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Inequalities in Multimorbidity between Older Migrants and Natives across Europe

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ABSTRACT

Multimorbidity patterns in immigrants may differ from those in the native population due to immigrants' differential experiences in the origin and the receiving country. This study addresses inequalities in multimorbidity between immigrants and natives by comparing the patterns by gender, age, origin country, and receiving country. Our analysis includes 113,470 individuals from 28 European countries who participated in the Survey of Health, Ageing, and Retirement in Europe. The immigrant-native gap is illustrated by first estimating the risk difference and the relative risk of each chronic disease combination. Then, we compare the estimates across gender, age, origin country, and receiving country. According to the results, several multimorbidity patterns that include stomach ulcers or diabetes are more common in immigrants than in natives. This immigrant disadvantage becomes larger when they are women, born in Eastern Europe or Asia, and living in Northern Europe. Our results indicate that inequalities in multimorbidity between immigrants and natives can be amplified for specific disease combinations and in certain population subgroups. Our study provides evidence in selecting priority groups that should be monitored to minimize health inequalities in Europe.

Keywords Migrants; Multimorbidity; Chronic diseases; Europe

INTRODUCTION

As the world has become increasingly interconnected, large numbers of individuals have crossed borders in recent decades [1]. This demographic transformation has been accompanied by the aging of immigrant populations, underscoring the need for public health policies aimed at addressing the inequalities in healthy aging that the immigrant community faces. Such inequalities stem primarily from the unique life experiences of immigrants [2]. Influenced by personal attributes, such as the reason for migration, and broader contextual-level factors, including immigration policies and prevailing social norms, the differential experiences of immigrants accumulate over the life course and add extra layers of either protection from or increased risk of adverse health outcomes [2,3]. Consequently, the cumulative impact of experiences throughout the migration process shapes unique healthy aging profiles in immigrants, which are distinct even from one another [2,4].

Given the heterogeneity in healthy aging processes within immigrant populations, there is a need to precisely identify where the inequalities between immigrants and natives are amplified. A clear illustration of varied aging processes across different populations can be provided by examining patterns of multimorbidity, i.e., the coexistence of two or more chronic health conditions in an individual. This is because although older adults share a high risk of having several chronic conditions in general – which may, in turn, result in a higher risk of multimorbidity – the speed at which they accumulate such conditions and develop multimorbidity differs between populations based on several individual and social contexts [5–7]. This suggests that individuals from certain backgrounds may be more likely to develop specific types of chronic diseases at faster rates than other subgroups, which can result in different patterns of multimorbidity across populations.

Similarly, immigrants develop chronic diseases at different rates compared to natives [4]. Several studies have documented an immigrant advantage in the risk of multimorbidity that dissipates over the duration of stay in the receiving country [8–11]. These findings align with the broader phenomenon of the “healthy immigrant effect,” which generally shows that immigrants are, on average, in better health than the non-migrant population due to the positive selection favoring healthier individuals throughout the migration process [12,13]. The initial health advantage of immigrants tends to dilute over time as immigrants adapt to the health behaviors of the native population [14,15]. These findings suggest that immigrant-native disparities in age-health trajectories are reflected in the risk of multimorbidity.

Previous attempts to understand the chronic disease combinations of multimorbidity have further determined that these patterns vary by country, gender, age, race/ethnicity, and socioeconomic status [5,16–18]. For example, previous studies have found that the risk of developing each chronic disease combination differs

even within Europe, with a high concurrent presence of cardiovascular and metabolic diseases being found in Southern Europe and a high concurrent presence of cancer and cardiovascular diseases being observed in Eastern Europe [19,20]. In addition, earlier studies have found that the risk of simultaneously having cardiovascular and metabolic diseases is higher among women and older individuals than among men and younger individuals [18,21]. There is also evidence that the risk of simultaneously having nicotine-dependent diseases and hypertension is higher among African and Native Americans than among Caucasian Americans, especially at younger ages; and that highly deprived individuals face a higher risk than less deprived individuals of having any chronic disease combination, including those involving pain, depression, or anxiety [22,23]. These results indicate that multimorbidity patterns vary considerably across populations and can, therefore, be used to pinpoint where the inequalities between populations lie. However, research that has specifically examined the patterns of multimorbidity based on immigrant status remains scarce. Furthermore, research on immigrant-native disparities within each specific pattern is lacking.

This study aims to describe inequalities in multimorbidity between immigrants and natives in Europe by comparing their respective patterns across gender, age, and region. To this end, we seek to determine the prevalence of each chronic disease combination among immigrants and compare it to that of their native-born counterparts in 28 European countries. Moreover, we examine the magnitude and the direction of these immigrant-native health disparities for each population subgroup, which may, in turn, indicate which disease combinations are the most prevalent and which subpopulations are the most affected by the health inequalities between immigrants and natives.

METHODS

Data and Study Population

This study uses data from the Survey of Health, Ageing, and Retirement in Europe (SHARE) on the health and socioeconomic status of individuals aged 50 and above in 28 European countries and Israel. We include waves 2 through 8 (2006-2020) in our analysis while excluding wave 1 (n = 6,545) and wave 3 (n = 1,058) due to the lack of information on the diagnosis of dementia and the current medical issues, respectively. Participants younger than age 50 (n = 2,075), who are mainly the spouses of the core study participants, are omitted from the analysis, given that multimorbidity is more common among older adults [5]. We also consider that because immigrants with health problems can return to their origin countries, it may appear that immigrant populations are becoming healthier at older ages [13]. To reduce the potential issues from such return migration bias, we exclude participants aged 80 years and older (n = 12,687) from the analysis. Furthermore, since the geographical focus of this paper is on Europe, individuals from Israel are excluded (n = 3,051). After removing participants with missing information on migration-related variables (n = 696) and present chronic conditions (n = 543), a total of 113,470 participants (289,584 observations) are included in the final sample.

Multimorbidity and Chronic Diseases

The main outcome measure of this study is the prevalence of chronic disease combinations. We first select 14 chronic conditions based on a literature review, which categorized each chronic health condition based on the frequency of appearance in the previous studies on multimorbidity into low, medium, and high levels [24]. Our study includes the conditions classified as having medium to high levels, except for chronic kidney disease, which is excluded due to the insufficient number of respondents with the disease, especially among immigrants, as it was included in the survey in recent waves only. We estimate the presence of the selected conditions based on self-reported doctor-diagnosed conditions. For mental disorders, individuals who have had depression or have been treated for depression are also considered in the disease prevalence estimates. Furthermore, as patients on medications may have attenuated symptoms and underreport their medical issues, we include individuals taking drugs for hypertension, heart conditions, diabetes, sleep problems, anxiety, depression, osteoporosis, chronic bronchitis, and asthma in the estimates of disease prevalence. This study considers chronic diseases to be irreversible and, therefore, defines individuals with a history of ever having had a condition as having the condition.

Next, we recategorize the selected chronic conditions into eight groups: cancer, cardiovascular diseases, diabetes, dementia, mental disorders, musculoskeletal diseases, respiratory diseases, and stomach ulcers. We do so to avoid the double estimation of co-occurring conditions for which the distinctions between them are vague, such as heart failure and hypertension (a detailed list of diagnoses and drugs can be found in Table S1) [25]. In addition to noting the presence of each chronic disease, we also count the number of chronic diseases in each individual at each survey wave and define those individuals who have multiple conditions simultaneously as having multimorbidity. Finally, we pair two of the eight chronic diseases to arrive at a total of 28 disease combinations.

Immigration Background

In this study, the term immigrant refers to individuals born in a foreign country. To investigate regional variations in multimorbidity patterns, we group immigrants based on the origin country and the receiving country. The country of origin is defined as the birth country of the immigrant, while the receiving country is defined as the country in which the immigrant is currently living and is giving the interview. Both the origin and the receiving countries are categorized into geographical subgroups as defined by the United Nations [26]. The origin country groups include five continent-based subgroups (Africa, the Americas, Asia and Oceania, Eastern Europe, and other European countries), while the receiving countries are categorized into four regional subgroups within Europe (Northern, Southern, Eastern, and Western Europe) (see Table S1 for the detailed list of countries). Exceptions include Cyprus, which is reassigned to Southern Europe, and the former Soviet republics, which are assigned to Eastern Europe regardless of their current borders.

Statistical Analysis

We use frequencies and percentages for the descriptive analysis of the study population by gender and immigrant status. We run χ^2 tests to measure the significance of the differences in each of the descriptive characteristics at the study entry between immigrants and natives.

The prevalence is estimated in the person-years of all the study years pooled together. For individual chronic health conditions, we calculate the prevalence as the years lived with a condition divided by the total person-years of all individuals. For multimorbidity, the prevalence is computed as the conditional probability of having condition B, given that the individual has condition A. In other words, the years lived during the study years with the combination of both conditions A and B is the numerator, while the total person-years lived with

condition A during those years is the denominator. In the total sample, the prevalence for both the single chronic diseases and the two-disease combinations are age-standardized using the 2013 European Standard Population [27].

Finally, to compare the multimorbidity patterns of immigrants and natives, we measure absolute inequalities by estimating the risk difference (the marginal risk for immigrants compared to that for natives), and we measure relative inequalities by estimating the relative risk. We calculate both absolute and relative inequalities, as absolute inequalities can indicate the magnitude of the overall differences in the prevalence between immigrants and natives, while relative inequalities can reveal how these gaps are proportional to the health status of immigrants. All analyses are performed by gender. In the subgroup analysis, we estimate our outcome measure by age group, origin country group, and receiving country group. All 95% confidence intervals are gained from the bootstrapping based on the binomial assumption (1,000 repetitions).

RESULTS

Table 1 summarizes the demographic profile of the study population. In our final sample, immigrants in their fifties outnumber their native-born peers for both genders. The study participants mainly live in Western Europe regardless of their gender and immigrant status, with the largest shares of both male and female immigrants being born in other European regions. Immigrants exhibit a higher prevalence of chronic diseases and multimorbidity than natives in the 50 to 59 age group, but in the 70 to 79 age group, the only gap that remains is a difference in multimorbidity prevalence among women.

[Table 1]

Prevalence of Chronic Diseases and Multimorbidity

Figure 1 presents the age-standardized prevalence of chronic diseases and multimorbidity (see Table S2-3 for the details). Immigrants generally have a higher prevalence of individual chronic diseases, except for cardiovascular diseases among men, with varying statistical significance levels. This immigrant disadvantage is also observed in the risk of multimorbidity, but it is typically more pronounced in women than in men. Furthermore, we find notable discrepancies between the patterns of single chronic diseases and multimorbidity. For instance, although cardiovascular diseases are the most prevalent and dementia is the least prevalent of the chronic diseases (panel a), multimorbidity is most frequently found in dementia patients and is least frequently observed in persons with cardiovascular diseases (panel b). Another example is that while immigrant men have a higher prevalence of diabetes than their native-born counterparts, the risk of multimorbidity in individuals with diabetes is similar for immigrant and native men.

