Country of Birth, Country of Residence, and Multimorbidity

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Abstract

Health and disease are believed to be intertwined with contextual circumstances and early life experiences. Examining the health of migrants can bring new understanding to the role of place in shaping health. We investigate the prevalence of chronic disease with a focus on multimorbidity - the presence of two or more chronic diseases concurrently. The overarching goal is to determine whether country of origin or country of current residence is the more important factor in health. We used the Survey of Health, Aging, and Retirement in Europe (SHARE), a cross-national panel survey of individuals aged 50 years and older (n=112,612 native-born and 11,266 foreign-born in 2002-2017). Self-reported chronic conditions used to define multimorbidity were: heart attack, high blood pressure, high blood cholesterol, stroke, diabetes, chronic lung disease, cancer, stomach ulcer, Parkinson's disease, cataracts, and hip fracture. We used multinomial logistic regression models. 37.65% of migrants and 35.10% of native-born individuals reported multiple conditions. Compared to native-born people, multimorbidity was higher among migrants born in Eastern Europe (OR: 1.41, 95% CI: 1.31, 1.52) and Central and West Asia (OR: 1.16, 95% CI: 0.96, 1.40), and lowest among migrants born in Southeast, South, and East Asia (OR: 0.66, 95% CI: 0.51, 0.87). Foreign-born people from Africa and from other European countries living in Northern Europe, and foreign-born Europeans living in Eastern Europe had lower odds of multimorbidity than native-born people living in the same region. Country of birth and country of residence are each associated with multimorbidity.

1. Introduction

Multimorbidity, indicating that a person has multiple chronic conditions, is a global concern and is expected to increase due to population aging and changing lifestyles (1–3)It represents the progression and accumulation of chronic diseases across the lifespan (4), often leading to disability, high medical costs, and poor quality of life (4). The prevalence of multimorbidity increases with age and is higher among women and people with low socioeconomic status (5–7).

International migrants tend to be a healthy group in most populations (ref), but limited access to care (ref) and repeated stressful exposures (ref) may leave migrants at risk of developing multimorbidity. Indeed, their health tends to worsen with time after migration, and health problems eventually resemble or even exceed those of the general population in their country of resettlement (11–15). The process of migration can have both positive and negative implications for health: it can lead people to environments with lower risks of infectious diseases and better quality of living conditions and health care(20); at the same time, it may also lead them to environments condusive to chronic disease due to eating patterns, smoking, and physical inactivity (20).

Measuring multimorbidity among international migrants can also provide insites into how place affects health: if health varies with place of origin, then we may emphasize the importance of the long arm of childhood exposures, and habits, diets, and preferences developed early in life, affect us throughout our lives, regardless of migrant status. On the other hand, if health varies with place of current residence, then current exposures and behaviors may be most important for chronic disease trajectories, rather than occurances and exposures earlier in life. If there is an interaction between current residence and place of birth, then early life exposures operate

differently according to current exposures and thus some current circumstances can be expected to be more harmful for some people than for others; some people will be more vulnerable to current environments and behaviors than others. Using a large cross-national study that includes multiple measures of health across foreign-born and native-born people across Europe, we attempt to disentangle these associations between the role of places and the development of multiple chronic conditions. We characterize the prevalence of multimorbidity among foreign-born people across Europe and determine the importance of place of origin and place of resettlement in shaping risks for chronic disease.

2. Material and Methods

2.1 Data Sources and Study Design

The Survey of Health, Ageing and Retirement in Europe (SHARE) is a cross-national household-based panel survey that measures health, socio-economic status, and social and family networks (21). SHARE has collected 7 waves of data on 140,000 individuals and covers 27 European countries and Israel. *easy*SHARE is a simplified version of the SHARE dataset that contains the same number of observations as the main release of SHARE, simplified data structure, and a selection of central SHARE variables.

In 2004-6, the first wave of SHARE was fielded in 11 countries: Austria, Belgium, Switzerland, Germany, Denmark, Spain, France, Greece, Italy, the Netherlands, Sweden, and Israel. In wave 2 (2006-2007), Czech Republic and Poland were added. Wave 3 was fielded in 2008-2011 and wave 4 in 2010-2012, adding Estonia, Hungary, Portugal and Slovenia. Wave 5 was fielded in 2013, adding Luxembourg, wave 6 in 2015, adding Croatia, and wave 7 in 2017

adding Finland, Lithuania, Latvia, Slovakia, Romania, Bulgaria, Malta and Cyprus; thus, all continental EU Member States were represented in wave 7.

