self-rated health and place of birth: a cross-sectional study among people at high risk of developing pre-diabetes and diabetes in Sweden

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Abstract

Objective The first aim was to determine the extent of the relationship between place of birth and self-rated health in primary healthcare patients born outside Sweden and those born in Sweden. The second aim was to investigate whether socioeconomic and lifestyle factors explained any differences.

Setting Two academic primary healthcare centres in Stockholm County, Sweden.

Participants 825 patients at high risk of developing pre-diabetes and diabetes, aged 18-74 years, attending academic healthcare centres in areas with large numbers of immigrants, 56.8% born abroad and 43.2% born in Sweden. Patients with a diagnosis of diabetes were excluded. Inclusion criteria were based on previous research showing that people born in Middle Eastern and Asian countries who live in Sweden have a high prevalence of and risk for diabetes.

Outcome Self-rated health was dichotomized as optimal (very good/good) and suboptimal (fair/bad/very bad) and compared in those born outside Sweden and in Sweden.

Results There was a statistically significant difference in the self-rated health of the two groups (p=0.008). Logistic regression analysis showed a crude OR for reduced SRH of 1.46 (95% CI 1.10-1.92) in patients born outside Sweden. After controlling for education, employment and marital status, the OR increased to 1.50 (95% CI 1.11-2.02). After controlling for physical activity and smoking, it decreased to 1.36 (95% CI 1.00-1.85).

Conclusions Socioeconomic and lifestyle factors influenced self-rated health. It could therefore be useful for clinicians to consider these factors when providing care for patients born outside Sweden and resettled in areas with large numbers of immigrants.

Keywords: Self-rated health, immigrants, primary healthcare, Sweden

Article summary

Strengths

The questionnaire was available in different languages.

To the best of our knowledge, the study is the first in Sweden to investigate self-rated health in people at higher risk for pre-diabetes and diabetes.

Including of the two health care centres' catchment areas with a large number of immigrants.

Limitations

The study design did not permit us to establish a temporal relationship between the exposure and outcome.

Non-random sampling limited the ability to draw conclusions.

Those born outside Sweden were grouped together regardless of place of birth, potentially masking inequalities by place of birth.

The study did not include information on cultural perceptions about health.

Background

According to the World Health Organization (WHO), good health includes a balance between good objectively measurable and good subjectively experienced health. Whereas objective health is assessed by diagnosing diseases and measuring various clinical parameters, subjective health combines the physical, mental and social well-being of the individual (1). Self-rated health (SRH) has emerged as a unified, reliable measure of subjective health status that can provide valuable information and serve as a complement to objective health measures (2-4). SRH is widely used in the field of public health, including national and international health surveys (5). Prior studies have shown that SRH is an independent predictor of mortality (4, 6, 7). It is associated with higher rates of mortality from numerous diseases, including cardiovascular diseases (CVD) (8) and diabetes, as well as all-cause mortality (9). A meta-analysis from 2006 found that people who reported their health as fair or bad had a twofold higher risk of all-cause mortality than those who reported their health as good (7).

SRH is influenced by many factors. Examples include gender (10), socioeconomic status (SES) (11) and age (12). Women, people with low SES and older adults are more likely to report poor health. Lifestyle factors such as obesity, physical inactivity and smoking are also related to poor SRH (11, 13). Furthermore, the way people rate their health in relation to self-reported diseases or functional ability seems to vary by country, as shown in a comparative study of people in Finland, Sweden, Spain, the Netherlands and Israel (12). However, some indicators seem to be significantly associated with SRH regardless of country of origin, including marital status, hypertension, stroke, diabetes, cancer, musculoskeletal diseases and activities of daily living (12).

The factors that potentially influence how people rate their health differ from

one individual to another, and even those with similar levels of objective ill health can perceive their health differently. A study of young people with type 1 diabetes mellitus found that participants varied in their SRH even after adjusting for multiple risk factors (14). Similarly, studies have found discrepancies in SRH among people with hypertension (15) and advanced cancer (16).

Immigrants make up a growing portion of the Swedish population, currently over 20% (17). In 2016, almost 80% of the population growth in Sweden resulted from immigration. Prior studies suggest that immigrants in Sweden generally have lower SRH than their Swedish-born counterparts (18, 19). Many studies on SRH in immigrant groups in Sweden focus on Finnish immigrants (20, 21), as they constitute one of the largest immigrant groups in the country. Similarly, studies have been conducted on immigrants from other European countries living in Sweden (18, 22). According to such studies, people born in Finland, Eastern Europe and Southern Europe living in Sweden rate their health poorer than those born in Sweden (20, 23). A similar pattern has been observed in immigrants from outside Europe, including adolescent boys (24), immigrants from the Middle East (25) and Assyrians with diabetes from Turkey (19).

Research also shows that immigrants are more vulnerable to diseases than are native-born populations (26-28). This raises the question of whether differences in SRH could be explained by differences in objective health status. However, in previous studies, the inclusion of diseases has not eliminated the differences in SRH between foreign-born and native-born populations. In addition, a study comparing Kurdish immigrants to people born in Sweden found that the immigrants were more likely to report lower SRH despite comparable objective health, including chronic diseases, eczema, psoriasis, urinary tracts complaints and diabetes (29).

Comparison between studies of self-rated health in immigrants vs. native populations is made difficult by differences in study populations and methodological approaches. For instance, many previous studies in Sweden focus on middle-aged and older adults, which limits their representativeness. According to Statistics Sweden, people between the ages of 18 and 35 years make up around 20% of the total immigrant population (30). This group therefore needs to be included when studying immigrants' health.

There is a gap in knowledge about the SRH of people living in Sweden who were born outside Sweden, particularly those born in the Middle East, Asia and Africa – a group with a high risk of developing pre-diabetes and diabetes (31, 32). More information about SRH in this group has the potential to improve health care services for these people.

Aims

The first aim of the current study was to determine the extent of the relationship between place of birth and self-rated health in primary healthcare patients born outside Sweden and those born in Sweden. The second aim of the study was to investigate whether socioeconomic and lifestyle factors explained any differences.

Methods

The study design was cross-sectional.