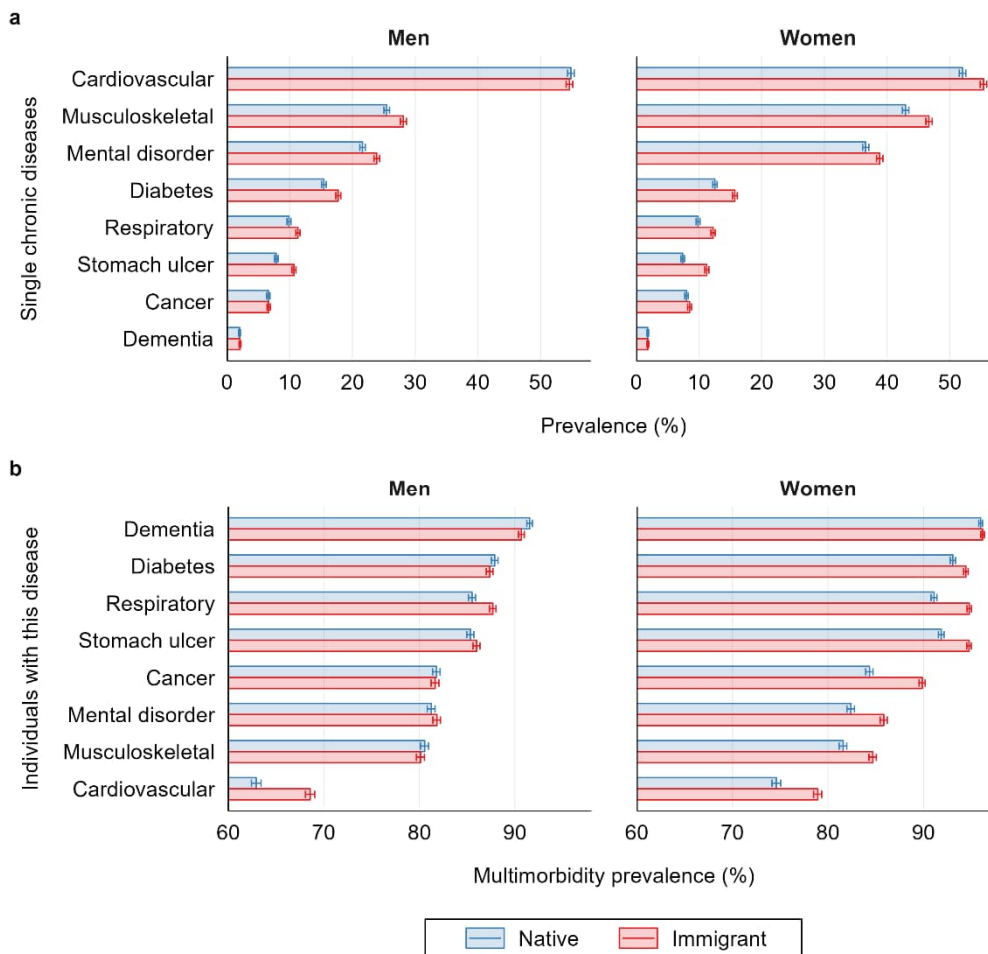


Fig. 1 Age-standardized prevalence of chronic diseases by immigrant status for each gender. **a** prevalence of single chronic diseases on the Y-axis; **b** prevalence of multimorbidity within individuals who have chronic diseases on the Y-axis.

Immigrant-Native Disparities in Multimorbidity Patterns

Table 2 presents the chronic disease combinations with the largest absolute inequalities in prevalence between immigrants and natives. Among men, the immigrant disadvantage is the largest for the “dementia-diabetes” (14.3; 95% CI 13.6-14.9) combination, followed by the “dementia-stomach ulcer” (7.4; 95% CI 6.8-7.9) and “diabetes-mental disorder” (6.5; 95% CI 5.9-7.0) patterns. Among women, inequalities are most pronounced for the “respiratory diseases-stomach ulcer” combination (7.5; 95% CI 6.9-8.0), followed by the “cancer-respiratory diseases” (7.1; 95% CI 6.6-7.7) and “cancer-stomach ulcer” (7.0; 95% CI 6.5-7.5) patterns.

[Table 2]

Figure 2 displays the relative risk of chronic disease combinations among immigrants and natives by gender (detailed results in Table S4). Our findings show that regardless of whether the distribution of the direction of the risk of chronic disease combinations favors immigrants or natives, it is fairly equal among men.

For instance, the probability of having stomach ulcers in combination with any other chronic diseases is higher among immigrants than among natives, while the risk of having cancer among individuals with musculoskeletal diseases, mental disorders, diabetes, or dementia is lower for immigrants than for natives. Conversely, compared to native women, immigrant women have a higher prevalence of most chronic disease combinations, except for some patterns that include dementia.

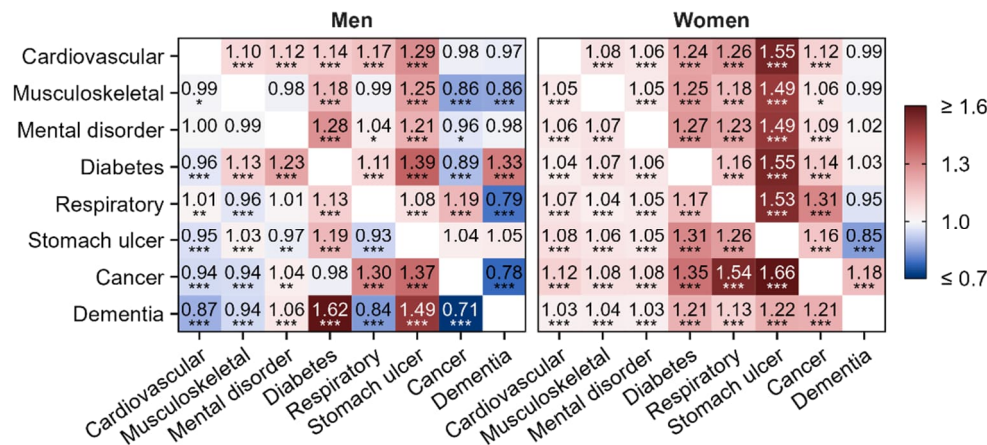


Fig. 2 Relative risks of having the chronic disease on the X-axis given that the condition on the Y-axis is present in immigrants versus natives by gender. Values are age-standardized using the 2013 European standard population.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Age Profiles of the Disparities in Multimorbidity between Immigrants and Natives

Figure 3 illustrates the relative risk of having chronic disease combinations among immigrants versus among natives by gender and age group (detailed results in Table S5-6). Similar to the gender-specific patterns, we find immigrant disadvantages for most disease combinations among women, with these disadvantages being less apparent among men across all ages. However, these age-specific patterns diverge from those of the general population in some cases. At younger ages, immigrant men face a lower risk of having cardiovascular diseases or cancer and a higher risk of developing diabetes or stomach ulcers in combination with some other chronic diseases compared to those of native men. These immigrant-native disparities dissipate at older ages, except for the prevalence of stomach ulcers, for which an immigrant disadvantage remains. Among women, we also find a declining trend in the immigrant disadvantage for several chronic disease combinations, including chronic respiratory diseases in combination with all other chronic health conditions apart from musculoskeletal diseases. In some other cases, similar to the trend among men, immigrant women have a similar or even greater disadvantage compared to native women at older ages.

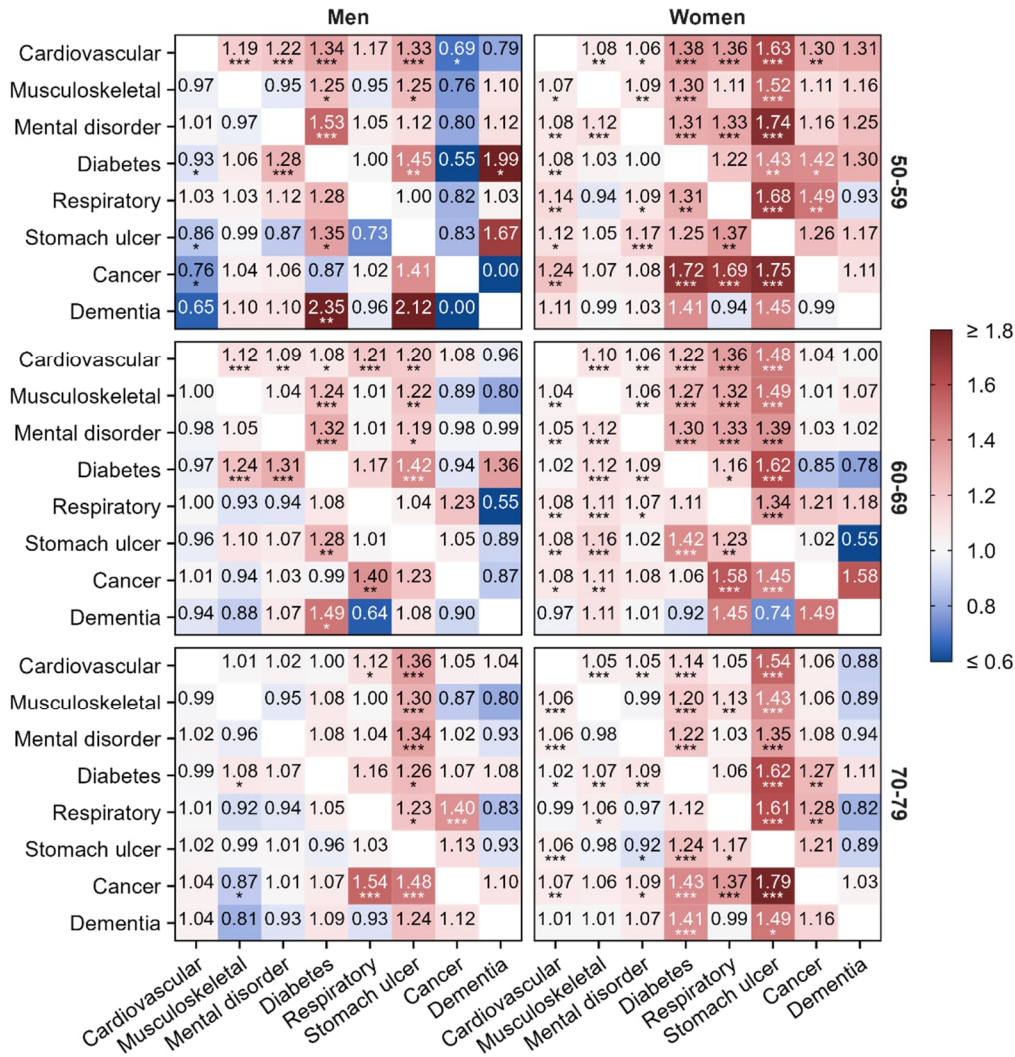


Fig. 3 Relative risks of having the chronic disease on the X-axis given that the condition on the Y-axis is present in immigrants versus in natives by gender and age group.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Geographic Profiles of the Disparities in Multimorbidity between Immigrants and Natives

Figure 4 shows the probability of having chronic disease combinations among immigrants versus among natives with risk ratios by origin country group (details in Table S7-8). In general, immigrants have a higher prevalence of the most chronic disease combinations than natives among women from Eastern Europe. Notably, the patterns of immigrant-native disparities for chronic disease combinations, including those involving stomach ulcers, vary across origin country groups. Immigrant men from the Americas with any sort of chronic disease have a lower risk of developing stomach ulcers compared to their native-born counterparts, while both immigrant men and women from Asia and Oceania, Eastern Europe, and other Europe, regardless of gender, have a higher risk of developing stomach ulcers compared to their native-born counterparts, with only a few

exceptions.