SHARE represents people aged 50 and older living in Europe who have their regular domicile in the respective SHARE country. People who are incarcerated, hospitalized, out of the country during the entire survey period, unable to speak the country's languages. SHARE produces similar distributions of employment, income, education, and health with three other prominent European surveys: European Union Labour Force Survey (EU-LFS), the European Community Household Panel (ECHP), and the European Social Survey (ESS) (22).

All SHARE respondents who were interviewed in any previous wave are part of the longitudinal sample. If they have a new co-residing partner, the partner is eligible as well, regardless of age. Proxy respondents are allowed for family, financial or household matters if physical or cognitive limitations make it too difficult for a respondent to complete the interview independently, as well as for end-of-life interviews. Age-eligible respondents are traced and re-interviewed if they move within the country.

Trained interviewers conduct face-to-face interviews in respondent's homes using a laptop with computer-assisted personal interviewing (CAPI). Interviews consist of questionnaires and physical exams. SHARE uses ex-ante harmonisation, with one common questionnaire translated and used throughout.

2.2 Variables

The main independent variable in this study is country of birth, collapsed into geographic regions. Country of birth was recorded by asking the respondent "In which country were you born? Please name the country that your birthplace belonged to at the time of your birth". The countries were classified based on the ISO (International Organization for Standardization)

country codes created by the United Nations Statistics Division (UNSD), which also provides codes for countries that no longer exist (23). Using UNSD categorizations, country of birth was categorized into regions using the UNSD classifications (9,23): (1) Western, Northern, & Southern Europe, (2) Eastern Europe, (3) Latin America & the Caribbean, (4) Central & West Asia, (5) Southeast, South, & East Asia, (6) Africa, and (7) North America & Oceania.

Respondents were asked, "Do you currently have any of the conditions on this card? With this we mean that a doctor has told you that you have this condition, and that you are either currently being treated for or bothered by this condition". The 11 conditions used for analysis were (1) heart attack, (2) high blood pressure or hypertension, (3) high blood cholesterol, (4) stroke or cerebrovascular disease, (5) diabetes or high blood sugar, (6) chronic lung disease, (7) cancer or malignant tumor, (8) stomach or duodenal ulcer, peptic ulcer (9) Parkinson disease, (10) cataracts, and (11) hip fracture or femoral fracture. We defined multimorbidity as the presence of 2 or more of these conditions, coding health as: 0 chronic diseases, 1 chronic disease, and 2 chronic diseases (multimorbidity).

Variables analyzed as possible confounders were age, sex, country of residence, education, working status, and household income. Country of residence was coded as the country where the interview took place and categorized into regions: Western Europe, Northern Europe, Southern Europe, and Eastern Europe. Education was a generated variable created with country-specific measurements and ex-post harmonization (24); which we categorized into the 3-level variable, following previous studies that used SHARE: None or primary, Secondary, Post-secondary (includes still in school and other) (9). Working status captured if respondents were retired, employed or self-employed (including working for family business), unemployed, permanently sick or disabled, homemaker, and others. For analysis, this was condensed into five

categories: retired, employed, unemployed, permanently sick, and homemaker/other (25). Household income was measured by asking the participant, "Thinking of your household's total monthly income, would you say that your household is able to make ends meet..." with the responses: with great difficulty, with some difficulty, fairly easily, or easily. These categorizations were used for analysis.

2.3 Statistical Analyses

The *easy*SHARE data are stored in long format, where one data line represents one wave in which each respondent participated. In order to capture each respondent once for a cross sectional analysis, we restricted to the last (most recent) observation for each respondent. Additionally, we restricted the captured waves to 1, 2, 4, 5, 6, and 7, as wave 3 did not collect prospective data. We restricted ages to older than 50 years old at the time of interview, which excludes partners who were younger than 50 years old.

All analyses were conducted using SAS 9.1 using the *easy*SHARE dataset, which does not include survey weights.

The demographic and socioeconomic characteristics of the SHARE study in 2002-2017 are presented in Tables 1 and 2. Multinomial logistic regression was used to estimate association between country of birth and multimorbidity, with odds ratios and 95% confidence interval presented in Table 3. Respondents who reported 0 chronic diseases were treated as the reference category and were compared to respondents who reported 1 chronic disease and 2+ chronic diseases. For the minimally adjusted model, we controlled for age and sex. For the fully adjusted model, we additionally controlled for country of residence, education, working status, and household income. We tested for interaction between country of birth and residence country.