Data source

Data were drawn from the "4D Diabetes Project: Screening and Treatment of Prediabetes and Diabetes in Primary Care – A Pilot Study", a large study conducted by Karolinska Institutet and the Stockholm County Council. The

overall aim of the 4D Diabetes Project was to develop methods and procedure for early identification and/or prevention of pre-diabetes and diabetes in people at high risk for those diseases. People born in the Middle East, Asia and Africa who live in Sweden have a higher risk of developing pre-diabetes and diabetes than native Swedes and develop diabetes an average of 10 years earlier (31, 32). Two areas with large populations of immigrants – in particular, immigrants born in the Middle East and Asia – were selected for the 4D Diabetes Project: Flemingsberg and Jakobsberg (30). Inclusion criteria for the 4D Diabetes Project were as follows: attending an academic primary health care centre in Flemingsberg or Jakobsberg during the period between 2013 and 2015, being between the ages of 18 and 74 years and being either a first- or second generation immigrant or a person born in Sweden whose parents were born in Sweden. Patients with a diagnosis of diabetes were excluded from the study. The project aimed to consecutively recruit patients attending participating health care centres during the study period. All patients who fulfilled the study criteria were asked whether or not they wished to take part in the study. Information on the total number eligible patients who were asked to participate was not recorded. A total of 830 patients (389 from Flemingsberg and 441 from Jakobsberg) from 69 countries (including Sweden) agreed to participate and were included in the project. A total of 56.9% (n=469) were born outside Sweden and 42.1% (n=356) were born in Sweden. The biggest groups were from Turkey (n=86), Iran (n=52), Iraq (n=48), Finland (n=39), Bangladesh (n=24), Chile (n=23) and Syria

(n=20). Five people in the 4D Diabetes Project were missing information about their place of birth. The final sample size in the current analysis was thus 825.

Data collection

The data were collected via face-to-face interviews at the academic primary health care centres in Flemingsberg and Jakobsberg. The interviews lasted approximately 15 to 20 minutes and were conducted in a separate room at the centres to maintain privacy for the participants. The questionnaire was available in Swedish, Arabic, Persian and Turkish.

Patient and public involvement

Neither patients nor the public were involved in the design of the study, which was developed on the basis of previous research as well as the clinical experience of members of the 4D Diabetes Project group. Patients who met the inclusion criteria were provided with written and verbal information about the study and actively chose whether or not they wished to participate. The results of the study will be disseminated via seminars for health care professionals and patients at academic primary health care centres in the Stockholm region, including the participating centres. Centres across the Stockholm region will also receive short written summaries of the results.

Outcome variable

Self-rated health (SRH) was assessed using a single question, "How would you rate your general state of health?" There were five response alternatives as recommended by WHO, ranging from "very good" to "very bad" (5). Responses were dichotomized in the analysis. Those who chose the alternatives "very good" or "good" were considered to have optimal SRH, whereas those who chose "fair", "bad" or "very bad" were considered to have suboptimal SRH.

This classification has been used in previous studies (33, 34).

Independent variable

Place of birth was the independent variable in this study. Place of birth was divided into two categories, "born outside Sweden" and "born in Sweden". The first category included immigrants from all countries and the second category included those born in Sweden whose parents were born in Sweden.

Explanatory variables

The explanatory variables included in the study were **sex** (male or female), **age**, **socioeconomic status** (SES) and **lifestyle factors**. Patients were divided into two age groups, 18 through 44 and 45 through 74 years. We included three measures of SES. The first, *educational level*, was divided into 9 or fewer years, 10 to 12 years and more than 12 years. The second, e*mployment status*, was divided into employed, unemployed (including homemakers) or other (retired/student). The third, *marital status*, was divided into married/cohabiting or single (divorced or separated/widowed). Two lifestyle factors were included in the study. The first, *physical activity*, was based on self-reported time spent in any kind of physical activity per week. It included five response alternatives divided into four categories in our study: <30 minutes, 30-60 minutes, 60-90 minutes and >90 minutes. The second lifestyle factor was *smoking*. In the current study, patients were divided into non-smokers, former smokers and current smokers.

Statistical analysis

Descriptive statistics were used to assess the study population's characteristics by place of birth. For the categorical variables, i.e., sex, educational level, employment status, marital status, physical activity and smoking, the differences in percentages were compared using the chi-squared test. A p-value of <0.05

was considered statistically significant. Logistic regression was performed to determine the association between low SRH in those born outside Sweden and the explanatory variables. Those born in Sweden were used as the reference group. The results are presented as odds ratios (ORs) with 95% confidence interval (95% CIs). The statistical analyses were performed with STATA version 14 (StataCorp LP, Texas, USA).

Ethical considerations

The cross-sectional nature of this study limited the potential ethical problems, as there were no interventions that could have resulted in psychological or physical harm to the participants. Potential participants were provided with written and verbal information about the study and informed that participation was voluntary and that they had the right to withdraw from the study whenever they wished without facing any consequences. Since many potential participants were born abroad and had limited or no knowledge of Swedish, the written and verbal study information and questionnaires were available in Swedish, Arabic, Persian and Turkish. All participants provided written informed consent before inclusion in the study. Individual identities were replaced with code numbers prior to analysing the data. The link between the code number and identities is stored in a locked vault in keeping with the ethical rules of Karolinska Institutet.

The results of this study can help form the basis of future studies to deepen our understanding of SRH and could thus benefit patients in the future, including but not limited to our study participants. The present study was approved by the Ethical Review Board in Stockholm (reference number for 4D Diabetes Project: 2013/2303-31/3).

Results

Demographic characteristics

Demographic characteristics of the study population by place of birth are shown in Table 1. A total of 825 patients participated; 56.8% were born outside Sweden and 43.2% were born in Sweden. No significant differences were found between the two groups with regard to sex or marital status. Those born outside Sweden were significantly younger, had a higher educational level and were less physically active. On the other hand, a significantly higher percentage of those born outside Sweden than those born in Sweden were current smokers. The mean age of those born outside Sweden was 46 and those born in Sweden was 52. More than half the participants had more than 12 years of education (54.0%). More than two-thirds of the participants were married/cohabiting (70.0%). The majority of the participants reported being physically active (63.3%), and more than half were employed (53.5%). The percentage of people born outside Sweden with optimal SRH (51.7%) was lower than in those born in Sweden (57.6%).