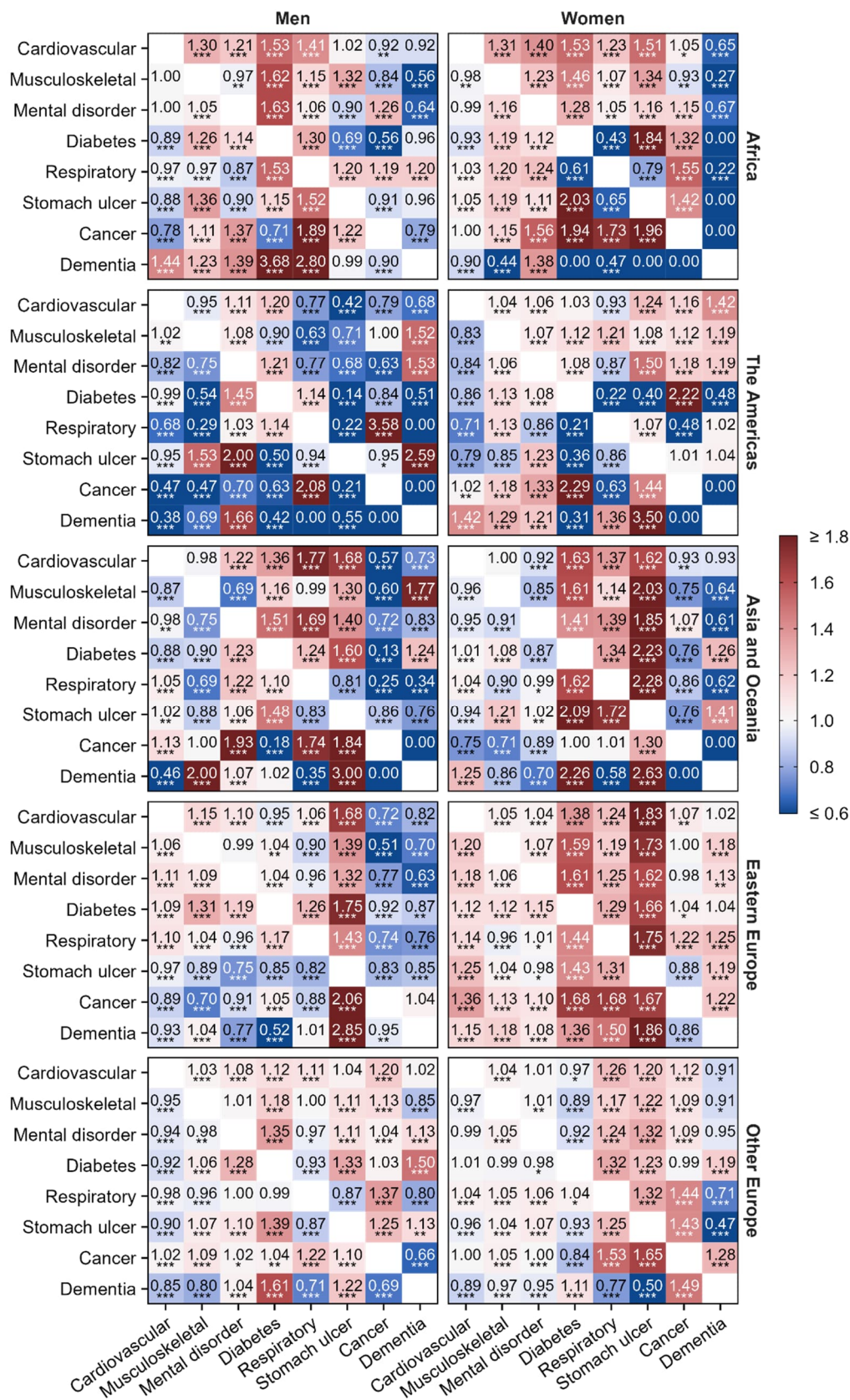


Fig. 4 Relative risks of having the chronic disease on the X-axis given that the condition on the Y-axis is present in immigrants versus in

natives by gender and origin country group. Values are age-standardized using the 2013 European standard population.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

We observe varying patterns of inequalities in multimorbidity between immigrants and natives across the receiving countries (Figure 5; details in Table S9-10). In particular, immigrant-native disparities in stomach ulcer-related combinations show a region-dependent pattern for both genders. The probability of having stomach ulcers when any other chronic disease is present is significantly higher among immigrants than among natives across all genders and regions, except among men living in Southern Europe. This immigrant disadvantage is particularly pronounced among both men and women living in Northern Europe and among women living in Eastern Europe. We also find that compared to native men in Eastern Europe, immigrant men in Eastern Europe have a lower prevalence of all chronic diseases if they have dementia.

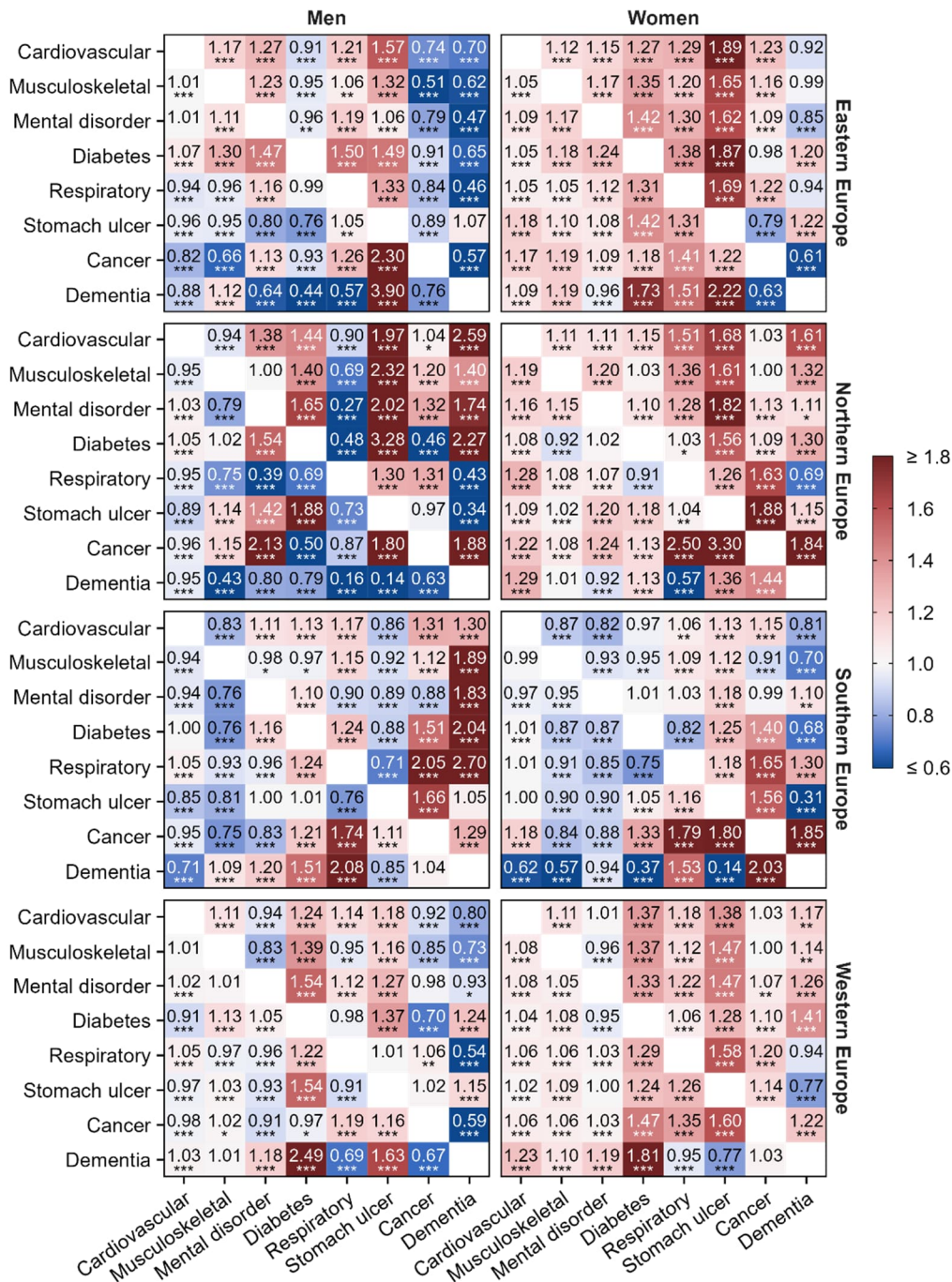


Fig. 5 Relative risks of having the chronic disease on the X-axis given that the condition on the Y-axis is present in immigrants versus natives by gender and receiving country group. Values are age-standardized using the 2013 European standard population.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

DISCUSSION

Findings from this study reveal that inequalities in multimorbidity between immigrants and natives can be amplified for specific disease combinations and also in certain subgroups by gender, age, country of origin, and country of destination. For instance, we find that the combination of stomach ulcers or diabetes with other chronic diseases is more common among immigrants than among natives of both genders. Furthermore, our findings suggest that among women, there is a large immigrant disadvantage for most chronic disease combinations. Broken down by region, our study shows that immigrants face a higher risk of having many chronic disease combinations, especially those including stomach ulcers, when they are from Eastern Europe or Asia/Oceania and when they are living in Northern Europe. Our findings on the different magnitudes of the inequalities between immigrants and natives based on gender, age, country of origin, and country of destination are in line with the theory that because immigrants have heterogeneous experiences throughout their life course, the health outcomes of immigrants may vary across different subgroups [3].

Notably, we observe that immigrants with chronic health conditions that are more prevalent among immigrants than among natives do not necessarily have a higher risk of multimorbidity. For example, while immigrant men have a higher prevalence of diabetes than native men, the risk of multimorbidity among diabetes patients is lower for immigrants, although the difference is not statistically significant. In previous studies, disparities in the risk of multimorbidity between immigrants and natives have been well-established, with immigrants having an overall advantage [8–10]. However, given the discrepancies we observed between individual chronic diseases and multimorbidity, there is a need to investigate immigrant-native disparities by specific chronic disease combinations, particularly to identify the primary source of the inequalities.

Another finding from our study is that several multimorbidity patterns are much more common among immigrants than among natives, which underscores the importance of investigating multimorbidity by including specific chronic health conditions in the estimation. In particular, the findings of this study suggest that immigrants have a higher risk of developing stomach ulcers or diabetes. A potential explanation for these findings is that immigrants have different health-related behaviors compared to natives [28]. Findings from several previous studies have reported that both stomach ulcers and diabetes are closely related to health behaviors, including smoking, alcohol consumption, and an unhealthy diet, and that these relationships exist not only for individual diseases but also for the development of comorbidities based on them [29–36]. Our findings on the immigrant disadvantage for the risk of developing chronic disease combinations that include stomach ulcers and diabetes are well-explained by the differential behaviors of immigrants and natives. However, as

these results are solely based on descriptive analysis, further studies are needed to investigate the association between stomach ulcer- or diabetes-related combinations of chronic disease conditions and the health-related behaviors of immigrants.

In terms of subgroup differences, our findings show that the prevalence of chronic disease combinations is, in general, higher among immigrant women than among their native counterparts, whereas among men, immigrants have disadvantages for some combinations but advantages for others. We also observe that disparities between immigrants and natives decrease with age for certain chronic disease combinations. The existing literature posits that immigrants tend to retain health-related behaviors from their country of origin when they first arrive in the receiving country, but they eventually adopt the norms of the receiving country [28]. This transition usually means moving from healthier to less healthy behavior. For example, as their length of stay in the receiving country increases, the alcohol consumption and smoking rates of immigrants tend to rise [28,37,38]. As a result, while immigrants often arrive in the receiving country in better health than natives, their health advantage tends to decline over time spent in the receiving society [15,39]. Our results partly conform to this narrative, especially for the risk of having cardiovascular diseases or cancer together with several other chronic diseases among men, as we find that immigrants have a lower risk of developing these combinations than natives at younger ages, but that the risk becomes similar at older ages.

However, a convergence between immigrants and natives is not observed for the risk of developing all the disease combinations examined in our study. These heterogeneous age-related trends can be explained by the unhealthy lifestyle of the countries of origin, something that is less discussed in the literature. For instance, immigrants from certain origins may have an unhealthy diet [40,41], and adapting to the diet in the receiving country can actually lead to better health outcomes. This explanation is supported by our finding of persistent immigrant disadvantages even at younger ages for combinations including diabetes or stomach ulcers, which are conditions that are highly associated with dietary patterns [42,43].