We used the joint test, for an effect that all the parameters associated with that effect are zero, and Wald Chi p-value to assess the significance of the interaction term.

3. Results

Characteristics of participants by country of birth are shown in Table 1. In the SHARE study, 9.09% of participants were born in a country other than their current country of residence. 54.98% were women and the mean age was 68 years. 73.62% of foreign-born people were born in Europe, with 41.91% in Eastern Europe and 31.71% Northern, Western, and Southern Europe. The majority of foreign-born individuals resided in Western Europe (40.05%) and Northern Europe (25.65%). Foreign-born people had similar education levels to native-born, but were less often retired, and were more likely to report household income struggles. Foreign-born individuals born in Africa and Central & West Asia reported the lowest education levels and worst income struggles, while those from North America & Oceania reported the highest education levels and were least likely to report income struggles. Although foreign-born individuals born in Northern, Southern, and Western Europe and foreign-born individuals born in Eastern Europe both reported high education and high retirement levels, foreign-born individuals born in Eastern Europe were more likely to report income struggles than foreign-born individuals born in Northern, Southern, and Western Europe.

Table 1 here.

The distribution of the number of chronic diseases by sample characteristics, categorized as 0, 1, and 2+ diseases, is shown in Table 2. Men, older people, those with lower education status, those not working due to permanent sickness, and those with income struggles were more likely to report multimorbidity. 37.65% of foreign-born individuals and 35.10% of native-born individuals reported 2+ chronic diseases. Reporting 1 chronic disease did not differ largely

between foreign and native-born individuals (29.52% versus 29.95% for foreign-born and native-born, respectively). Foreign-born individuals born in Eastern Europe had the highest levels of multimorbidity (43.07%), followed by foreign-born individuals born in Central and West Asia (39.69%). Foreign-born individuals born in Latin America and the Caribbean and Southeast, South, and East Asia were on average younger than other regions and reported the lowest multimorbidity levels at 26.72% and 24.40.

Table 2 here.

Multinomial logistic regressions are shown in Table 3. After controlling for other characteristics, foreign-born individuals born in Eastern Europe (compared to native-born individuals) had significantly higher odds of reporting 1 chronic disease (OR: 1.20, 95% CI: 1.11, 1,30) and multimorbidity (2+ chronic diseases) (OR: 1.41, 95% CI: 1.31, 1.52) rather than no chronic conditions (Table 3). Foreign-born individuals born in Southeast, South, & East Asia were significantly less likely to report 1 chronic disease (OR: 0.78, 95% CI: 0.61, 0.99) or 2+ chronic diseases (OR: 0.66, 95% CI: 0.51, 0.87). While in unadjusted models foreign-born individuals born in North America and Oceania were significantly less likely to report 1 chronic disease and 2+ chronic diseases, their odds for chronic conditions were similar to those of native-born people after adjusting for other characteristics. Foreign-born individuals from Central and West Asia were significantly more likely to report multimorbidity but not 1 single chronic disease. Foreign-born individuals born in Northern, Southern, and Western Europe, Latin America and the Caribbean, and Africa had similar chronic disease patterns to native-born people.

Table 3 here.

Even after comtrolling for place of birth, country of residence was associated with multimorbidity. Among both foreign and native-born individuals, those residing in Northern Europe and Eastern Europe, compared to Western Europe, had significantly higher odds of multimorbidity (OR: 1.12, 95% CI: 1.08, 1.17 (Northern Europe); OR: 1.24, 95% CI: 1.19, 1.29 (Eastern Europe).

Table 3 here.

Table 4 shows interactions between country of birth and country of residence. Foreign-born people from Africa and Europe living in Northern Europe had lower odds of having multimorbidity rather than no disease than did native-born people living in the same country. Foreign-born European living in Eastern European countries had lower odds of multimorbidity than native-born people living in the same country.

Table 4 here.

4. Discussion

The goal of this study was to investigate whether multimorbidity is associated with country of birth among migrants aged 50 years and older residing in Europe, and whether this association is modified by country of residence. The findings suggest that the risk of multimorbidty is associated both with early life experiences in the country of origin and with the post-migration circumstances and lifestyle in the country of resettlement.