Table 1: Characteristics of the study population[a] in total and by place of birth

Variables	Category	Total	Born outside Sweden	Born in Sweden	P-value
Sample size, n, (%)		825 (100)	469 (56.8)	356 (43.2)	
Age Mean (SD)		49 (0.5)	46 (12.8)	52 (16.4)	**<0.0001[b,c]**
	18-44 years	323 (39.0)	209 (44.6)	111 (31.3)	**<0.0001[c]**
	45-74 years	506 (61.0)	260 (55.4)	244 (68.7)	

Sex, n (%)	Female	475 (57.2)	269 (57.4)	203 (57.0)	0.924[b]
	Male	355 (42.8)	200 (42.6)	153 (43.0)	
SRH*, n (%)	Optimal	430 (52.3)	204 (51.7)	204 (57.6)	**0.008[b]**
	Suboptimal	392 (47.7)	226 (48.3)	150 (42.4)	
SES, n (%)	*Educational level***				**<0.0001[b]**
	9 or fewer years	148 (18.0)	97 (20.8)	51 (14.3)	
	10 to 12 years	230 (28.0)	98 (21.0)	132 (37.1)	
	Over 12 years	445 (54.0)	272 (58.2)	173 (48.6)	
	*Employment status****				**<0.0001[b]**
	Employed	433 (53.5)	260 (56.5)	173 (49.6)	
	Unemployed	102 (12.6)	73 (15.9)	29 (8.3)	
	Other	274 (33.9)	127 (27.6)	147 (42.1)	
	Marital status				0.066[b]
	Single	248 (30.1)	129 (27.5)	119 (33.4)	
	Married/cohabiting	577 (69.9)	340 (72.5)	237 (66.6)	
Lifestyle factors, n (%)	*Physical activity*****				**<0.0001[b]**
	< 30 min	103 (12.5)	80 (17.1)	23 (6.5)	
	30-60 min	105 (12.7)	76 (16.2)	29 (8.1)	
	60-90 min	95 (11.5)	58 (12.4)	37 (10.4)	
	> 90 min	521 (63.3)	254 (54.3)	267 (75.0)	
	*Smoking******				**<0.0001[b]**
	Non-smoker	412 (50.1)	245 (52.4)	167 (47.0)	
	Former smoker	248 (30.1)	115 (24.6)	133 (37.5)	
	Current smoker	163 (19.8)	108 (23.0)	55 (15.5)	

[a]The study population consisted of the 4D Diabetes Project population minus 5 individuals missing data on place of birth. [b]Bold numbers are significant, [c]Chi-squared test, * 3 missing, ** 2 missing, ***16 missing, **** 1 missing, ***** 2 missing

Table 2 presents the distribution of SRH by place of birth and sex. There were statistically significant differences in SRH between women and men in the study population as a whole and in people born outside Sweden. No significant sex differences were observed in people born in Sweden.

Table 2. Distribution of optimal and suboptimal self-rated health (SRH) in the study population[a] by place if birth and sex (n=822[b])

Characteristic	Optimal SRH, n=392		Suboptimal SRH, n=430		P-value
	Female	Male	Women	Men	
In total, n (%)	232 (53.3)	198 (46.1)	239 (61.0)	153 (39.0)	**0.042[c]**
Born outside Sweden	155 (64.1)	87 (35.9)	113 (50.0)	113 (50.0)	**0.002**
Born in Sweden	84 (56.0)	66 (44.0)	119 (58.3)	85 (41.7)	0.661

[a]The study population consisted of the 4D Diabetes Project population minus 5 individuals missing data on place of birth.

[b]Data on sex were missing for 3 individuals.

[c] Bold numbers are significant.

Logistic regression

Table 3 presents the odds ratios of suboptimal SRH in patients born outside Sweden and patients born in Sweden in three models. Model one was adjusted for age and sex; model two, for age, sex and SES (employment status, educational level and marital status); and model three, for age, sex, SES and lifestyle factors (physical activity and smoking). The crude OR of reporting suboptimal health was 1.46 (95% CI 1.10-1.92) for those born outside Sweden (reference group: those born in Sweden). This relationship increased to 1.50 after controlling for educational level, employment and marital status (95% CI 1.11-2.02) and decreased to 1.36 but remained significant after adjustment for physical activity and smoking (95% CI, 1.00-1.85).

Table 3. Prevalence ratios (ORs) and their 95% confidence intervals (CIs) of suboptimal self-rated health for those born outside Sweden[a]

Variable	Crude OR	Model 1: + age, sex	Model 2: +educ. level, employment, marital status	Model 3: + physical activity, smoking
Born in Sweden	Reference	Reference	Reference	Reference
Born outside Sweden	**1.46*** 1.10-1.92	**1.48** 1.12-1.97	**1.50** 1.11-2.02	**1.36** 1.00-1.85
Age				
18-44 years		Reference	Reference	Reference
45-74 years		0.94 0.70-1.24	1.00 0.74-1.37	0.94 0.68-1.29
Sex				
Female		Reference	Reference	Reference
Male		**1.34** 1.02-1.78	1.16 0.87-1.55	1.18 0.88-1.60
Educational level				
9 or fewer years				
10-12 years			Reference	Reference
			1.40 0.90-2.17	1.30 0.83-2.02
Over 12 years			**1.57** 1.05-2.33	1.46 0.97-2.20

Employment status		
Employed		
Unemployed	Reference	Reference
	0.47	**0.47**
Other	0.29-0.74	0.29-0.75
	0.76	0.75
	0.55-1.05	0.54-1.04
Marital Status		
Married/cohabiting	Reference	Reference
Single	**0.61**	**0.62**
	0.45-0.83	0.45-0.86
Physical activity		
<30 min		
30-60 min		Reference
		1.96
60-90 min		1.09-3.52
		2.10
>90 min		1.13-3.79
		2.80
		1.74-4.50
Smoking		
Non-smoker		Reference
Former smoker		0.99
		0.70-1.41
Current smoker		1.01
		0.67-1.50

[a]The study population consisted of the 4D Diabetes Project population.