Furthermore, our stratified analysis illuminates multimorbidity patterns among immigrants by the origin and the receiving country in comparison to those among the native-born population. One notable finding is that there are regional inequalities in the immigrant-native disparities in stomach ulcer-related combinations. We observe that immigrants have a higher risk of stomach ulcers in the presence of other chronic diseases than natives, especially when they are from Asia or Eastern Europe. In addition, we identify a large immigrant disadvantage for these combinations in Northern Europe. We can interpret these results by examining the health behavior of immigrants, as mentioned above, which differs substantially across countries. In particular,

behavioral risks in Asia and Eastern Europe are known to be highly burdening, as opposed to the healthier lifestyle in Northern Europe [44]. For instance, one of the common characteristics of the Asian diet is the heavy use of spices and sodium, which can exacerbate stomach conditions [40,41]. Moreover, it has been noted that a behavioral transition among immigrants is less apparent for dietary patterns than for other health behaviors [42,43]. Therefore, immigrants are likely to retain some characteristics of the diet from their origin country, which may contribute to the large regional disparities in all combinations that include stomach ulcers. Similarly, the Global Burden of Disease project reports a higher burden of peptic ulcer diseases in Asia and Eastern Europe than in other regions around the world [45]. This is in line with our findings that the immigrant disadvantages in stomach ulcer-related combinations become particularly pronounced for individuals coming from these origins.

Limitations

This study has several limitations. First, as the study focuses on patterns of multimorbidity, the differences in patterns found between immigrants and natives do not necessarily reflect a causal relationship between the immigration background and chronic health outcomes. Second, in this study, we do not consider the order of the onset of chronic health conditions in estimating the prevalence of each chronic disease combination. This is due to the nature of our data. As SHARE contains information on each participant's medical history in the form of self-reported doctor-diagnosed conditions, it is difficult to determine the exact onset point for each condition. Although SHARE does ask participants to report the exact onset points retrospectively, the trustworthiness of this data cannot be guaranteed, as 47% of the total observations have missing information on the variable. Moreover, as many chronic diseases develop over time and exist on a spectrum rather than as a binary outcome of existence/non-existence, it is challenging to determine which condition started developing before the other. However, as some chronic diseases are known risk factors for others in terms of their pathological mechanisms, the sequence of the development of these conditions is still a valid topic for future research, especially among immigrant populations, as the biological traits and the etiology may differ between immigrants and natives.

CONCLUSION

To the best of our knowledge, this is the first cross-national study to describe multimorbidity patterns in immigrants and natives and to compare the immigrant-native disparities in these patterns between subgroups by

gender, age, and region. Our results indicate that the disadvantages of immigrants are greater for certain chronic disease combinations, such as for those including stomach ulcers or diabetes, and among individuals with certain gender-, age-, and region-specific backgrounds, such as women, immigrants living in Northern Europe, and immigrants from Asia or Eastern Europe. Our findings can be used to inform social policy about the size of the health inequalities between immigrants and natives across European regions and to identify the target populations and health conditions that should be prioritized in efforts to reduce the immigrant-native health disparities in aging societies. Furthermore, future studies of the multimorbidity patterns among immigrants should recognize the variabilities between specific disease combinations rather than generalizing about the simultaneous presence of multiple chronic conditions.

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Competing Interests

The authors have no relevant financial or non-financial interests to disclose.

Author Contributions

All authors contributed to the study conception and design. Data curation, formal analysis, and visualization were performed by Su Yeon Jang. The original draft of the manuscript was written by Su Yeon Jang. All authors

commented on the manuscript for the review and editing. All authors read and approved the final manuscript.

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TABLES

Table 1. Descriptive characteristics ^a of the study population

| | Men | | | | Women | | | |
|--|---------|---------|------------|------------|---------|---------|------------|------------|
| | Natives | | Immigrants | | Natives | | Immigrants | |
| | N | % | N | % | N | % | N | % |
| Total | 46,767 | (100.0) | 4,410 | (100.0) | 56,706 | (100.0) | 5,587 | (100.0) |
| Age groups | | | | | | | | |
| 50 - 59 | 18,030 | (38.6) | 1,817 | (41.2) *** | 24,118 | (42.5) | 2,517 | (45.1) *** |
| 60 - 69 | 17,606 | (37.6) | 1,576 | (35.7) * | 19,589 | (34.5) | 1,756 | (31.4) *** |
| 70 - 79 | 11,131 | (23.8) | 1,017 | (23.1) | 12,999 | (22.9) | 1,314 | (23.5) |
| Region of residence ^b | | | | | | | | |
| Eastern Europe | 12,773 | (27.3) | 1,045 | (23.7) *** | 16,548 | (29.2) | 1,538 | (27.5) ** |
| Northern Europe | 5,686 | (12.2) | 333 | (7.6) *** | 6,495 | (11.5) | 432 | (7.7) *** |
| Southern Europe | 13,358 | (28.6) | 827 | (18.8) *** | 16,038 | (28.3) | 978 | (17.5) *** |
| Western and Central Europe | 14,950 | (32.0) | 2,205 | (50.0) *** | 17,625 | (31.1) | 2,639 | (47.2) *** |
| Origin country group ^b | | | | | | | | |
| Africa | | | 481 | (10.9) | | | 476 | (8.5) |
| The Americas | | | 160 | (3.6) | | | 257 | (4.6) |
| Asia and Oceania | | | 286 | (6.5) | | | 299 | (5.4) |
| Eastern Europe | | | 1,369 | (31.0) | | | 2,068 | (37.0) |
| Other European countries | | | 2,114 | (47.9) | | | 2,487 | (44.5) |
| Ever had chronic diseases ^c | | | | | | | | |
| 50 - 59 | 12,550 | (26.8) | 1,295 | (29.4) *** | 17,849 | (31.5) | 1,895 | (33.9) *** |
| 60 - 69 | 14,603 | (31.2) | 1,343 | (30.5) | 17,085 | (30.1) | 1,563 | (28.0) *** |
| 70 - 79 | 9,890 | (21.1) | 908 | (20.6) | 12,059 | (21.3) | 1,229 | (22.0) |
| Ever had multimorbidity ^c | | | | | | | | |
| 50 - 59 | 6,746 | (14.4) | 741 | (16.8) *** | 10,676 | (18.8) | 1,257 | (22.5) *** |
| 60 - 69 | 9,317 | (19.9) | 884 | (20.0) | 12,146 | (21.4) | 1,173 | (21.0) |
| 70 - 79 | 6,488 | (13.9) | 626 | (14.2) | 9,119 | (16.1) | 1,001 | (17.9) *** |

* p < 0.05; ** p < 0.01; *** p < 0.001

^a Unweighted observations of samples

^b Detailed list of included countries can be found in Table S1.

^c Age-specific estimation

Table 2. Top 10 chronic disease combinations with the leading immigrant-native gap by gender (in percentages)

| Rank | Men | | | | | | Women | | | | | | | |
|------|-----------------|-----------------|------|--------|------|----------------------|-------------------------|-----------------|----------------|-----|--------|-----|----------------------|-------------------------|
| | Condition 1 | Condition 2 | RD | 95% CI | | Natives ^a | Immigrants ^a | Condition 1 | Condition 2 | RD | 95% CI | | Natives ^a | Immigrants ^a |
| 1 | Dementia | Diabetes | 14.3 | 13.6 | 14.9 | 22.9 | 37.2 | Respiratory | Stomach ulcer | 7.5 | 6.9 | 8.0 | 14.0 | 21.5 |
| 2 | Dementia | Stomach ulcer | 7.4 | 6.8 | 7.9 | 14.9 | 22.3 | Cancer | Respiratory | 7.1 | 6.6 | 7.7 | 13.2 | 20.3 |
| 3 | Diabetes | Mental disorder | 6.5 | 5.9 | 7.0 | 27.7 | 34.2 | Cancer | Stomach ulcer | 7.0 | 6.5 | 7.5 | 10.6 | 17.6 |
| 4 | Mental disorder | Diabetes | 5.5 | 5.0 | 6.1 | 19.5 | 25.0 | Cancer | Cardiovascular | 6.7 | 6.1 | 7.4 | 55.5 | 62.2 |
| 5 | Cancer | Respiratory | 4.7 | 4.1 | 5.2 | 15.4 | 20.0 | Diabetes | Stomach ulcer | 5.8 | 5.4 | 6.3 | 10.7 | 16.5 |
| 6 | Cancer | Stomach ulcer | 4.3 | 3.8 | 4.8 | 11.7 | 16.0 | Mental disorder | Stomach ulcer | 5.8 | 5.3 | 6.4 | 11.8 | 17.6 |
| 7 | Diabetes | Musculoskeletal | 4.1 | 3.5 | 4.8 | 32.1 | 36.2 | Musculoskeletal | Stomach ulcer | 5.5 | 4.9 | 6.0 | 11.2 | 16.7 |
| 8 | Diabetes | Stomach ulcer | 3.7 | 3.2 | 4.2 | 9.5 | 13.2 | Stomach ulcer | Cardiovascular | 5.4 | 4.7 | 6.1 | 63.7 | 69.1 |
| 9 | Musculoskeletal | Diabetes | 3.5 | 3.0 | 4.1 | 19.3 | 22.8 | Stomach ulcer | Diabetes | 5.3 | 4.8 | 5.9 | 17.5 | 22.8 |
| 10 | Stomach ulcer | Diabetes | 3.5 | 3.0 | 4.0 | 18.2 | 21.7 | Cancer | Diabetes | 5.2 | 4.7 | 5.8 | 14.8 | 20.0 |

* p < 0.05; ** p < 0.01; *** p < 0.001

^a Estimated based on the conditional probability of having condition 2 given that condition 1 is present.

Note: Values are age-standardized using the 2013 European standard population.