Individuals born in Southeast, South, and East Asia, and North America and Oceania had lower odds of reporting one chronic disease and multimorbidity compared to native-born individuals in the European country where they were residing. Such differences could originate from the impact of social and structural environment in which people grew up. They could also be a result of selective migration, whereby people who are in good health are more likely to

resettle in a different country. At the same time, people born in Eastern Europe and Central and West Asia had a higher odds of reporting multiple conditions than native-born people in their country of residence. Thus, there is great variability in health among migrants, even after accounting for the country where they resettled and for personal characteristics. These differences in health among migrants may result from differences in early life environemnts, socio-cultural and behavioral patterns associated with country of origin. They could also result in part from differences in selection of people into migration, that is, the more difficult it is to migrate, the more those who do migrate are better health and socioeconomic position. These findings are consistent with previous literature, for example, showing that Eastern European migrants have higher odds of multimorbidity compared to foreign-born individuals from Western Europe, North America, Asia, Africa and Latin America (11).

After accounting for country of origin, country of residence was also associated with multimorbidity, highlighting the additional importance of current living environments. Individuals residing in Northern and Eastern Europe had higher odds of multimorbidity than those living in Western Europe; individuals residing in Southern Europe had similar multi-morbidity patterns to those in Western Europe. These regional differences in prevalence of multimorbidity may relate to differences in age distribution of the population, differences in diagnosis of chronic conditions, as well as to living environments, lifestyles, and healthcare systems.

Additionally, among foreign-born people residing in European countries, there were differences in multimorbidity depending on their country of origin. Foreign-born people from Africa and Europe living in Northern Europe, and foreign-born European living in Eastern Europe had lower odds of multimorbidity than native-born people living in the same region. Two

previous studies using SHARE data have reported significant interaction between country of residence and migration status, characterized as migrants and native-born, in the association between migration status and frailty (9,26). These patterns suggest that early life conditions can have different implications for health depending on later-life circumstances. Barker and colleauges proposed that a mismatch between early life programming and adult circumstances can entail high risk for chronic diseases, and these findings based on migrant health lend support to this idea.

An important limitations of this analysis is that, using *easy*SHARE, we were unable to use sampling weights to adjust for study design. Without these, we cannot generalize to the population of the participating countries (21). Previous studies using SHARE for migration-related analyses have noted that SHARE excludes migrants whose permanent residence is not in the country of interview, for example transient workers and asylum seekers (9). Because these types of migrants may have poorer health than resettled migrants, the findings presented here may indicate better health among migrants in Europe than is actually the case. Southern Europe especially houses a large population of undocumented migrants (9,27), and we did not find evidence of interactions between country of birth and residence in Southern Europe. A related limitation is that, in using *easy*SHARE, we were not able to control for citizenship status or length of stay in the country of residence, which could relate to social integration and healthcare access.(11,13,14,28).

The measures of multimorbidity presented here are based on respondents' reports of chronic diseases in the first wave. Future studies using the full SHARE dataset can expand these analyses to also include other fractures; Alzheimer's disease, dementia, and memory impairment; affective or emotional disorders; rheumatoid arthritis; osteoarthritis, and chronic kidney

disease. Lastly, because only the count of the chronic disease(s) for each respondent was included in the dataset, we were not able to examine the prevalence of each individual chronic diseases or examine chronic disease combinations.

5. Conclusion

This study using a large multi-country dataset showed that there is heterogeneity in chronic disease multimorbidity across country of birth and country of residence. It also showed that the risks of multimorbidity are different for people born in one country according to which country they subsequently resettled. These findings have implications for our understanding of migrant health and for resettlement programs. People resettling in the same environment may have different health vulnerabilities, of which they, and their healthcare providers, should be aware. These findings are also relevant to our understanding of how our living environments across life may contribute to health trajectories even for people who do not migrate. Because migrants are individuals who, by definition, have been exposed to multiple living environments, we can see from their health, as demonstrated here, that their early life and adult living environments each contribute individually to adult health, as well as interacting to create different health trajectories with changing living environments. Notably, changes in living environments can also occur in situ, with possible implications for migrants and non-migrants alike.