* Bold numbers are significant

Discussion

In this study, we aimed to assess and compare the association between SRH and place of birth in primary health care patients born outside Sweden and in Sweden. Those born outside Sweden had significantly lower SRH than their Swedish-born counterparts. This result agrees with the results of previous studies that investigated SRH in patients born outside Sweden, especially those born in the Middle East (22, 29).

Chronic diseases are more prevalent in non-European immigrants to Europe than in native Europeans (35, 36). The presence of chronic diseases can alter quality of life, which could potentially negatively impact SRH. However, we were unable to explore this issue because of limited data. Additionally, psychological

status can affect SRH (37, 38). Psychological distress can be triggered by various situations. Migration per se is a stressful process (39). Immigrants can also be affected by past traumatic experiences; ongoing stress and worry about the situation in their home country, including family left behind; and discrimination in the host country (38). They can also face obstacles such as the need to learn a new language and to translate educational and professional competencies to those of the host country (40).

The finding that SRH differs significantly between immigrants and their Swedish-born counterparts agrees with results of several previous Swedish studies (33, 40-42). For example, our analyses confirm the results of a study of nearly 9000 older adult immigrants (age 55-74 years) in Sweden from a variety of ethnic backgrounds (22) but extend the findings to a larger age range. Similarly, the current study extends the results of a study of ethnicity and low SRH in Assyrians living in the town of Södertälje, which focused solely on people with diabetes, did not include lifestyle factors as a possible confounder and collected data in a different way (29, 43).

Several studies carried out in Sweden have had similar results despite differences in data collection methods. The current study, carried out with face-to-face interviews and questionnaires in several languages; the study of Assyrians in Södertälje, carried out using an interpreter (29) and a study of immigrants in Malmö, carried out with mailed questionnaires that were not translated into immigrants' native languages (24) all found that immigrants reported poorer health than native Swedes.

In a large cross-sectional study of immigrants from Turkey, Iran and Poland, differences between the immigrants and native Swedes in reporting significantly poorer health disappeared after accounting for socioeconomic status, knowledge of the Swedish language and discrimination (40). In our study, as in the study of

older immigrants in Malmö (18), the differences in SRH between groups remained statistically significant after adjustment for socioeconomic status.

In contrast to our study, a study of 93 age- and sex-matched pairs of native born Swedes and people from Somalia and Iraq who had recent permanent residence permits found that the immigrants did not have worse subjective physical or psychological health than the Swedish controls (36). The authors of the case-control study suggested that a number of factors may have contributed to this finding, including a healthy refugee effect, the environment of the study location and the relatively high levels of education in the men from Iraq. However, more than half of those born abroad in our study (58.2%) had more than 12 years of education, and we still found a significant difference in SRH between those born abroad and native-born Swedes.

As in our study of people in two largely immigrant neighbourhoods in the Stockholm area, a study of European and non-European immigrants in a single neighbourhood in Denmark found that immigrants had lower SRH than the native-born people in the study population (44). Unlike in our study, however, the authors of the Danish study found that immigrants had fewer life resources and that this explained the results. Life resources in that study comprised a multiple factors, including “living with others”, “has children”, “has studied beyond primary school”, “has occupational income” and more. We fewer but similar SES factors in our study, including education, employment and marital status. They had a significant impact on the results but did not fully explain the differences between immigrants and native Swedes.

SRH is an easy item to collect since it is assessed through a single question. Despite that, it has an impact on a major heath outcome (mortality). Efforts to

understand SRH and the factors related to can benefit the health care system in many ways. The current study adds support to previous research that found lower SRH in immigrant than in native populations. In our study, as in others, socioeconomic and lifestyle factors influenced SRH. It could therefore be useful for clinicians to consider these factors when providing care for patients born outside Sweden and resettled in areas with large numbers of immigrants. Future studies should further investigate what lies behind the discrepancies in SRH in immigrant and native-born primary healthcare patients.

Author Contributions

MT, AA and HS designed the study. CGÖ, KS, FL and MT were responsible for data collection. MT, AA and HS wrote the first draft of the manuscript and conducted analyses. CGÖ, KS and FL contributed to the choice of analytical methods. MT extracted the data. MT and AA conducted the initial analyses and interpretation of the results. All authors contributed to the analyses and editing of the manuscript and approval the final version.

The authors have no competing interests to declare.

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Project, including the current study, was designed by 4D Diabetes Project research team.

Competing interests

The authors declare that we have no conflicts of interest.

Data Sharing

Identified data were replaced with code numbers, and the link between the code numbers and identities is stored in a locked vault. In keeping with the ethical rules of Karolinska Institutet, only deidentified participant data is available to researchers with the proper ethical permission. For more information, contact the corresponding author of this study.

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found – PAGE 1-2
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported PAGE 4-6
Objectives	3	State specific objectives, including any prespecified hypotheses, PAGE 6
Methods		
Study design	4	Present key elements of study design early in the paper PAGE 6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection PAGE 8
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants PAGE 7-8
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable PAGE 8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group PAGE 9
Bias	9	Describe any efforts to address potential sources of bias PAGE 7
Study size	10	Explain how the study size was arrived PAGE 7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why PAGE 9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding PAGE 9
		(*b*) Describe any methods used to examine subgroups and interactions PAGE 9
		(*c*) Explain how missing data were addressed PAGE
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy PAGE 9
		(*e*) Describe any sensitivity analyses

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed PAGE 11
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram PAGE 11
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders PAGE 12
		(b) Indicate number of participants with missing data for each variable of interest PAGE
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures PAGE 12
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included PAGE 13
		(*b*) Report category boundaries when continuous variables were categorized PAGE 9
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives PAGE 14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias PAGE 14-17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results PAGE 18
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based PAGE 19

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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The extent of the association between self-rated health and place of birth: a cross-sectional study among people at high risk of developing pre-diabetes and diabetes in Sweden

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The extent of the association between self-rated health and place of birth: a cross-sectional study among people at high risk of developing pre-diabetes and diabetes in Sweden

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Abstract

Objective The first aim was to determine the extent of the relationship between place of birth and self-rated health in primary healthcare patients born outside Sweden and those born in Sweden. The second aim was to investigate whether socioeconomic and lifestyle factors explained any differences.

Setting Two academic primary healthcare centres in Stockholm County, Sweden.

