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Country of birth and body mass index: A national study of 2,000 immigrants in Sweden

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Abstract. The aim of this study is to analyse the influence of country of birth on body mass index (BMI) after adjustment for age, educational status, physical activity and smoking habits. Two random samples of men and women, aged 27–60, were used: 1,957 immigrants and 2,975 Swedes, both from 1996. Men and women were analysed in separate models by the use of linear regression. The BMI levels were significantly higher among Polish (0.8 BMI units) and Chilean (0.7 BMI units) men, and Chilean (1.9 BMI units) and Turkish (1.5 BMI units) women than among their Swedish controls, after adjustment for all explanatory variables. Other intermediate risk factors for cardiovascular disease, such as physical inactivity and daily smoking, were also more frequent among almost all the immigrant subgroups. This study shows a strong influence of country of birth on BMI even after adjustment for age, educational status, physical activity and smoking habits.

Key words: BMI, Country of birth, Physical activity, Survey

Introduction

The purpose of this study is to analyse the complex relationship between country of birth, educational status, a sedentary lifestyle and body mass index (BMI) in four different immigrant subgroups in Sweden.

Obesity has reached epidemic proportions in industrialised societies during the last two decades. The lifestyle in the modern, urbanised society has been called the 'Civilisation Syndrome', i.e. visceral obesity with the ingredients of a positive energy balance, including physical inactivity [1]. In both Britain and the US the prevalence of obesity has increased, despite a decline in the average recorded energy intake, suggesting a more pronounced decrease in physical activity and demanded energy needs [2–5]. Increasing BMI levels have also been observed in Sweden [6]. Moreover, an association between country of birth and BMI has been shown in previous studies. In New Zealand, a prospective study of 654 adult Tokelauans showed that their BMI levels increased significantly from 24.1 to 28.7 between 1968 and 1982 compared with non-migrants whose BMI levels increased from 24.8 to 26.1 [7]. In Sweden, an 8-year prospective study showed that BMI had increased among both Swedish-born and foreign-born women and men. The increase in BMI was significantly higher among men from South Europe than among Swedish-born men [6]. This is of great importance because an established body of research has shown a clear and consistent association between increased BMI and different health outcomes including coronary heart disease (CHD), one of the major causes of death in western countries [8–12]. The first aim of the present study is to analyse the relationship between country of birth and BMI. The second aim is to analyse whether this relationship persists after accounting for age, educational status (used as a proxy for socio-economic status = SES), physical activity and smoking habits. Previous studies of the effect of country of birth on BMI have been of a local nature, have not accounted for confounders such as SES and other lifestyle factors, have analysed only men or women or only one or two different immigrant subgroups. For the purpose of the present study we had the opportunity to use a national sample of four immigrant subgroups, including both men and women, from different parts of the world: Poland, Chile, Turkey and Iran.

Methods

A simple random national sample of 3000 immigrant men and women born in Poland, Chile, Turkey, and Iran was drawn from the Swedish population register. The age range 27–60 was used because people of this age represent the socio-economically active part of the population. Of these 3000 individuals 108 were excluded, because they had lived abroad for many years, or died. The remaining sample consisted of 2892

individuals. In order to characterise their living conditions, the respondents were interviewed face to face by trained interviewers, and were presented with questions and response alternatives in four languages: Polish, Spanish, Turkish and Farsi (Iranians). The questionnaire used was the same as the Swedish Survey of Living Conditions [13], but was supplemented by immigrant-specific questions [14]. The interviews were performed from September 1996 to January 1997 and were conducted by Statistics Sweden. The response rate was about 68%, resulting in 909 male and 1048 female immigrants born in Poland (n = 568), Chile (n = 564), Turkey (n = 512), and Iran (n = 313). Respondents born in Poland, Chile, and Turkey arrived in Sweden between 1980 and 1989 and respondents born in Iran arrived between 1985 and 1989. The respondents were compared with a sample of Swedish-born men and women (n = 2975), interviewed during 1996 as a part of the annual Swedish Survey of Living Conditions, also conducted by Statistics Sweden. This survey represents the first Swedish national survey of immigrants conducted as a joint project by the National Board of Health and Welfare, the Swedish Immigration Board, the National Institute of Public Health, and the Swedish Government.