Abbreviations: RD = risk difference

Supplementary Materials

Table S1. Description of categorization for selected variables

| Variable | Description |
|-----------------------------|--|
| Origin country-group | |
| Africa | Africa, Algeria, Angola, Benin, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Congo, Congo (Democratic Republic of), Congo (Republic of), Cote d'Ivoire, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Ethiopia (before Eritrea broke away), Former Protectorate of Northern Rhodesia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Libyan Arab Jamahiriya, Madagascar, Mali, Mauritania, Mauritius, Morocco, Mozambique, Nigeria, Reunion, Rwanda, Sao Tome and Principe, Senegal, Somalia, South Africa, Sudan, Tanzania (United Republic of), Togo, Tunisia, Zambia, Zimbabwe |
| The Americas | Argentina, Aruba, Bolivia, Brazil, Canada, Chile, Colombia, Costa Rica, Cuba, Curaçao, Dominican Republic, Ecuador, El Salvador, French Guiana, Greenland, Grenada, Guadeloupe, Haiti, Honduras, Martinique, Mexico, Netherlands Antilles, Paraguay, Peru, Suriname, United States of America, Uruguay, Venezuela |
| Asia and Oceania | Afghanistan, Afghan-Turkish, Australia, Bangladesh, Bhutan, Borneo Island, Cambodia, China, Former Netherlands East-Indies, French Polynesia, Hong Kong, India, Indonesia, Iran (Islamic Republic of), Iraq, Israel, Japan, Jordan, Korea (Republic of), Lao People's Democratic Republic, Lebanon, Macau, Malaysia, Minor Asia, New Zealand, Pakistan, Palestinian Territory (occupied), Philippines, Singapore, Sri Lanka, Syrian Arab Republic, Taiwan, Thailand, Turkey, Turkish-Kurdish, Viet Nam |
| Eastern Europe ¹ | Armenia, Azerbaijan, Belarus, Bulgaria, Chechnya, Czech Republic, Czechoslovakia, Estonia, Former Eastern Territory of German Reich, Georgia, Hungary, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Republic of, Poland, Romania, Russian Federation, Slovakia, Tajikistan, Turkmenistan, Ukraine, Union of Soviet Socialist Republics, Uzbekistan |
| Other European countries | Albania, Austria, Belgium, Bosnia and Herzegovina, Croatia, Cyprus, Denmark, Faroe Islands, Finland, Former Territories of German Reich, France, German Spanish, Germany, Greece, Iceland, Ireland, Italy, Kosovo, Liechtenstein, Luxembourg, Macedonia (former Yugoslav Republic of), Malta, Monaco, Montenegro, Netherlands, Norway, Portugal, Serbia, Slovenia, Socialist Federal Republic of Yugoslavia, Spain, Sweden, Switzerland, United Kingdom |
| Region of residence | |
| Eastern Europe ^a | Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia |
| Northern Europe | Denmark, Finland, Ireland, Sweden |
| Southern Europe | Croatia, Cyprus, Greece, Italy, Malta, Portugal, Slovenia, Spain |
| Western/central Europe | Austria, Belgium, France, Germany, Luxembourg, Netherlands, Switzerland |
| Chronic disease groups | |
| Cancer | Diagnoses: cancer or malignant tumor |
| Cardiovascular diseases | Diagnoses: heart attack (including myocardial infarction, coronary thrombosis, or any other heart problem including congestive heart failure), high blood pressure or hypertension, stroke, and/or cerebral vascular disease; Medication: drugs for high blood pressure, coronary or cerebrovascular diseases, and/or other heart diseases |
| Diabetes | Diagnoses: diabetes and/or high blood sugar; Medication: drugs for diabetes |

| | |
|--------------------------|--|
| Dementia | Diagnoses: Alzheimer's disease, dementia, organic brain syndrome, senility or any other serious memory impairment, Parkinson's disease |
| Mental disorders | Diagnoses: affective or emotional disorders including anxiety, nervous, or psychiatric problems; Medication: drugs for sleep problems, anxiety, and/or depression; Other criteria: depression for two weeks or longer, ever treated for depression |
| Musculoskeletal diseases | Diagnoses: arthritis, rheumatoid arthritis, osteoarthritis, and/or other rheumatism, osteoporosis, hip fracture, and/or femoral fracture; Medication: drugs for osteoporosis (hormonal and non-hormonal) |
| Respiratory diseases | Diagnoses: chronic lung disease (e.g., chronic bronchitis or emphysema) and/or asthma; Medication: drugs for chronic bronchitis and/or asthma |
| Stomach ulcer | Diagnoses: stomach ulcer, duodenal ulcer, and/or peptic ulcer |

^a Including the former Soviet republics

Table S2. Age-standardized prevalence ^a of chronic diseases ^b by gender and immigrant status (in percentages)

| Rank | Men | | | | | | Women | | | | | | | | | |
|------|----------------------------|-------|--------|----------------------------|-----------------|--------|----------------------------|-------|-----------------|----------------------------|-------|--------|-----------------|-------|-------|-------|
| | Natives | | | Immigrants | | | Natives | | | Immigrants | | | | | | |
| | Disease group ^b | Prev. | 95% CI | Disease group ^b | Prev. | 95% CI | Disease group ^b | Prev. | 95% CI | Disease group ^b | Prev. | 95% CI | | | | |
| 1 | Cardiovascular | 54.85 | 54.31 | 55.36 | Cardiovascular | 54.61 | 54.08 | 55.12 | Cardiovascular | 52.04 | 51.51 | 52.55 | Cardiovascular | 55.37 | 54.84 | 55.89 |
| 2 | Musculoskeletal | 25.46 | 25.01 | 25.93 | Musculoskeletal | 28.12 | 27.66 | 28.60 | Musculoskeletal | 42.94 | 42.44 | 43.47 | Musculoskeletal | 46.67 | 46.17 | 47.20 |
| 3 | Mental disorder | 21.59 | 21.17 | 22.05 | Mental disorder | 23.87 | 23.44 | 24.33 | Mental disorder | 36.58 | 36.09 | 37.09 | Mental disorder | 38.81 | 38.32 | 39.34 |
| 4 | Diabetes | 15.44 | 15.08 | 15.84 | Diabetes | 17.74 | 17.35 | 18.15 | Diabetes | 12.54 | 12.20 | 12.90 | Diabetes | 15.72 | 15.36 | 16.12 |
| 5 | Respiratory | 9.88 | 9.56 | 10.20 | Respiratory | 11.30 | 10.98 | 11.64 | Respiratory | 9.86 | 9.55 | 10.18 | Respiratory | 12.26 | 11.92 | 12.61 |
| 6 | Stomach ulcer | 7.86 | 7.57 | 8.14 | Stomach ulcer | 10.67 | 10.35 | 11.00 | Cancer | 8.02 | 7.73 | 8.31 | Stomach ulcer | 11.27 | 10.94 | 11.61 |
| 7 | Cancer | 6.59 | 6.33 | 6.86 | Cancer | 6.65 | 6.38 | 6.91 | Stomach ulcer | 7.41 | 7.13 | 7.69 | Cancer | 8.50 | 8.20 | 8.80 |
| 8 | Dementia | 2.01 | 1.86 | 2.15 | Dementia | 2.08 | 1.93 | 2.23 | Dementia | 1.85 | 1.71 | 1.99 | Dementia | 1.86 | 1.72 | 2.00 |

^a Values are age-standardized using the 2013 European standard population.

^b Circulatory diseases = Heart attack including myocardial infarction or coronary thrombosis or any other heart problem including congestive heart failure, high blood pressure or hypertension, and stroke; Musculoskeletal diseases = Rheumatoid arthritis, osteoarthritis, and osteoporosis; Mental disorder = Affective or emotional disorders, including anxiety, nervous or psychiatric problems; Respiratory diseases = Chronic lung disease such as chronic bronchitis or emphysema and asthma; Dementia = Alzheimer's disease, dementia, organic brain syndrome, senility, or any other serious memory impairment and Parkinson's disease

Abbreviations: Prev. = prevalence

Table S3. Age-standardized prevalence ^a of multimorbidity given that a chronic disease ^b is present by gender and immigrant status (in percentages)

| Rank | Men | | | | | | Women | | | | | | | | | |
|------|----------------------------|-------|--------|----------------------------|-----------------|--------|----------------------------|-------|-----------------|----------------------------|-------|--------|-----------------|-------|-------|-------|
| | Natives | | | Immigrants | | | Natives | | | Immigrants | | | | | | |
| | Disease group ^b | Prev. | 95% CI | Disease group ^b | Prev. | 95% CI | Disease group ^b | Prev. | 95% CI | Disease group ^b | Prev. | 95% CI | | | | |
| 1 | Dementia | 91.54 | 91.24 | 91.84 | Dementia | 90.68 | 90.37 | 90.99 | Dementia | 95.97 | 95.77 | 96.17 | Dementia | 96.18 | 95.99 | 96.38 |
| 2 | Diabetes | 87.89 | 87.54 | 88.23 | Respiratory | 87.69 | 87.34 | 88.03 | Diabetes | 93.07 | 92.79 | 93.34 | Respiratory | 94.79 | 94.55 | 95.02 |
| 3 | Respiratory | 85.52 | 85.14 | 85.88 | Diabetes | 87.36 | 87.01 | 87.70 | Stomach ulcer | 91.86 | 91.56 | 92.15 | Stomach ulcer | 94.76 | 94.52 | 94.99 |
| 4 | Stomach ulcer | 85.34 | 84.96 | 85.70 | Stomach ulcer | 85.99 | 85.61 | 86.34 | Respiratory | 91.10 | 90.79 | 91.40 | Diabetes | 94.43 | 94.19 | 94.67 |
| 5 | Cancer | 81.80 | 81.39 | 82.17 | Mental disorder | 81.84 | 81.43 | 82.21 | Cancer | 84.34 | 83.95 | 84.71 | Cancer | 89.86 | 89.54 | 90.17 |
| 6 | Mental disorder | 81.25 | 80.82 | 81.65 | Cancer | 81.66 | 81.23 | 82.05 | Mental disorder | 82.39 | 81.98 | 82.78 | Mental disorder | 85.84 | 85.46 | 86.19 |
| 7 | Musculoskeletal | 80.57 | 80.13 | 80.97 | Musculoskeletal | 80.13 | 79.70 | 80.54 | Musculoskeletal | 81.59 | 81.16 | 81.96 | Musculoskeletal | 84.69 | 84.30 | 85.06 |
| 8 | Cardiovascular | 62.95 | 62.44 | 63.45 | Cardiovascular | 68.58 | 68.09 | 69.05 | Cardiovascular | 74.60 | 74.14 | 75.05 | Cardiovascular | 78.93 | 78.49 | 79.35 |

^a Values are age-standardized using the 2013 European standard population.

^b Circulatory diseases = Heart attack including myocardial infarction or coronary thrombosis or any other heart problem including congestive heart failure, high blood pressure or hypertension, and stroke; Musculoskeletal diseases = Rheumatoid arthritis, osteoarthritis, and osteoporosis; Mental disorder = Affective or emotional disorders, including anxiety, nervous or psychiatric problems; Respiratory diseases = Chronic lung disease such as chronic bronchitis or emphysema and asthma; Dementia = Alzheimer's disease, dementia, organic brain syndrome, senility, or any other serious memory impairment and Parkinson's disease

Abbreviations: Prev. = prevalence

Table S4. Conditional probability (in percentages) ^a and relative risk of chronic disease combinations by immigrant status and gender