Participants 825 patients at high risk of developing pre-diabetes and diabetes, aged 18-74 years, attending academic healthcare centres in areas with large numbers of immigrants, 56.8% born abroad and 43.2% born in Sweden. Patients with a diagnosis of diabetes were excluded. Inclusion criteria were based on previous research showing that people born in Middle Eastern and Asian countries who live in Sweden have a high prevalence of and risk for diabetes.

Outcome Self-rated health was dichotomized as optimal (very good/good) and suboptimal (fair/bad/very bad) and compared in those born outside Sweden and in Sweden.

Results There was a statistically significant difference in the self-rated health of the two groups (p=0.008). Logistic regression analysis showed a crude OR for reduced SRH of 1.46 (95% CI 1.10-1.92) in patients born outside Sweden. After controlling for education, employment and marital status, the OR increased to 1.50 (95% CI 1.11-2.02). After controlling for physical activity and smoking, it decreased to 1.36 (95% CI 1.00-1.85).

Conclusions Socioeconomic and lifestyle factors influenced self-rated health. It could therefore be useful for clinicians to consider these factors when providing care for patients born outside Sweden and resettled in areas with large numbers of immigrants.

Keywords: Self-rated health, immigrants, primary healthcare, Sweden

Article summary

Strengths

The questionnaire was available in different languages.

Including of the two health care centres' catchment areas with a large number of immigrants.

Limitations

Non-random sampling limited the ability to draw conclusions.

Those born outside Sweden were grouped together regardless of place of birth, potentially masking inequalities by place of birth.

The study did not include information on cultural perceptions about health.

Background

According to the World Health Organization (WHO), good health includes a balance between good objectively measurable and good subjectively experienced health. Whereas objective health is assessed by diagnosing diseases and measuring various clinical parameters, subjective health combines the physical, mental and social well-being of the individual (1). Self-rated health (SRH) has emerged as a unified, reliable measure of subjective health status that can provide valuable information and serve as a complement to objective health measures (2-4). SRH is widely used in the field of public health, including national and international health surveys (5). Prior studies have shown that SRH is an independent predictor of mortality (4, 6, 7). It is associated with higher rates of mortality from numerous diseases, including cardiovascular diseases (CVD) (8) and diabetes, as well as all-cause mortality (9). A meta-analysis from 2006 found that people who reported their health as fair or bad had a twofold higher risk of all-cause mortality than those who reported their health as good (7).

SRH is influenced by many factors. Examples include gender (10), socioeconomic status (SES) (11) and age (12). Women, people with low SES and older adults are more likely to report poor health. Lifestyle factors such as obesity, physical inactivity and smoking are also related to poor SRH (11, 13). Furthermore, the way people rate their health in relation to self-reported diseases or functional ability seems to vary by country, as shown in a comparative study of people in Finland, Sweden, Spain, the Netherlands and Israel (12). However, some indicators seem to be significantly associated with SRH regardless of country of origin, including marital status, hypertension, stroke, diabetes, cancer, musculoskeletal diseases and activities of daily living (12).

The factors that potentially influence how people rate their health differ from

one individual to another, and even those with similar levels of objective ill health can perceive their health differently. A study of young people with type 1 diabetes mellitus found that participants varied in their SRH even after adjusting for multiple risk factors (14). Similarly, studies have found discrepancies in SRH among people with hypertension (15) and advanced cancer (16).

Immigrants make up a growing portion of the Swedish population, currently over 20% (17). In 2016, almost 80% of the population growth in Sweden resulted from immigration. Prior studies suggest that immigrants in Sweden generally have lower SRH than their Swedish-born counterparts (18, 19). Many studies on SRH in immigrant groups in Sweden focus on Finnish immigrants (20, 21), as they constitute one of the largest immigrant groups in the country. Similarly, studies have been conducted on immigrants from other European countries living in Sweden (18, 22). According to such studies, people born in Finland, Eastern Europe and Southern Europe living in Sweden rate their health poorer than those born in Sweden (20, 23). A similar pattern has been observed in immigrants from outside Europe, including adolescent boys (24), immigrants from the Middle East (25) and Assyrians with diabetes from Turkey (19).

Research also shows that immigrants are more vulnerable to diseases than are native-born populations (26-28). This raises the question of whether differences in SRH could be explained by differences in objective health status. However, in previous studies, the inclusion of diseases has not eliminated the differences in SRH between foreign-born and native-born populations. In addition, a study comparing Kurdish immigrants to people born in Sweden found that the immigrants were more likely to report lower SRH despite comparable objective health, including chronic diseases, eczema, psoriasis, urinary tracts complaints and diabetes (29).

Comparison between studies of self-rated health in immigrants vs. native populations is made difficult by differences in study populations and methodological approaches. For instance, many previous studies in Sweden focus on middle-aged and older adults, which limits their representativeness. According to Statistics Sweden, people between the ages of 18 and 35 years make up around 20% of the total immigrant population (30). This group therefore needs to be included when studying immigrants' health.

There is a gap in knowledge about the SRH of people living in Sweden who were born outside Sweden, particularly those born in the Middle East, Asia and Africa – a group with a high risk of developing pre-diabetes and diabetes (31, 32). More information about SRH in this group has the potential to improve health care services for these people.

Aims

The first aim of the current study was to determine the extent of the relationship between place of birth and self-rated health in primary healthcare patients born outside Sweden and those born in Sweden. The second aim of the study was to investigate whether socioeconomic and lifestyle factors explained any differences.

Methods

The study design was cross-sectional.