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2020;

Table 1. Sample Characteristics of Survey of Health of Aging and Retirement in Europe (SHARE) by Migrant Status as characterized by Country of Birth Geographic Region (N=123,878)

	Migrant Status		**Country of Birth**						
	Native-born	*Foreign-born (All)*	*N, S, & W Europe*	*E Europe*	*LAC*	*Central & W Asia*	*SE, S, & E Asia*	*Africa*	*N America*
Sex, %									
Female	54.89	55.84	55.92	58.03	59.08	50.21	52.96	50.82	59.66
Male	45.11	44.16	44.08	41.97	40.92	49.79	47.04	49.18	40.34
Age, %									
Mean (SD)	68.21 (10.22)	68.02 (10.40)	68.33 (10.23)	69.35 (10.44)	63.68 (9.14)	66.92 (11.03)	64.42 (9.50)	65.63 (9.89)	65.27 (10.23)
50-59	21.53	23.83	22.61	19.46	38.62	30.58	35.48	30.58	32.77
60-69	34.60	32.31	31.51	32.11	35.73	26.79	35.99	35.57	36.97
70-79	26.88	26.58	29.58	27.09	18.16	25.95	20.57	22.24	15.97
80+	16.99	17.27	16.29	21.35	7.49	16.69	7.97	11.62	14.29
Number of Chronic Diseases[a], %									
0	34.96	32.82	34.73	27.53	44.96	33.52	48.07	36.71	50.42
1	29.95	29.52	30.87	29.39	28.53	26.79	27.51	29.22	23.53
≥ 2	35.10	37.65	34.40	43.07	26.51	39.69	24.42	34.07	26.05
Country of Residence, %									

Western Europe	32.07	40.05	73.24	10.31	35.16	34.36	59.90	53.74	45.38
Northern Europe	19.11	25.65	13.49	45.34	7.78	17.81	14.91	2.14	21.01
Southern Europe	27.19	15.32	6.30	22.81	45.53	5.75	6.43	13.54	8.40
Eastern Europe	21.63	18.98	6.97	21.54	11.53	42.08	18.77	30.58	25.21
Highest Level of Education, %									
None or primary	22.78	21.13	25.50	10.78	17.87	33.24	16.97	42.05	5.04
Secondary	57.37	51.71	48.95	60.48	49.28	42.64	50.13	36.71	30.25
Post-secondary	19.85	27.15	25.55	28.74	32.85	24.12	32.90	21.24	64.71
Working Status, %									
Retired	60.61	55.88	60.12	62.85	34.29	42.92	37.53	40.20	36.97
Employed	23.50	24.99	22.19	23.38	42.36	27.63	37.79	26.59	45.38
Unemployed	2.33	4.01	2.85	3.75	4.90	6.03	2.57	7.06	3.36
Permanently sick	3.39	5.33	4.73	4.11	4.90	9.12	7.71	8.70	2.52
Homemaker / Other	10.17	9.80	10.10	5.91	13.54	14.31	14.40	17.46	11.76
Household Income, % - Is household able to make ends meet?									
Easily	29.72	23.97	38.79	13.66	22.77	17.81	30.85	19.67	57.14
Fairly easily	30.35	27.56	31.54	26.28	31.99	21.74	30.85	23.16	21.85
With some difficulty	28.09	32.15	21.77	40.36	28.82	36.33	24.42	33.14	15.97

With great difficulty	11.84	16.31	7.89	19.70	16.43	24.12	13.88	24.02	5.04
Sample Size[b]	112612	11266	3573	4722	347	713	389	1403	119

[a]Number of Chronic Diseases is measured as 2+ of the following chronic diseases: heart attack, high blood pressure, high blood cholesterol, stroke, diabetes, chronic lung disease, cancer, stomach ulcer, Parkinson disease, cataracts, and hip fracture.
[b]Values are unweighted counts and unweighted percentages from SHARE Wave 1-7 (2002-2017).
Country of birth and country of residence regions were categorized based on the International Organization for Standardization (ISO) Geographic Region Classifications.