Outcome variable

BMI based on self-reported weight and height, was calculated as weight/height^2 (kg/m^2), which represents BMI units.

Explanatory variables

Age at the time of interview was classified according to the following groups: 27–34, 35–39, 40–44, 45–49, and 50–60 years of age.

Country of birth was divided in five groups: Swedes, Poles, Chileans, Turks, and Iranians.

Educational status at the time of the interview was divided into three categories:

(1) <10 years (compulsory school), (2) 10–11 years (at least 1 year of high school), and (3) ⩾12 years (completed high school or university studies).

Physical activity initially comprised five categories of leisure-time physical activity:

(1) No physical activity, (2) Physical activity occasionally, (3) Physical activity about once a week, (4) Physical activity about twice a week, and (5) Relatively hard physical activity at least twice a week. As the assessment regarding physical activity was rather rough, we chose to dichotomise this variable [6, 15, 16]. Therefore, in the analysis the five initial categories were collapsed into two: 'No' and 'Yes'. The first category constituted categories (1) and (2) of those mentioned above and the second (3)–(5).

Smoking habits comprised three categories: (1) 'Never smokers', (2) 'Former smokers', and (3) 'Daily smokers'.

Two additional variables were also used in the descriptive data but not in the models:
(1) Whether the respondent was living in an urban area or not and (2) whether the respondent was speaking Swedish at home. The latter was used as a measure of acculturation, which denotes the transformation that groups and individuals go through when they come into contact with another culture.

Analysis of non-respondents

The non-response rate was about 30% for Poles, 29% for Chileans, 34% for Turks and 32% for Iranians. About half of all non-respondents refused to participate, and the other half could not be located, a pattern that prevailed in all four immigrant groups. A possible reason for the relatively high proportion of missing individuals might be that some of the immigrants had repatriated without informing the Swedish authorities (i.e., the population registry) [17]. The age distribution and average age among respondents and non-respondents was about the same. Non-respondents had lower income than respondents.

Statistical analysis

Data were analysed using linear regression. The results are shown as β-coefficients with a 95% confidence interval (CI). Of the two models, the first was adjusted for age and the second (full model) for all the other explanatory variables. The fit of the models was judged by residual analysis.

Results

The distribution of the different explanatory variables, by gender and country of birth, is demonstrated in Table 1. The lowest proportions of individuals with low educational status were found among people born in Poland and Iran. In contrast, more than half of the Turkish men and women had a low educational status. Among all the immigrant subgroups, physical inactivity was more frequent than among Swedish-born people. The highest proportions of physical inactivity were seen among Chilean women, Turkish men and women and Iranian women. The highest proportions of daily smokers were found among men from Poland, Turkey and Iran. The level of acculturation is also shown, as proportions of people who speak Swedish at home. A small percentage of all the subgroups spoke Swedish at home, except for Polish women of who about 42% spoke Swedish at home. More than half of the immigrants lived in urban areas compared with less than one third of the Swedes (Table 1).

Table 2 shows the distribution of BMI means by all the explanatory variables. In general, people with low educational status had higher mean BMI than people

Table 1. Estimated population size, sample size and distribution (percentage) of the different variables, by gender and country of birth (ages 27–60 years, 1996, Sweden)