Data source

Data were drawn from the "4D Diabetes Project: Screening and Treatment of Prediabetes and Diabetes in Primary Care – A Pilot Study", a large study conducted by Karolinska Institutet and the Stockholm County Council. The

overall aim of the 4D Diabetes Project was to develop methods and procedure for early identification and/or prevention of pre-diabetes and diabetes in people at high risk for those diseases. People born in the Middle East, Asia and Africa who live in Sweden have a higher risk of developing pre-diabetes and diabetes than native Swedes and develop diabetes an average of 10 years earlier (31, 32). Two areas with large populations of immigrants – in particular, immigrants born in the Middle East and Asia – were selected for the 4D Diabetes Project: Flemingsberg and Jakobsberg (30). Inclusion criteria for the 4D Diabetes Project were as follows: attending an academic primary health care centre in Flemingsberg or Jakobsberg during the period between 2013 and 2015, being between the ages of 18 and 74 years and being either a first- or second generation immigrant or a person born in Sweden whose parents were born in Sweden. Patients with a diagnosis of diabetes were excluded from the study. The project aimed to consecutively recruit patients attending participating health care centres during the study period. All patients who fulfilled the study criteria were asked whether or not they wished to take part in the study. Information on the total number eligible patients who were asked to participate was not recorded. A total of 830 patients (389 from Flemingsberg and 441 from Jakobsberg) from 69 countries (including Sweden) agreed to participate and were included in the project. A total of 56.9% (n=469) were born outside Sweden and 42.1% (n=356) were born in Sweden. The biggest groups were from Turkey (n=86), Iran (n=52), Iraq (n=48), Finland (n=39), Bangladesh (n=24), Chile (n=23) and Syria

(n=20). Five people in the 4D Diabetes Project were missing information about their place of birth. The final sample size in the current analysis was thus 825.

Data collection

The data were collected via face-to-face interviews at the academic primary health care centres in Flemingsberg and Jakobsberg. The interviews lasted approximately 15 to 20 minutes and were conducted in a separate room at the centres to maintain privacy for the participants. The questionnaire was available in Swedish, Arabic, Persian and Turkish.

Patient and public involvement

Neither patients nor the public were involved in the design of the study, which was developed on the basis of previous research as well as the clinical experience of members of the 4D Diabetes Project group. Patients who met the inclusion criteria were provided with written and verbal information about the study and actively chose whether or not they wished to participate. The results of the study will be disseminated via seminars for health care professionals and patients at academic primary health care centres in the Stockholm region, including the participating centres. Centres across the Stockholm region will also receive short written summaries of the results.

Outcome variable

Self-rated health (SRH) was assessed using a single question, "How would you rate your general state of health?" There were five response alternatives as recommended by WHO, ranging from "very good" to "very bad" (5). Responses were dichotomized in the analysis. Those who chose the alternatives "very good" or "good" were considered to have optimal SRH, whereas those who chose "fair", "bad" or "very bad" were considered to have suboptimal SRH.

This classification has been used in previous studies (33, 34).

Independent variable

Place of birth was the independent variable in this study. Place of birth was divided into two categories, "born outside Sweden" and "born in Sweden". The first category included immigrants from all countries and the second category included those born in Sweden whose parents were born in Sweden.

Explanatory variables

The explanatory variables included in the study were **sex** (male or female), **age**, **socioeconomic status** (SES) and **lifestyle factors**. Patients were divided into two age groups, 18 through 44 and 45 through 74 years. We included three measures of SES. The first, *educational level*, was divided into 9 or fewer years, 10 to 12 years and more than 12 years. The second, e*mployment status*, was divided into employed, unemployed (including homemakers) or other (retired/student). The third, *marital status*, was divided into married/cohabiting or single (divorced or separated/widowed). Two lifestyle factors were included in the study. The first, *physical activity*, was based on self-reported time spent in any kind of physical activity per week. It included five response alternatives divided into four categories in our study: <30 minutes, 30-60 minutes, 60-90 minutes and >90 minutes. The second lifestyle factor was *smoking*. In the current study, patients were divided into non-smokers, former smokers and current smokers.

Statistical analysis

Descriptive statistics were used to assess the study population's characteristics by place of birth. For the categorical variables, i.e., sex, educational level, employment status, marital status, physical activity and smoking, the differences in percentages were compared using the chi-squared test. A p-value of <0.05

was considered statistically significant. Logistic regression was performed to determine the association between low SRH in those born outside Sweden and the explanatory variables. Those born in Sweden were used as the reference group. The results are presented as odds ratios (ORs) with 95% confidence interval (95% CIs). The statistical analyses were performed with STATA version 14 (StataCorp LP, Texas, USA).

Ethical considerations

The cross-sectional nature of this study limited the potential ethical problems, as there were no interventions that could have resulted in psychological or physical harm to the participants. Potential participants were provided with written and verbal information about the study and informed that participation was voluntary and that they had the right to withdraw from the study whenever they wished without facing any consequences. Since many potential participants were born abroad and had limited or no knowledge of Swedish, the written and verbal study information and questionnaires were available in Swedish, Arabic, Persian and Turkish. All participants provided written informed consent before inclusion in the study. Individual identities were replaced with code numbers prior to analysing the data. The link between the code number and identities is stored in a locked vault in keeping with the ethical rules of Karolinska Institutet.

The results of this study can help form the basis of future studies to deepen our understanding of SRH and could thus benefit patients in the future, including but not limited to our study participants. The present study was approved by the Ethical Review Board in Stockholm (reference number for 4D Diabetes Project: 2013/2303-31/3).

Results

Demographic characteristics

Demographic characteristics of the study population by place of birth are shown in Table 1. A total of 825 patients participated; 56.8% were born outside Sweden and 43.2% were born in Sweden. No significant differences were found between the two groups with regard to sex or marital status. Those born outside Sweden were significantly younger, had a higher educational level and were less physically active. On the other hand, a significantly higher percentage of those born outside Sweden than those born in Sweden were current smokers. The mean age of those born outside Sweden was 46 and those born in Sweden was 52. More than half the participants had more than 12 years of education (54.0%). More than two-thirds of the participants were married/cohabiting (70.0%). The majority of the participants reported being physically active (63.3%), and more than half were employed (53.5%). The percentage of people born outside Sweden with optimal SRH (51.7%) was lower than in those born in Sweden (57.6%).