Table 2. Sample Characteristics of Survey of Health of Aging and Retirement in Europe (SHARE)[a] (N=123,878)

	Overall (%)	**Number of Chronic Diseases[b]**		
		0	**1**	**2+**
Sample Size	N=123878	n=43063	n=37050	n=43765
Sex				
Female	68107 (54.98)	24318 (56.47)	20268 (54.70)	23521 (53.74)
Male	55771 (45.02)	18745 (43.53)	16782 (45.30)	20244 (46.26)
Age				
Mean (SD)	68.19 (10.24)	64.33 (9.59)	68.31 (9.95)	71.90 (9.68)
50-59	26935 (21.74)	15078 (35.01)	7313 (19.74)	4544 (10.38)
60-69	42602 (34.39)	16218 (37.66)	13540 (36.55)	12844 (29.35)
70-79	33260 (26.85)	7788 (18.09)	10186 (27.49)	15286 (34.93)

80+	21081 (17.02)	3979 (9.24)	6011 (16.22)	11091 (25.34)
Country of Birth				
Native-born	112612 (90.91)	39365 (91.41)	33724 (91.02)	39523 (90.31)
Western, Northern, Southern Europe	3573 (2.88)	1241 (2.88)	1103 (2.98)	1229 (2.81)
Eastern Europe	4722 (3.81)	1300 (3.02)	1388 (3.75)	2034 (4.65)
Latin America & the Caribbean (LAC)	347 (0.28)	156 (0.36)	99 (0.27)	92 (0.21)
Central & West Asia	713 (0.58)	239 (0.56)	191 (0.52)	283 (0.65)
Southeast, South, & East Asia	389 (0.31)	187 (0.43)	107 (0.29	95 (0.22)
Africa	1403 (1.13)	515 (1.20)	410 (1.11)	478 (1.09)
North America & Oceania	119 (0.1)	60 (0.14)	28 (0.08	31 (0.07)
Country of Residence				
Western Europe	40629 (32.80)	15354 (35.65)	12437 (33.57)	12838 (29.33)
Northern Europe	24412 (19.71)	8509 (19.76)	7323 (19.77)	8580 (19.60)
Southern Europe	32342 (26.11)	10480 (24.34)	9797 (26.44)	12065 (27.57)
Eastern Europe	26495 (21.39)	8720 (20.25)	7493 (20.22)	10282 (23.49)
Highest Level of Education				

None or Primary	28033 (22.63)	7092 (16.47)	8202 (22.14)	12739 (29.11)
Secondary	70433 (56.86)	25445 (59.09)	21099 (56.95)	23889 (54.58)
Post-secondary	25412 (20.51)	10526 (24.44)	7749 (20.91)	7137 (16.31)
Working Status				
Retired	74547 (60.18)	19646 (45.62)	22930 (61.89)	31971 (73.05)
Employed	29280 (23.64)	16357 (37.98)	8363 (22.57)	4560 (10.42)
Unemployed	3078 (2.48)	1520 (3.53)	852 (2.30)	706 (1.61)
Permanently sick	4417 (3.57)	1032 (2.40)	1196 (3.23)	2189 (5.00)
Homemaker /Other	12556 (10.14)	4508 (10.47)	3709 (10.01)	4339 (9.91)
Household Income - Is household able to make ends meet?				
Easily	36174 (29.20)	14196 (32.97)	11119 (30.01)	10859 (24.8)
Fairly easily	37279 (30.09)	13552 (31.47)	11320 (30.55)	12407 (28.35)
With some difficulty	35254 (28.46)	11166 (25.93)	10501 (28.34)	13587 (31.05)
With great difficulty	15171 (12.25)	4149 (9.63)	4110 (11.09)	6912 (15.79)

[a]Values are unweighted counts and unweighted percentages from SHARE Wave 1-7 (2002-2017).
[b]Number of Chronic Diseases is measured as 2+ of the following chronic diseases: heart attack, high blood pressure, high blood cholesterol, stroke, diabetes, chronic lung disease, cancer, stomach ulcer, Parkinson disease, cataracts, and hip fracture.
Country of birth and country of residence regions were categorized based on the International Organization for Standardization (ISO) Geographic Region Classifications.