| Condition 1 | Condition 2 | Men | | | | Women | | | |
|-----------------|-----------------|---------|------------|------|-----------|---------|------------|------|-----------|
| | | Natives | Immigrants | RR | 95% CI | Natives | Immigrants | RR | 95% CI |
| Cardiovascular | Musculoskeletal | 29.72 | 32.81 | 1.10 | 1.08 1.13 | 48.69 | 52.43 | 1.08 | 1.06 1.10 |
| Cardiovascular | Mental disorder | 25.07 | 28.12 | 1.12 | 1.10 1.15 | 41.51 | 43.82 | 1.06 | 1.04 1.07 |
| Cardiovascular | Diabetes | 21.75 | 24.70 | 1.14 | 1.11 1.16 | 18.81 | 23.31 | 1.24 | 1.20 1.27 |
| Cardiovascular | Respiratory | 11.94 | 13.92 | 1.17 | 1.12 1.21 | 12.40 | 15.61 | 1.26 | 1.21 1.31 |
| Cardiovascular | Stomach ulcer | 9.26 | 11.96 | 1.29 | 1.24 1.35 | 9.16 | 14.21 | 1.55 | 1.49 1.62 |
| Cardiovascular | Cancer | 7.29 | 7.13 | 0.98 | 0.94 1.02 | 8.56 | 9.59 | 1.12 | 1.07 1.17 |
| Cardiovascular | Dementia | 2.46 | 2.39 | 0.97 | 0.89 1.06 | 2.32 | 2.30 | 0.99 | 0.90 1.09 |
| Musculoskeletal | Cardiovascular | 64.14 | 63.45 | 0.99 | 0.98 1.00 | 58.92 | 62.16 | 1.05 | 1.04 1.07 |
| Musculoskeletal | Mental disorder | 31.71 | 31.12 | 0.98 | 0.96 1.00 | 47.85 | 50.28 | 1.05 | 1.03 1.07 |
| Musculoskeletal | Diabetes | 19.28 | 22.83 | 1.18 | 1.15 1.22 | 15.07 | 18.88 | 1.25 | 1.21 1.30 |
| Musculoskeletal | Respiratory | 15.84 | 15.61 | 0.99 | 0.95 1.02 | 14.28 | 16.91 | 1.18 | 1.15 1.23 |
| Musculoskeletal | Stomach ulcer | 12.65 | 15.84 | 1.25 | 1.21 1.30 | 11.23 | 16.68 | 1.49 | 1.43 1.54 |
| Musculoskeletal | Cancer | 7.94 | 6.80 | 0.86 | 0.81 0.90 | 9.38 | 9.90 | 1.06 | 1.01 1.10 |
| Musculoskeletal | Dementia | 2.91 | 2.49 | 0.86 | 0.79 0.94 | 2.30 | 2.27 | 0.99 | 0.90 1.08 |
| Mental disorder | Cardiovascular | 63.11 | 63.30 | 1.00 | 0.99 1.01 | 58.35 | 61.92 | 1.06 | 1.05 1.07 |
| Mental disorder | Musculoskeletal | 36.83 | 36.57 | 0.99 | 0.97 1.01 | 55.44 | 59.46 | 1.07 | 1.06 1.09 |
| Mental disorder | Diabetes | 19.49 | 25.04 | 1.28 | 1.25 1.32 | 15.54 | 19.74 | 1.27 | 1.23 1.31 |
| Mental disorder | Respiratory | 16.52 | 17.10 | 1.04 | 1.00 1.07 | 14.67 | 18.07 | 1.23 | 1.19 1.27 |
| Mental disorder | Stomach ulcer | 14.12 | 17.06 | 1.21 | 1.17 1.25 | 11.80 | 17.64 | 1.49 | 1.44 1.55 |
| Mental disorder | Cancer | 9.29 | 8.89 | 0.96 | 0.92 1.00 | 10.09 | 10.97 | 1.09 | 1.04 1.13 |
| Mental disorder | Dementia | 5.02 | 4.94 | 0.98 | 0.92 1.04 | 3.33 | 3.38 | 1.02 | 0.94 1.10 |
| Diabetes | Cardiovascular | 78.54 | 75.50 | 0.96 | 0.95 0.97 | 79.85 | 83.17 | 1.04 | 1.04 1.05 |
| Diabetes | Musculoskeletal | 32.08 | 36.20 | 1.13 | 1.11 1.15 | 52.64 | 56.52 | 1.07 | 1.06 1.09 |
| Diabetes | Mental disorder | 27.68 | 34.15 | 1.23 | 1.21 1.26 | 46.57 | 49.18 | 1.06 | 1.04 1.07 |
| Diabetes | Respiratory | 13.74 | 15.23 | 1.11 | 1.07 1.15 | 16.33 | 18.88 | 1.16 | 1.12 1.19 |
| Diabetes | Stomach ulcer | 9.51 | 13.20 | 1.39 | 1.33 1.45 | 10.66 | 16.51 | 1.55 | 1.49 1.61 |
| Diabetes | Cancer | 7.79 | 6.95 | 0.89 | 0.85 0.94 | 9.52 | 10.89 | 1.14 | 1.10 1.19 |
| Diabetes | Dementia | 2.85 | 3.79 | 1.33 | 1.23 1.44 | 3.07 | 3.16 | 1.03 | 0.95 1.12 |
| Respiratory | Cardiovascular | 66.49 | 67.47 | 1.01 | 1.01 1.02 | 64.91 | 69.43 | 1.07 | 1.06 1.08 |
| Respiratory | Musculoskeletal | 40.84 | 39.20 | 0.96 | 0.94 0.98 | 61.72 | 64.04 | 1.04 | 1.03 1.05 |
| Respiratory | Mental disorder | 36.90 | 37.40 | 1.01 | 0.99 1.03 | 55.09 | 57.85 | 1.05 | 1.04 1.06 |
| Respiratory | Diabetes | 21.26 | 24.05 | 1.13 | 1.10 1.16 | 19.91 | 23.33 | 1.17 | 1.14 1.20 |
| Respiratory | Stomach ulcer | 15.33 | 16.53 | 1.08 | 1.04 1.11 | 14.01 | 21.47 | 1.53 | 1.49 1.58 |
| Respiratory | Cancer | 9.79 | 11.67 | 1.19 | 1.14 1.24 | 10.71 | 14.02 | 1.31 | 1.26 1.36 |
| Respiratory | Dementia | 3.59 | 2.85 | 0.79 | 0.73 0.86 | 3.14 | 2.99 | 0.95 | 0.87 1.03 |
| Stomach ulcer | Cardiovascular | 64.04 | 60.75 | 0.95 | 0.94 0.96 | 63.70 | 69.10 | 1.08 | 1.07 1.10 |
| Stomach ulcer | Musculoskeletal | 40.37 | 41.55 | 1.03 | 1.01 1.05 | 64.40 | 68.56 | 1.06 | 1.06 1.07 |
| Stomach ulcer | Mental disorder | 39.14 | 38.10 | 0.97 | 0.96 0.99 | 58.58 | 61.50 | 1.05 | 1.04 1.06 |
| Stomach ulcer | Respiratory | 19.03 | 17.68 | 0.93 | 0.90 0.96 | 18.58 | 23.33 | 1.26 | 1.22 1.29 |
| Stomach ulcer | Diabetes | 18.19 | 21.68 | 1.19 | 1.16 1.22 | 17.48 | 22.82 | 1.31 | 1.27 1.34 |
| Stomach ulcer | Cancer | 9.62 | 9.99 | 1.04 | 1.00 1.08 | 11.43 | 13.21 | 1.16 | 1.11 1.20 |
| Stomach ulcer | Dementia | 3.46 | 3.62 | 1.05 | 0.97 1.13 | 3.12 | 2.64 | 0.85 | 0.78 0.92 |
| Cancer | Cardiovascular | 61.96 | 58.21 | 0.94 | 0.93 0.95 | 55.50 | 62.24 | 1.12 | 1.11 1.13 |
| Cancer | Mental disorder | 31.60 | 32.77 | 1.04 | 1.01 1.06 | 46.47 | 50.35 | 1.08 | 1.07 1.10 |
| Cancer | Musculoskeletal | 30.87 | 29.12 | 0.94 | 0.92 0.96 | 50.19 | 54.25 | 1.08 | 1.07 1.09 |
| Cancer | Diabetes | 18.73 | 18.31 | 0.98 | 0.95 1.01 | 14.77 | 19.97 | 1.35 | 1.31 1.40 |
| Cancer | Respiratory | 15.35 | 20.03 | 1.30 | 1.26 1.34 | 13.15 | 20.28 | 1.54 | 1.49 1.59 |
| Cancer | Stomach ulcer | 11.66 | 15.95 | 1.37 | 1.32 1.42 | 10.64 | 17.62 | 1.66 | 1.60 1.72 |
| Cancer | Dementia | 2.83 | 2.20 | 0.78 | 0.71 0.85 | 2.17 | 2.56 | 1.18 | 1.08 1.29 |
| Dementia | Cardiovascular | 70.96 | 61.94 | 0.87 | 0.86 0.88 | 70.76 | 72.95 | 1.03 | 1.02 1.04 |
| Dementia | Mental disorder | 61.32 | 64.75 | 1.06 | 1.04 1.07 | 72.47 | 74.93 | 1.03 | 1.03 1.04 |
| Dementia | Musculoskeletal | 39.78 | 37.30 | 0.94 | 0.92 0.95 | 58.12 | 60.21 | 1.04 | 1.02 1.05 |
| Dementia | Diabetes | 22.90 | 37.19 | 1.62 | 1.59 1.66 | 22.03 | 26.55 | 1.21 | 1.17 1.24 |
| Dementia | Respiratory | 19.49 | 16.45 | 0.84 | 0.82 0.87 | 19.41 | 21.85 | 1.13 | 1.09 1.16 |

| | | | | | | | | | | | |
|----------|---------------|-------|-------|------|------|------|-------|-------|------|------|------|
| Dementia | Stomach ulcer | 14.93 | 22.30 | 1.49 | 1.45 | 1.54 | 14.32 | 17.43 | 1.22 | 1.17 | 1.26 |
| Dementia | Cancer | 9.72 | 6.89 | 0.71 | 0.68 | 0.75 | 9.77 | 11.82 | 1.21 | 1.16 | 1.26 |

* p < 0.05; ** p < 0.01; *** p < 0.001

^a Probability of having condition 2 given that condition 1 is already present.

Note: Values are age-standardized using the 2013 European standard population.

Abbreviations: RR = relative risk; CI = confidence interval

Table S5. Conditional probability (in percentages) ^a and relative risk of chronic disease combinations by immigrant status and age group among men