Table 1: Characteristics of the study population[a] in total and by place of birth

Variables	Category	Total	Born outside Sweden	Born in Sweden	P-value
Sample size, n, (%)		825 (100)	469 (56.8)	356 (43.2)	
Age Mean (SD)		49 (0.5)	46 (12.8)	52 (16.4)	**<0.0001[b,c]**
	18-44 years	323 (39.0)	209 (44.6)	111 (31.3)	**<0.0001[c]**
	45-74 years	506 (61.0)	260 (55.4)	244 (68.7)	

Sex, n (%)	Female	475 (57.2)	269 (57.4)	203 (57.0)	0.924[b]
	Male	355 (42.8)	200 (42.6)	153 (43.0)	
SRH*, n (%)	Optimal	430 (52.3)	204 (51.7)	204 (57.6)	**0.008[b]**
	Suboptimal	392 (47.7)	226 (48.3)	150 (42.4)	
SES, n (%)	*Educational level***				**<0.0001[b]**
	9 or fewer years	148 (18.0)	97 (20.8)	51 (14.3)	
	10 to 12 years	230 (28.0)	98 (21.0)	132 (37.1)	
	Over 12 years	445 (54.0)	272 (58.2)	173 (48.6)	
	*Employment status****				**<0.0001[b]**
	Employed	433 (53.5)	260 (56.5)	173 (49.6)	
	Unemployed	102 (12.6)	73 (15.9)	29 (8.3)	
	Other	274 (33.9)	127 (27.6)	147 (42.1)	
	Marital status				0.066[b]
	Single	248 (30.1)	129 (27.5)	119 (33.4)	
	Married/cohabiting	577 (69.9)	340 (72.5)	237 (66.6)	
Lifestyle factors, n (%)	*Physical activity*****				**<0.0001[b]**
	< 30 min	103 (12.5)	80 (17.1)	23 (6.5)	
	30-60 min	105 (12.7)	76 (16.2)	29 (8.1)	
	60-90 min	95 (11.5)	58 (12.4)	37 (10.4)	
	> 90 min	521 (63.3)	254 (54.3)	267 (75.0)	
	*Smoking******				**<0.0001[b]**
	Non-smoker	412 (50.1)	245 (52.4)	167 (47.0)	
	Former smoker	248 (30.1)	115 (24.6)	133 (37.5)	
	Current smoker	163 (19.8)	108 (23.0)	55 (15.5)	

[a]The study population consisted of the 4D Diabetes Project population minus 5 individuals missing data on place of birth. [b]Bold numbers are significant, [c]Chi-squared test, * 3 missing, ** 2 missing, ***16 missing, **** 1 missing, ***** 2 missing

Table 2 presents the distribution of SRH by place of birth and sex. There were statistically significant differences in SRH between women and men in the study population as a whole and in people born outside Sweden. No significant sex differences were observed in people born in Sweden.

Table 2. Distribution of optimal and suboptimal self-rated health (SRH) in the study population[a] by place if birth and sex (n=822[b])

Characteristic	Optimal SRH, n=392		Suboptimal SRH, n=430		P-value
	Female	Male	Women	Men	
In total, n (%)	232 (53.3)	198 (46.1)	239 (61.0)	153 (39.0)	**0.042[c]**
Born outside Sweden	155 (64.1)	87 (35.9)	113 (50.0)	113 (50.0)	**0.002**
Born in Sweden	84 (56.0)	66 (44.0)	119 (58.3)	85 (41.7)	0.661

[a]The study population consisted of the 4D Diabetes Project population minus 5 individuals missing data on place of birth.

[b]Data on sex were missing for 3 individuals.

[c] Bold numbers are significant.

Logistic regression

Table 3 presents the odds ratios of suboptimal SRH in patients born outside Sweden and patients born in Sweden in three models. Model one was adjusted for age and sex; model two, for age, sex and SES (employment status, educational level and marital status); and model three, for age, sex, SES and lifestyle factors (physical activity and smoking). The crude OR of reporting suboptimal health was 1.46 (95% CI 1.10-1.92) for those born outside Sweden (reference group: those born in Sweden). This relationship increased to 1.50 after controlling for educational level, employment and marital status (95% CI 1.11-2.02) and decreased to 1.36 but remained significant after adjustment for physical activity and smoking (95% CI, 1.00-1.85).

Table 3. Prevalence ratios (ORs) and their 95% confidence intervals (CIs) of suboptimal self-rated health for those born outside Sweden[a]

Variable	Crude OR	Model 1: + age, sex	Model 2: +educ. level, employment, marital status	Model 3: + physical activity, smoking
Born in Sweden	Reference	Reference	Reference	Reference
Born outside Sweden	**1.46*** 1.10-1.92	**1.48** 1.12-1.97	**1.50** 1.11-2.02	**1.36** 1.00-1.85
Age				
18-44 years		Reference	Reference	Reference
45-74 years		0.94 0.70-1.24	1.00 0.74-1.37	0.94 0.68-1.29
Sex				
Female		Reference	Reference	Reference
Male		**1.34** 1.02-1.78	1.16 0.87-1.55	1.18 0.88-1.60
Educational level				
9 or fewer years				
10-12 years			Reference	Reference
Over 12 years			1.40 0.90-2.17	1.30 0.83-2.02
			1.57 1.05-2.33	1.46 0.97-2.20

Employment status		
Employed		
Unemployed	Reference	Reference
	0.47	**0.47**
Other	0.29-0.74	0.29-0.75
	0.76	0.75
	0.55-1.05	0.54-1.04
Marital Status		
Married/cohabiting	Reference	Reference
Single	**0.61**	**0.62**
	0.45-0.83	0.45-0.86
Physical activity		
<30 min		
30-60 min		Reference
		1.96
60-90 min		1.09-3.52
		2.10
>90 min		1.13-3.79
		2.80
		1.74-4.50
Smoking		
Non-smoker		Reference
Former smoker		0.99
		0.70-1.41
Current smoker		1.01
		0.67-1.50

[a]The study population consisted of the 4D Diabetes Project population.

* Bold numbers are significant

Discussion

In this study, we aimed to assess and compare the association between SRH and place of birth in primary health care patients born outside Sweden and in Sweden. Those born outside Sweden had significantly lower SRH than their Swedish-born counterparts. This result agrees with the results of previous studies that investigated SRH in patients born outside Sweden, especially those born in the Middle East (22, 29).

Chronic diseases are more prevalent in non-European immigrants to Europe than in native Europeans (35, 36). The presence of chronic diseases can alter quality of life, which could potentially negatively impact SRH. However, we were unable to explore this issue because of limited data. Additionally, psychological

status can affect SRH (37, 38). Psychological distress can be triggered by various situations. Migration per se is a stressful process (39). Immigrants can also be affected by past traumatic experiences; ongoing stress and worry about the situation in their home country, including family left behind; and discrimination in the host country (38). They can also face obstacles such as the need to learn a new language and to translate educational and professional competencies to those of the host country (40).