		Sweden		Poland		Chile		Turkey		Iran	
Variable	Level	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Age	Mean	42.8	42.8	43.1	41.1	39.5	40.3	38.6	38.6	37.6	38.2
Education	< 10	20.7	16.6	4.4	5.5	16.9	22.0	50.2	69.5	6.6	12.1
	10–11	51.3	51.5	44.4	48.0	49.5	53.9	27.2	21.9	43.7	51.7
	⩾12	28.0	31.9	51.2	46.5	33.7	24.1	22.6	8.6	49.8	36.2
Physical inactivity	Yes	45.7	41.3	56.3	54.5	52.4	65.4	69.5	78.1	54.3	66.4
Smoker	No	43.8	45.0	23.8	31.2	26.4	40.0	19.0	52.4	30.0	74.2
	Former	34.1	28.3	34.4	29.7	37.0	27.1	25.1	15.9	25.4	12.9
	Daily	22.1	26.7	41.9	39.1	36.0	32.9	55.9	31.7	44.6	12.9
Urban area	Yes	31.9	30.0	64.4	50.5	57.5	57.0	60.9	61.8	52.3	57.8
Speaks Swedish at home	Yes	–	–	11.9	42.1	14.3	11.5	10.4	5.6	11.7	6.0
Population	N	1,787,000	1,679,000	3033	6768	4457	4199	2992	2308	9790	5331
Sample	N	1500	1475	160	404	273	295	279	233	197	116

Table 2. BMI means and SD (in brackets) by gender and all the other explanatory variables (ages 27–60 years, 1996, Sweden)

		Sweden		Poland		Chile		Turkey		Iran	
Variable	Level	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Total		25.3 (3.2)	23.9 (3.8)	25.9 (3.3)	23.6 (3.6)	25.8 (3.8)	25.7 (4.4)	25.5 (3.4)	25.9 (4.1)	24.5 (2.9)	24.0 (3.5)
Age	27–34	24.6 (2.9)	23.1 (3.8)	25.8 (4.9)	22.5 (2.5)	25.2 (3.4)	24.7 (4.5)	24.6 (3.4)	24.4 (3.8)	24.0 (2.8)	22.0 (2.2)
	35–39	25.4 (3.2)	23.3 (3.3)	25.2 (3.4)	22.7 (3.6)	25.3 (3.4)	25.2 (4.3)	25.2 (3.2)	25.2 (4.1)	25.1 (2.8)	24.1 (3.2)
	40–55	25.2 (3.0)	23.4 (4.2)	25.5 (3.0)	23.9 (3.8)	25.8 (4.9)	25.8 (4.1)	25.9 (3.2)	27.4 (3.7)	24.3 (2.7)	24.8 (3.8)
	45–49	25.6 (3.2)	23.9 (3.6)	26.6 (2.4)	24.2 (3.1)	26.9 (3.3)	26.7 (4.4)	26.8 (3.6)	27.7 (3.9)	24.7 (4.0)	26.1 (4.2)
	50–60	25.9 (3.4)	24.9 (3.8)	26.8 (3.6)	25.3 (3.8)	27.1 (2.6)	27.6 (4.8)	26.8 (4.0)	27.9 (3.4)	25.0 (2.2)	27.3 (4.4)
Education	<10	25.9 (3.7)	24.8 (4.3)	25.5 (3.2)	24.1 (3.0)	27.1 (3.7)	27.8 (4.5)	25.2 (3.4)	26.7 (4.0)	25.0 (4.6)	25.1 (4.7)
	10–11	25.5 (3.1)	24.0 (3.9)	26.1 (3.5)	23.9 (4.0)	25.8 (3.9)	25.1 (4.4)	25.8 (3.6)	24.5 (3.8)	24.2 (2.7)	24.0 (3.6)
	⩾12	24.6 (2.8)	23.2 (3.2)	25.8 (3.1)	23.2 (3.1)	25.1 (3.4)	25.2 (3.8)	25.6 (2.9)	22.9 (3.5)	24.7 (2.8)	23.8 (2.8)
Physical activity	Yes	25.0 (2.8)	23.5 (3.3)	25.8 (3.4)	23.2 (3.4)	25.7 (3.4)	25.0 (4.0)	25.1 (3.1)	24.9 (4.0)	24.4 (2.7)	23.5 (3.2)
	No	25.7 (3.6)	24.4 (4.3)	25.9 (3.2)	23.7 (3.8)	25.9 (4.1)	26.1 (4.6)	25.7 (3.5)	26.2 (4.1)	24.7 (3.2)	24.3 (3.1)
Smoker	No	25.2 (3.1)	23.9 (3.9)	25.6 (3.3)	23.5 (3.7)	26.2 (3.5)	26.0 (4.1)	25.8 (3.4)	26.5 (4.2)	24.8 (2.6)	24.1 (3.4)
	Former	25.7 (3.2)	23.9 (3.7)	25.9 (3.4)	24.0 (3.6)	26.5 (4.2)	26.7 (4.9)	26.4 (3.1)	25.5 (3.7)	24.3 (3.1)	23.1 (3.1)
	Daily	25.1 (3.3)	23.7 (3.8)	26.0 (3.2)	23.4 (3.5)	24.9 (3.3)	24.6 (4.3)	24.9 (3.5)	25.0 (3.9)	24.4 (3.0)	24.7 (4.5)