| Condition 1 | Condition 2 | 50-59 | | | | 60-69 | | | | 70-79 | | | |
|-----------------|-----------------|---------|------------|------|-----------|---------|------------|------|-----------|---------|------------|------|-----------|
| | | Natives | Immigrants | RR | 95% CI | Natives | Immigrants | RR | 95% CI | Natives | Immigrants | RR | 95% CI |
| Cardiovascular | Mental disorder | 24.50 | 29.78 | 1.22 | 1.11 1.32 | 25.18 | 27.56 | 1.09 | 1.02 1.17 | 25.79 | 26.36 | 1.02 | 0.95 1.09 |
| Cardiovascular | Musculoskeletal | 23.09 | 27.47 | 1.19 | 1.08 1.30 | 31.01 | 34.82 | 1.12 | 1.06 1.18 | 38.02 | 38.26 | 1.01 | 0.96 1.06 |
| Cardiovascular | Diabetes | 16.99 | 22.77 | 1.34 | 1.20 1.48 | 23.51 | 25.47 | 1.08 | 1.01 1.16 | 26.61 | 26.60 | 1.00 | 0.93 1.06 |
| Cardiovascular | Respiratory | 9.69 | 11.31 | 1.17 | 0.97 1.35 | 11.98 | 14.51 | 1.21 | 1.10 1.33 | 15.28 | 17.09 | 1.12 | 1.02 1.22 |
| Cardiovascular | Stomach ulcer | 8.63 | 11.46 | 1.33 | 1.11 1.54 | 9.11 | 10.88 | 1.20 | 1.06 1.33 | 10.39 | 14.09 | 1.36 | 1.23 1.49 |
| Cardiovascular | Cancer | 4.06 | 2.79 | 0.69 | 0.48 0.93 | 7.26 | 7.81 | 1.08 | 0.93 1.22 | 12.18 | 12.79 | 1.05 | 0.94 1.16 |
| Cardiovascular | Dementia | 1.10 | 0.88 | 0.79 | 0.35 1.36 | 2.09 | 2.01 | 0.96 | 0.70 1.24 | 4.95 | 5.14 | 1.04 | 0.86 1.22 |
| Musculoskeletal | Cardiovascular | 51.03 | 49.57 | 0.97 | 0.90 1.05 | 67.54 | 67.66 | 1.00 | 0.97 1.04 | 79.44 | 78.88 | 0.99 | 0.96 1.02 |
| Musculoskeletal | Mental disorder | 31.72 | 30.17 | 0.95 | 0.84 1.06 | 31.97 | 33.33 | 1.04 | 0.96 1.12 | 31.37 | 29.72 | 0.95 | 0.86 1.03 |
| Musculoskeletal | Diabetes | 14.08 | 17.53 | 1.25 | 1.03 1.47 | 20.45 | 25.29 | 1.24 | 1.12 1.35 | 25.60 | 27.63 | 1.08 | 0.97 1.18 |
| Musculoskeletal | Respiratory | 13.36 | 12.64 | 0.95 | 0.75 1.14 | 15.89 | 16.02 | 1.01 | 0.89 1.14 | 19.47 | 19.53 | 1.00 | 0.89 1.12 |
| Musculoskeletal | Stomach ulcer | 12.18 | 15.23 | 1.25 | 1.01 1.49 | 12.79 | 15.56 | 1.22 | 1.06 1.38 | 13.17 | 17.11 | 1.30 | 1.14 1.47 |
| Musculoskeletal | Cancer | 3.95 | 3.02 | 0.76 | 0.45 1.15 | 8.16 | 7.28 | 0.89 | 0.71 1.07 | 13.66 | 11.85 | 0.87 | 0.73 1.00 |
| Musculoskeletal | Dementia | 1.44 | 1.58 | 1.10 | 0.50 1.97 | 2.49 | 1.99 | 0.80 | 0.50 1.18 | 5.64 | 4.51 | 0.80 | 0.59 1.02 |
| Mental disorder | Cardiovascular | 48.50 | 48.95 | 1.01 | 0.94 1.08 | 66.54 | 65.21 | 0.98 | 0.94 1.03 | 80.67 | 82.41 | 1.02 | 0.99 1.06 |
| Mental disorder | Musculoskeletal | 28.42 | 27.49 | 0.97 | 0.86 1.08 | 38.78 | 40.58 | 1.05 | 0.97 1.12 | 46.96 | 45.06 | 0.96 | 0.88 1.03 |
| Mental disorder | Respiratory | 13.34 | 14.01 | 1.05 | 0.85 1.25 | 16.84 | 17.07 | 1.01 | 0.88 1.15 | 20.87 | 21.77 | 1.04 | 0.91 1.18 |
| Mental disorder | Stomach ulcer | 13.13 | 14.66 | 1.12 | 0.91 1.32 | 14.11 | 16.79 | 1.19 | 1.04 1.35 | 15.63 | 21.01 | 1.34 | 1.16 1.53 |
| Mental disorder | Diabetes | 13.05 | 20.03 | 1.53 | 1.30 1.77 | 20.77 | 27.33 | 1.32 | 1.18 1.45 | 27.50 | 29.62 | 1.08 | 0.96 1.19 |
| Mental disorder | Cancer | 5.10 | 4.06 | 0.80 | 0.52 1.09 | 9.52 | 9.33 | 0.98 | 0.78 1.17 | 15.29 | 15.57 | 1.02 | 0.84 1.19 |
| Mental disorder | Dementia | 2.58 | 2.88 | 1.12 | 0.66 1.64 | 4.26 | 4.20 | 0.99 | 0.70 1.28 | 9.67 | 8.99 | 0.93 | 0.72 1.14 |
| Diabetes | Cardiovascular | 70.87 | 66.05 | 0.93 | 0.87 1.00 | 80.83 | 78.11 | 0.97 | 0.93 1.00 | 87.11 | 86.33 | 0.99 | 0.96 1.02 |
| Diabetes | Mental disorder | 27.50 | 35.33 | 1.28 | 1.11 1.46 | 27.03 | 35.43 | 1.31 | 1.18 1.44 | 28.78 | 30.75 | 1.07 | 0.94 1.18 |
| Diabetes | Musculoskeletal | 26.57 | 28.18 | 1.06 | 0.89 1.23 | 32.27 | 39.90 | 1.24 | 1.13 1.34 | 40.10 | 43.50 | 1.08 | 1.00 1.17 |
| Diabetes | Respiratory | 11.76 | 11.78 | 1.00 | 0.73 1.28 | 13.77 | 16.08 | 1.17 | 0.99 1.36 | 16.66 | 19.32 | 1.16 | 0.98 1.34 |
| Diabetes | Stomach ulcer | 9.41 | 13.63 | 1.45 | 1.09 1.83 | 9.17 | 13.06 | 1.42 | 1.16 1.69 | 10.10 | 12.75 | 1.26 | 1.01 1.51 |
| Diabetes | Cancer | 5.07 | 2.77 | 0.55 | 0.27 0.92 | 7.47 | 7.01 | 0.94 | 0.70 1.18 | 12.28 | 13.14 | 1.07 | 0.86 1.28 |
| Diabetes | Dementia | 1.39 | 2.77 | 1.99 | 0.92 3.48 | 2.22 | 3.02 | 1.36 | 0.82 2.00 | 5.85 | 6.31 | 1.08 | 0.79 1.40 |
| Respiratory | Cardiovascular | 54.93 | 56.80 | 1.03 | 0.91 1.15 | 69.02 | 69.17 | 1.00 | 0.95 1.06 | 80.60 | 81.31 | 1.01 | 0.97 1.05 |
| Respiratory | Mental disorder | 38.18 | 42.80 | 1.12 | 0.95 1.29 | 36.73 | 34.40 | 0.94 | 0.83 1.05 | 35.20 | 33.14 | 0.94 | 0.82 1.06 |
| Respiratory | Musculoskeletal | 34.26 | 35.20 | 1.03 | 0.84 1.21 | 42.05 | 39.29 | 0.93 | 0.84 1.03 | 49.17 | 45.09 | 0.92 | 0.83 1.00 |
| Respiratory | Diabetes | 15.98 | 20.40 | 1.28 | 0.95 1.62 | 23.08 | 25.00 | 1.08 | 0.92 1.25 | 26.85 | 28.32 | 1.05 | 0.91 1.20 |
| Respiratory | Stomach ulcer | 14.00 | 14.00 | 1.00 | 0.71 1.35 | 16.23 | 16.92 | 1.04 | 0.83 1.25 | 16.17 | 19.85 | 1.23 | 0.99 1.47 |
| Respiratory | Cancer | 6.35 | 5.20 | 0.82 | 0.40 1.34 | 10.09 | 12.41 | 1.23 | 0.94 1.55 | 14.59 | 20.42 | 1.40 | 1.14 1.65 |
| Respiratory | Dementia | 1.94 | 2.00 | 1.03 | 0.21 2.22 | 3.10 | 1.69 | 0.55 | 0.23 0.99 | 6.70 | 5.59 | 0.83 | 0.54 1.17 |

| | | | | | | | | | | | | | | | | |
|---------------|-----------------|-------|-------|------|------|------|-------|-------|------|------|------|-------|-------|------|------|------|
| Stomach ulcer | Cardiovascular | 52.31 | 45.00 | 0.86 | 0.76 | 0.98 | 65.85 | 63.30 | 0.96 | 0.89 | 1.03 | 79.34 | 81.12 | 1.02 | 0.97 | 1.07 |
| Stomach ulcer | Mental disorder | 40.22 | 35.00 | 0.87 | 0.73 | 1.01 | 38.62 | 41.28 | 1.07 | 0.94 | 1.18 | 38.16 | 38.69 | 1.01 | 0.89 | 1.14 |
| Stomach ulcer | Musculoskeletal | 33.43 | 33.12 | 0.99 | 0.83 | 1.16 | 42.44 | 46.56 | 1.10 | 0.98 | 1.21 | 48.15 | 47.79 | 0.99 | 0.89 | 1.09 |
| Stomach ulcer | Respiratory | 14.98 | 10.94 | 0.73 | 0.51 | 0.99 | 20.37 | 20.64 | 1.01 | 0.81 | 1.21 | 23.41 | 24.01 | 1.03 | 0.85 | 1.21 |
| Stomach ulcer | Diabetes | 13.68 | 18.44 | 1.35 | 1.02 | 1.72 | 19.29 | 24.77 | 1.28 | 1.06 | 1.52 | 23.56 | 22.61 | 0.96 | 0.77 | 1.15 |
| Stomach ulcer | Cancer | 4.91 | 4.06 | 0.83 | 0.42 | 1.38 | 10.05 | 10.55 | 1.05 | 0.77 | 1.35 | 16.13 | 18.18 | 1.13 | 0.90 | 1.38 |
| Stomach ulcer | Dementia | 1.49 | 2.50 | 1.67 | 0.57 | 3.39 | 3.59 | 3.21 | 0.89 | 0.44 | 1.44 | 6.26 | 5.83 | 0.93 | 0.60 | 1.35 |
| Cancer | Cardiovascular | 50.59 | 38.46 | 0.76 | 0.57 | 0.96 | 63.78 | 64.50 | 1.01 | 0.92 | 1.10 | 76.70 | 79.80 | 1.04 | 0.99 | 1.09 |
| Cancer | Mental disorder | 32.08 | 34.07 | 1.06 | 0.76 | 1.40 | 31.68 | 32.57 | 1.03 | 0.85 | 1.19 | 30.77 | 31.06 | 1.01 | 0.86 | 1.17 |
| Cancer | Musculoskeletal | 22.28 | 23.08 | 1.04 | 0.65 | 1.50 | 32.90 | 30.94 | 0.94 | 0.77 | 1.12 | 41.15 | 35.86 | 0.87 | 0.75 | 0.99 |
| Cancer | Diabetes | 15.15 | 13.19 | 0.87 | 0.44 | 1.42 | 19.10 | 18.89 | 0.99 | 0.75 | 1.25 | 23.63 | 25.25 | 1.07 | 0.87 | 1.26 |
| Cancer | Respiratory | 13.96 | 14.29 | 1.02 | 0.54 | 1.64 | 15.38 | 21.50 | 1.40 | 1.08 | 1.74 | 17.41 | 26.77 | 1.54 | 1.27 | 1.80 |
| Cancer | Stomach ulcer | 10.10 | 14.29 | 1.41 | 0.73 | 2.33 | 12.21 | 14.98 | 1.23 | 0.91 | 1.56 | 13.29 | 19.70 | 1.48 | 1.19 | 1.81 |
| Cancer | Dementia | 1.68 | 0.00 | 0.00 | 0.00 | 0.00 | 2.26 | 1.95 | 0.87 | 0.27 | 1.78 | 5.27 | 5.81 | 1.10 | 0.68 | 1.59 |
| Dementia | Mental disorder | 71.30 | 78.57 | 1.10 | 0.85 | 1.34 | 57.35 | 61.64 | 1.07 | 0.86 | 1.28 | 51.41 | 47.97 | 0.93 | 0.78 | 1.10 |
| Dementia | Cardiovascular | 60.43 | 39.29 | 0.65 | 0.35 | 0.98 | 74.41 | 69.86 | 0.94 | 0.79 | 1.08 | 82.32 | 85.81 | 1.04 | 0.96 | 1.11 |
| Dementia | Musculoskeletal | 35.65 | 39.29 | 1.10 | 0.58 | 1.71 | 40.67 | 35.62 | 0.88 | 0.59 | 1.17 | 44.85 | 36.49 | 0.81 | 0.64 | 0.99 |
| Dementia | Respiratory | 18.70 | 17.86 | 0.96 | 0.21 | 1.93 | 19.16 | 12.33 | 0.64 | 0.27 | 1.11 | 21.11 | 19.59 | 0.93 | 0.62 | 1.28 |
| Dementia | Diabetes | 18.26 | 42.86 | 2.35 | 1.28 | 3.83 | 22.99 | 34.25 | 1.49 | 1.00 | 2.05 | 29.73 | 32.43 | 1.09 | 0.84 | 1.36 |
| Dementia | Stomach ulcer | 13.48 | 28.57 | 2.12 | 0.82 | 3.98 | 17.68 | 19.18 | 1.08 | 0.58 | 1.69 | 13.62 | 16.89 | 1.24 | 0.80 | 1.76 |
| Dementia | Cancer | 7.39 | 0.00 | 0.00 | 0.00 | 0.00 | 9.15 | 8.22 | 0.90 | 0.28 | 1.78 | 13.93 | 15.54 | 1.12 | 0.71 | 1.61 |

* p < 0.05; ** p < 0.01; *** p < 0.001

^a Probability of having condition 2 given that condition 1 is already present.