Table 3. Multinomial logistic regression models for predicting multimorbidity among migrants in Europe, controlling for selected characteristics

	One chronic disease		**Two or more chronic diseases**	
	Reference: No chronic diseases			
Country of Birth (Native-born)	**Minimally Adjusted OR (95% CI)[a]**	**Fully Adjusted OR (95% CI)[b]**	**Minimally Adjusted OR (95% CI)[a]**	**Fully Adjusted OR (95% CI)[b]**
Western, Northern, Southern Europe	1.03 (0.95, 1.12)	1.05 (0.96, 1.14)	0.98 (0.90, 1.06)	1.06 (0.97, 1.15)
Eastern Europe	1.22 (1.13, 1.32)**	1.20 (1.11, 1.30)**	1.50 (1.39, 1.61)**	1.41 (1.31, 1.52)**
Latin America & the Caribbean	0.88 (0.68, 1.13)	0.90 (0.69, 1.16)	0.81 (0.62, 1.06)	0.89 (0.67, 1.17)
Central & West Asia	1.01 (0.83, 1.23)	0.99 (0.82, 1.21)	1.33 (1.11, 1.60)**	1.16 (0.96, 1.40)**
Southeast, South, & East Asia	0.76 (0.59, 0.96)**	0.78 (0.61, 0.99)**	0.64 (0.50, 0.83)**	0.66 (0.51, 0.87)**
Africa	1.03 (0.90, 1.18)	1.00 (0.88, 1.15)	1.12 (0.98, 1.28)	0.98 (0.85, 1.12)
North America & Oceania	0.60 (0.38, 0.95)**	0.69 (0.44, 1.09)	0.61 (0.39, 0.97)**	0.83 (0.52, 1.33)
Sex (Female)				
Male	1.07 (1.04, 1.10)**	1.07 (1.04, 1.11)**	1.12 (1.09, 1.15)**	1.16 (1.13, 1.20)**
Age (continuous)	1.05 (1.04, 1.05)**	1.03 (1.03, 1.04)**	1.08 (1.08, 1.08)**	1.06 (1.06, 1.06)**
Country of Residence (Western Europe)				
Northern Europe		1.04 (0.99, 1.08)		1.12 (1.08, 1.17)**

Southern Europe		1.03 (0.99, 1.07)		1.03 (0.99, 1.07)
Eastern Europe		1.01 (0.97, 1.05)		1.24 (1.19, 1.29)**
Highest Level of Education (Post-secondary)				
None or Primary		1.11 (1.06, 1.16)**		1.34 (1.28, 1.41)**
Secondary		1.04 (1.00, 1.08)**		1.14 (1.10, 1.19)**
Working Status (Retired)				
Employed		0.70 (0.67, 0.73)**		0.43 (0.41, 0.45)**
Unemployed		0.70 (0.64, 0.77)**		0.56 (0.51, 0.62)**
Permanently sick		1.35 (1.23, 1.47)**		2.14 (1.97, 2.32)**
Homemaker / Other		0.83 (0.79, 0.87)**		0.77 (0.73, 0.81)**
Household Income - Is household able to make ends meet? (Easily)				
With great difficulty		1.25 (1.18, 1.32)**		1.97 (1.87, 2.08)**
With some difficulty		1.17 (1.13, 1.22)**		1.45 (1.39, 1.51)**
Fairly easily		1.04 (1.01, 1.08)**		1.12 (1.08, 1.16)**

Note: Reference categories are shown in parentheses.
[a]Minimally Adjusted Model: included country of birth, sex, age.
[b]Fully Adjusted Model: included country of birth, sex, age, country of residence, education, working status, and household income.
Country of birth and country of residence regions were categorized based on the International Organization for Standardization (ISO) Geographic Region Classifications.
** Significant at the 0.05 level.

Table 4. Multinomial Logistic Regression Adjusted Beta Estimates and Standard Errors for predicting multimorbidity by country of birth modified by country of residence, controlling for selected characteristics[a]

	Country of Residence							
	Western Europe		**Northern Europe**		**Eastern Europe**		**Southern Europe**	
(Baseline: 0 CD)[b]	**1 CD**	**2+ CD**	**1 CD**	**2+ CD**	**1 CD**	**2+ CD**	**1 CD**	**2+ CD**
Country of Birth (Native-born ref)								
Western, Northern, & Southern Europe				0.31 (0.18)*		0.52 (0.18)**		
Eastern Europe						0.53 (0.15)**		
Latin America & the Caribbean								
Central & West Asia								
Southeast, South, & East Asia								
Africa			-0.41 (0.20)**	-0.52 (0.21)**				
North America & Oceania								

[a]Fully adjusted model controlled for age, sex, country of residence, education, working status, and household income.
[b]Chronic disease abbreviated as 'CD'.
[c]Country of birth and country of residence regions were categorized based on the International Organization for Standardization (ISO) Geographic Region Classifications.
** Significant at the 0.05 level.
* Significant at the 0.10 level.