with high educational status, except for men from Poland, Turkey and Iran. Those who were physically inactive had on average higher BMI than those who were physically active. Smoking seemed to be associated with lower mean BMI, especially among Chilean men and women.

Table 3 shows the age-adjusted and full models of the relationship between country of birth and BMI. Chilean men and women had significantly higher BMI than the Swedish men and women, after adjustment for age. Turkish women also had higher BMI than Swedish women, 2.47 BMI units. In contrast, Iranian men had significantly lower BMI than Swedish men in the age-adjusted model. The full model is adjusted for all the different explanatory variables.

Among Turkish women BMI decreased but remained significantly higher than among Swedish women after adjustment for educational status, physical activity and smoking habits. In contrast, a significant difference between Polish men and Swedish men in BMI was seen in the full model, a difference that was absent in the age-adjusted model. Among the Chilean men and women the BMI was significantly higher than among the Swedish men and women. In addition (data not shown) the full model showed that there was a clear association between increasing age, low educational status and increased BMI. The association between physical inactivity and increased BMI was particularly strong among women. Daily smokers had significantly lower BMI than non-smokers.

Table 3. Age-adjusted and full models of the relationship between country of birth and BMI, by gender, showing β coefficients (BMI units) with 95% confidence intervals (CI)

		β(CI)	
Variable	Level	Men	Women
Age-adjusted model			
Country of birth	Sweden	0 (reference)	0 (reference)
	Poland	0.50 (−0.04;1.04)	−0.06 (−0.49;0.37)
	Chile	0.62 (0.20;1.05)	2.18 (1.70;2.66)
	Turkey	0.37 (−0.05;0.79)	2.47 (1.94;3.00)
	Iran	−0.52 (−1.01; −0.03)	0.67 (−0.09;1.43)
Full model			
Country of birth	Sweden	0 (reference)	0 (reference)
	Poland	0.77 (0.23;1.31)	0.11 (−0.31;0.54)
	Chile	0.72 (0.29;1.15)	1.88 (1.40;2.36)
	Turkey	0.41 (−0.03;0.86)	1.49 (0.92;2.07)
	Iran	−0.24 (−0.73;0.26)	0.37 (−0.36;1.09)

The full model is adjusted for education, physical activity and smoking habits.
Linear regression. Ages 27–60 years, 1996, Sweden

Discussion

The main finding of this study was that country of birth is associated with increased BMI levels. This holds true for women born in Chile and Turkey, and men from Chile and Poland, who had substantially higher BMI levels than the Swedish women and men after adjustment for age, SES (education), physical activity and smoking habits.

A relationship between country of birth and increased BMI levels has been found in some other Swedish studies. For example, a population-based study showed that South European men had higher mean BMI than Swedish men [6] and another study showed that Mediterranean immigrants had a higher mean BMI than Swedes [18]. Other studies from different parts of the world have also shown an increase in BMI in the Diaspora [7, 19, 20].