The finding that SRH differs significantly between immigrants and their Swedish-born counterparts agrees with results of several previous Swedish studies (33, 40-42). For example, our analyses confirm the results of a study of nearly 9000 older adult immigrants (age 55-74 years) in Sweden from a variety of ethnic backgrounds (22) but extend the findings to a larger age range. Similarly, the current study extends the results of a study of ethnicity and low SRH in Assyrians living in the town of Södertälje, which focused solely on people with diabetes, did not include lifestyle factors as a possible confounder and collected data in a different way (29, 43).

Several studies carried out in Sweden have had similar results despite differences in data collection methods. The current study, carried out with face-to-face interviews and questionnaires in several languages; the study of Assyrians in Södertälje, carried out using an interpreter (29) and a study of immigrants in Malmö, carried out with mailed questionnaires that were not translated into immigrants' native languages (24) all found that immigrants reported poorer health than native Swedes.

In a large cross-sectional study of immigrants from Turkey, Iran and Poland, differences between the immigrants and native Swedes in reporting significantly poorer health disappeared after accounting for socioeconomic status, knowledge of the Swedish language and discrimination (40). In our study, as in the study of

older immigrants in Malmö (18), the differences in SRH between groups remained statistically significant after adjustment for socioeconomic status.

In contrast to our study, a study of 93 age- and sex-matched pairs of native born Swedes and people from Somalia and Iraq who had recent permanent residence permits found that the immigrants did not have worse subjective physical or psychological health than the Swedish controls (36). The authors of the case-control study suggested that a number of factors may have contributed to this finding, including a healthy refugee effect, the environment of the study location and the relatively high levels of education in the men from Iraq. However, more than half of those born abroad in our study (58.2%) had more than 12 years of education, and we still found a significant difference in SRH between those born abroad and native-born Swedes.

As in our study of people in two largely immigrant neighbourhoods in the Stockholm area, a study of European and non-European immigrants in a single neighbourhood in Denmark found that immigrants had lower SRH than the native-born people in the study population (44). Unlike in our study, however, the authors of the Danish study found that immigrants had fewer life resources and that this explained the results. Life resources in that study comprised a multiple factors, including “living with others”, “has children”, “has studied beyond primary school”, “has occupational income” and more. We found fewer but similar SES factors in our study, including education, employment and marital status. They had a significant impact on the results but did not fully explain the differences between immigrants and native Swedes.

A Swedish study of patients with type 2 diabetes that had a study population similar to ours with regard to countries of birth, found a similar pattern of self-

rated health (29). That is, the patients in the previous study who were born in the Middle East had lower self-rated health than the patients born in Sweden. As in our study, in the previous study, statistically significant difference in self-rated general health were not explained by socioeconomic or lifestyle factors. Future studies could focus on lifestyle, mental health, stress, and comorbidity as potential explanations for self-rated health in people born in Middle East and Africa with a high risk of diabetes.

SRH is an easy item to collect since it is assessed through a single question. Despite that, it has an impact on a major heath outcome (mortality). Efforts to understand SRH and the factors related to can benefit the health care system in many ways. The current study adds support to previous research that found lower SRH in immigrant than in native populations. In our study, as in others, socioeconomic and lifestyle factors influenced SRH. It could therefore be useful for clinicians to consider these factors when providing care for patients born outside Sweden and resettled in areas with large numbers of immigrants. Future studies should further investigate what lies behind the discrepancies in SRH in immigrant and native-born primary healthcare patients.

The current study has several strengths and limitations. One strength of the study was the way data were collected. The questionnaire was available in different languages spoken by many people living in the study areas: Arabic, Persian, Turkish and Swedish. Another strength of the study was that the catchment areas of the healthcare centres in the current study included a large number of immigrants. Sampling was non-random, which limited our ability to draw conclusions. Another limitation of the study was grouping together those born outside Sweden regardless of place of birth, which might have masked potential inequalities. Furthermore, even people from the same country can come from different ethnic and religious groups, different cultures and different

socioeconomic and political situations. Therefore, the final limitation of this study is the lack of information on cultural perceptions about health and lifestyle in the study population, which might partially explain the low self-rated health in patients born outside Sweden.

Author Contributions

MT, AA and HS designed the study. CGÖ, KS, FL and MT were responsible for data collection. MT, AA and HS wrote the first draft of the manuscript and conducted analyses. CGÖ, KS and FL contributed to the choice of analytical methods. MT extracted the data. MT and AA conducted the initial analyses and interpretation of the results. All authors contributed to the analyses and editing of the manuscript and approval the final version.

The authors have no competing interests to declare.

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Competing interests

The authors declare that we have no conflicts of interest.

Data Sharing

Identified data were replaced with code numbers, and the link between the code numbers and identities is stored in a locked vault. In keeping with the ethical rules of Karolinska Institutet, only deidentified participant data is available to researchers with the proper ethical permission. For more information, contact the corresponding author of this study.

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found – PAGE 1-2
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported PAGE 4-6
Objectives	3	State specific objectives, including any prespecified hypotheses, PAGE 6
Methods		
Study design	4	Present key elements of study design early in the paper PAGE 6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection PAGE 8
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants PAGE 7-8
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable PAGE 8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group PAGE 9
Bias	9	Describe any efforts to address potential sources of bias PAGE 7
Study size	10	Explain how the study size was arrived PAGE 7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why PAGE 9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding PAGE 9
		(*b*) Describe any methods used to examine subgroups and interactions PAGE 9
		(*c*) Explain how missing data were addressed PAGE
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy PAGE 9
		(*e*) Describe any sensitivity analyses

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed PAGE 11
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram PAGE 11
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders PAGE 12
		(b) Indicate number of participants with missing data for each variable of interest PAGE
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures PAGE 12
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included PAGE 13
		(*b*) Report category boundaries when continuous variables were categorized PAGE 9
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives PAGE 14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias PAGE 14-17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results PAGE 18
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based PAGE 19

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.