There could be several plausible explanations to the differences in BMI due to country of birth, e.g. the adaptation of a westernised life style. One study among Japanese men living in Hawaii showed that those who lived most westernised were more obese, and less physically active [21]. The level of SES, including SES before and after migration, might also be important, as low SES is shown to be associated with obesity, and also with other unhealthy life style factors, such as physical inactivity and poor dietary habits [16, 22, 23]. In our study people with low educational status had in general higher mean BMI than people with high educational status. In addition, those who were physically inactive had a higher BMI than those who were physically active. The prevalence of physical inactivity was especially high among Turkish women (78.1%) among whom also BMI was markedly higher than among their Swedish controls, even after adjustment for SES. In another study from the same database we found an increased prevalence of diabetes mellitus among Turkish-born women in Sweden compared to Swedish-born, odds ratio 3.22, but not among Turkish-born men [24]. This over-risk for diabetes, however, disappeared when adjusting for educational level, employment status and BMI. Another plausible explanation behind ethnical differences in BMI might be a stress caused by a socio-economic degradation in the Diaspora. In our study some immigrants work below their attained level of education, e.g., among the Chileans, where 90% were workers or low non-manual employees, although about 34% of the Chilean men and 24% of the Chilean women had a high educational status (data not shown). This might constitute a substantial stress in the migration process, leading to increased BMI. Besides, the observed differences in BMI could be due to ethnical differences in body proportions and percent body fat [25], as Mediterraneans seem to have a higher mean BMI when compared to other groups in the world [26].

Our study has some limitations. The non-response rate was about 30%, with non-respondents having lower incomes than respondents. Owing to this non-response, it is probable that the BMI levels in the sample were underestimated to some extent because previous studies have shown an association between low SES and increased BMI, for example in Poland [27, 28] Relative risks are however probably less influenced by non-response than absolute measures, such as prevalence of increased BMI. Our results cannot tell whether the higher BMI is linked to the migration process in itself since such data were not available to us.

BMI was calculated on self-reported values of height and weight. The validity of self-reported height, weight and BMI in the Swedish Survey of Living Conditions has been studied earlier, and were found to be closer to the mean values, or the 'desirable' values [29]. However, even if there are other ways of determining obesity, e.g., waist/hip ratio (WHR), waist circumference, abdominal sagittal

diameter or measuring the amount of abdominal visceral adipose tissue by computed tomography [30], the general conclusion is that correlations between self-reported and measured BMI are high, even if there is a tendency for erroneous self-reporting of a 'slim-body shape' [31–33]. Thus, the BMI levels in our study are probably underestimated. It is possible to correct for this [29], but we did not believe such an adjustment to be necessary; there are no indications in previous research that this possible underestimation in BMI should vary according to country of birth. There is thus probably no differential misclassification in this study. To sum up, the use of self-reported weight and height in the calculation of BMI has been shown to be reliable in previous research.

Our study has also several strengths. The sample used is a national sample and includes four different immigrant subgroups from different parts of the world. Moreover, we had the opportunity to adjust for several important confounders, such as SES, physical activity and smoking habits. The reliability of the dependent and independent variables was analysed in 1989 in re-interviews (test–retest method) about 4 weeks after the main interview of a random sample of 410 respondents (response rate 88.4%) for the following variables: educational status, physical activity, smoking habits and weight and height (BMI). The kappa coefficients were 0.7–0.9 which indicate a high level of reliability [34].

Conclusions

The present study showed that country of birth is associated with increased BMI levels for Chilean men and women, Turkish women and Polish men. This is important, considering the fact that increased BMI is associated with coronary heart disease. Moreover, coronary heart disease was recently found to be more common among Poles, Turks, and Iranians in Sweden, compared to Swedish-born subjects [35]. The higher prevalence of several other coronary risk factors among immigrants, including smoking and physical inactivity, will cause a high pressure on primary health care and increasing costs in the whole health care budget. Therefore, efforts should be made to promote a healthier lifestyle among immigrants, especially among women and those with a low educational status. If included in the primary health care these efforts might prove to be cost-effective.

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