Abbreviations: RR = relative risk; CI = confidence interval

Table S6. Conditional probability (in percentages) ^a and relative risk of chronic disease combinations by immigrant status and age group among women

| Condition 1 | Condition 2 | 50-59 | | | | 60-69 | | | | 70-79 | | | |
|-----------------|-----------------|---------|------------|------|-----------|---------|------------|------|-----------|---------|------------|------|-----------|
| | | Natives | Immigrants | RR | 95% CI | Natives | Immigrants | RR | 95% CI | Natives | Immigrants | RR | 95% CI |
| Cardiovascular | Mental disorder | 39.87 | 42.25 | 1.06 | 1.00 1.11 | 41.76 | 44.07 | 1.06 | 1.01 1.10 | 43.65 | 45.88 | 1.05 | 1.01 1.09 |
| Cardiovascular | Musculoskeletal | 37.96 | 40.93 | 1.08 | 1.02 1.14 | 51.00 | 56.09 | 1.10 | 1.06 1.13 | 61.85 | 64.99 | 1.05 | 1.02 1.08 |
| Cardiovascular | Diabetes | 13.82 | 19.12 | 1.38 | 1.25 1.52 | 20.36 | 24.82 | 1.22 | 1.14 1.30 | 24.32 | 27.64 | 1.14 | 1.07 1.20 |
| Cardiovascular | Respiratory | 10.82 | 14.68 | 1.36 | 1.20 1.51 | 12.33 | 16.74 | 1.36 | 1.25 1.47 | 14.85 | 15.53 | 1.05 | 0.96 1.12 |
| Cardiovascular | Stomach ulcer | 8.13 | 13.26 | 1.63 | 1.42 1.83 | 9.40 | 13.89 | 1.48 | 1.34 1.61 | 10.40 | 16.05 | 1.54 | 1.42 1.67 |
| Cardiovascular | Cancer | 6.25 | 8.11 | 1.30 | 1.09 1.52 | 9.27 | 9.62 | 1.04 | 0.92 1.15 | 11.14 | 11.78 | 1.06 | 0.96 1.15 |
| Cardiovascular | Dementia | 1.04 | 1.37 | 1.31 | 0.81 1.93 | 1.96 | 1.96 | 1.00 | 0.75 1.27 | 4.68 | 4.12 | 0.88 | 0.74 1.03 |
| Musculoskeletal | Mental disorder | 46.61 | 50.58 | 1.09 | 1.03 1.14 | 48.02 | 51.11 | 1.06 | 1.02 1.11 | 49.50 | 48.78 | 0.99 | 0.95 1.02 |
| Musculoskeletal | Cardiovascular | 44.97 | 48.07 | 1.07 | 1.01 1.12 | 61.20 | 63.58 | 1.04 | 1.01 1.07 | 76.94 | 81.47 | 1.06 | 1.04 1.08 |
| Musculoskeletal | Respiratory | 12.92 | 14.35 | 1.11 | 0.97 1.25 | 14.31 | 18.83 | 1.32 | 1.21 1.42 | 16.27 | 18.31 | 1.13 | 1.03 1.22 |
| Musculoskeletal | Diabetes | 10.60 | 13.77 | 1.30 | 1.13 1.46 | 15.62 | 19.85 | 1.27 | 1.17 1.36 | 21.08 | 25.31 | 1.20 | 1.12 1.28 |
| Musculoskeletal | Stomach ulcer | 10.28 | 15.64 | 1.52 | 1.34 1.70 | 11.55 | 17.23 | 1.49 | 1.36 1.62 | 12.25 | 17.55 | 1.43 | 1.31 1.56 |
| Musculoskeletal | Cancer | 7.23 | 8.04 | 1.11 | 0.91 1.32 | 10.00 | 10.07 | 1.01 | 0.90 1.12 | 11.81 | 12.47 | 1.06 | 0.94 1.16 |
| Musculoskeletal | Dementia | 1.06 | 1.22 | 1.16 | 0.65 1.81 | 1.90 | 2.04 | 1.07 | 0.79 1.40 | 4.68 | 4.14 | 0.89 | 0.71 1.05 |
| Mental disorder | Cardiovascular | 42.93 | 46.56 | 1.08 | 1.03 1.14 | 61.05 | 63.91 | 1.05 | 1.01 1.08 | 78.05 | 82.41 | 1.06 | 1.03 1.08 |
| Mental disorder | Musculoskeletal | 42.36 | 47.46 | 1.12 | 1.06 1.18 | 58.51 | 65.40 | 1.12 | 1.08 1.15 | 71.14 | 69.89 | 0.98 | 0.95 1.01 |
| Mental disorder | Respiratory | 12.55 | 16.67 | 1.33 | 1.18 1.48 | 14.72 | 19.58 | 1.33 | 1.21 1.45 | 17.78 | 18.24 | 1.03 | 0.93 1.13 |
| Mental disorder | Diabetes | 9.93 | 12.98 | 1.31 | 1.15 1.50 | 16.30 | 21.16 | 1.30 | 1.19 1.41 | 23.00 | 28.06 | 1.22 | 1.13 1.31 |
| Mental disorder | Stomach ulcer | 9.87 | 17.21 | 1.74 | 1.54 1.94 | 12.35 | 17.12 | 1.39 | 1.26 1.52 | 13.99 | 18.94 | 1.35 | 1.23 1.48 |
| Mental disorder | Cancer | 7.49 | 8.70 | 1.16 | 0.98 1.36 | 10.80 | 11.12 | 1.03 | 0.91 1.15 | 13.10 | 14.19 | 1.08 | 0.96 1.20 |
| Mental disorder | Dementia | 1.40 | 1.75 | 1.25 | 0.82 1.80 | 2.83 | 2.88 | 1.02 | 0.77 1.28 | 6.88 | 6.48 | 0.94 | 0.77 1.11 |
| Diabetes | Cardiovascular | 69.33 | 75.22 | 1.08 | 1.03 1.15 | 84.06 | 85.52 | 1.02 | 0.99 1.05 | 90.24 | 92.09 | 1.02 | 1.00 1.04 |
| Diabetes | Mental disorder | 46.26 | 46.34 | 1.00 | 0.90 1.11 | 46.03 | 50.28 | 1.09 | 1.02 1.17 | 47.72 | 52.05 | 1.09 | 1.03 1.16 |
| Diabetes | Musculoskeletal | 44.87 | 46.12 | 1.03 | 0.92 1.14 | 53.75 | 60.33 | 1.12 | 1.06 1.19 | 62.86 | 67.27 | 1.07 | 1.03 1.12 |
| Diabetes | Respiratory | 16.23 | 19.83 | 1.22 | 0.97 1.48 | 16.15 | 18.67 | 1.16 | 1.00 1.33 | 16.68 | 17.72 | 1.06 | 0.92 1.21 |
| Diabetes | Stomach ulcer | 10.13 | 14.44 | 1.43 | 1.10 1.78 | 10.57 | 17.13 | 1.62 | 1.38 1.88 | 11.59 | 18.82 | 1.62 | 1.41 1.85 |
| Diabetes | Cancer | 6.69 | 9.48 | 1.42 | 1.00 1.89 | 11.08 | 9.39 | 0.85 | 0.66 1.03 | 11.76 | 14.91 | 1.27 | 1.07 1.46 |
| Diabetes | Dementia | 1.16 | 1.51 | 1.30 | 0.42 2.64 | 2.97 | 2.32 | 0.78 | 0.46 1.16 | 6.06 | 6.71 | 1.11 | 0.86 1.39 |
| Respiratory | Mental disorder | 55.14 | 60.13 | 1.09 | 1.01 1.17 | 54.67 | 58.47 | 1.07 | 1.00 1.14 | 55.56 | 53.65 | 0.97 | 0.90 1.04 |
| Respiratory | Musculoskeletal | 51.59 | 48.58 | 0.94 | 0.85 1.03 | 64.74 | 71.94 | 1.11 | 1.06 1.16 | 73.04 | 77.14 | 1.06 | 1.01 1.10 |
| Respiratory | Cardiovascular | 51.17 | 58.39 | 1.14 | 1.05 1.24 | 66.93 | 72.50 | 1.08 | 1.03 1.13 | 82.95 | 82.06 | 0.99 | 0.95 1.03 |
| Respiratory | Diabetes | 15.31 | 20.04 | 1.31 | 1.05 1.58 | 21.24 | 23.47 | 1.11 | 0.95 1.25 | 25.12 | 28.10 | 1.12 | 0.98 1.27 |
| Respiratory | Stomach ulcer | 11.91 | 20.04 | 1.68 | 1.33 2.03 | 15.46 | 20.69 | 1.34 | 1.14 1.56 | 15.31 | 24.60 | 1.61 | 1.38 1.84 |
| Respiratory | Cancer | 7.31 | 10.89 | 1.49 | 1.08 1.93 | 12.43 | 15.00 | 1.21 | 0.98 1.43 | 13.62 | 17.46 | 1.28 | 1.05 1.52 |
| Respiratory | Dementia | 1.64 | 1.53 | 0.93 | 0.29 1.88 | 2.81 | 3.33 | 1.18 | 0.73 1.76 | 5.82 | 4.76 | 0.82 | 0.52 1.13 |

| | | | | | | | | | | | | | | | | |
|---------------|-----------------|-------|-------|------|------|------|-------|-------|------|------|------|-------|-------|------|------|------|
| Stomach ulcer | Mental disorder | 55.75 | 65.07 | 1.17 | 1.09 | 1.25 | 59.63 | 60.93 | 1.02 | 0.96 | 1.09 | 61.51 | 56.89 | 0.92 | 0.86 | 1.00 |
| Stomach ulcer | Musculoskeletal | 52.75 | 55.48 | 1.05 | 0.96 | 1.15 | 67.92 | 78.48 | 1.16 | 1.10 | 1.21 | 77.37 | 75.53 | 0.98 | 0.93 | 1.02 |
| Stomach ulcer | Cardiovascular | 49.44 | 55.25 | 1.12 | 1.02 | 1.22 | 66.33 | 71.69 | 1.08 | 1.03 | 1.14 | 81.75 | 86.55 | 1.06 | 1.03 | 1.09 |
| Stomach ulcer | Respiratory | 15.31 | 21.00 | 1.37 | 1.09 | 1.65 | 20.10 | 24.67 | 1.23 | 1.05 | 1.41 | 21.54 | 25.12 | 1.17 | 1.00 | 1.34 |
| Stomach ulcer | Diabetes | 12.27 | 15.30 | 1.25 | 0.97 | 1.54 | 18.07 | 25.66 | 1.42 | 1.23 | 1.63 | 24.55 | 30.47 | 1.24 | 1.10 | 1.40 |
| Stomach ulcer | Cancer | 9.08 | 11.42 | 1.26 | 0.91 | 1.64 | 12.33 | 12.58 | 1.02 | 0.80 | 1.25 | 13.80 | 16.69 | 1.21 | 0.98 | 1.45 |
| Stomach ulcer | Dementia | 1.56 | 1.83 | 1.17 | 0.40 | 2.38 | 2.70 | 1.49 | 0.55 | 0.23 | 1.02 | 6.00 | 5.35 | 0.89 | 0.60 | 1.22 |
| Cancer | Mental disorder | 44.34 | 47.84 | 1.08 | 0.94 | 1.22 | 46.65 | 50.42 | 1.08 | 0.99 | 1.18 | 49.44 | 54.00 | 1.09 | 1.00 | 1.19 |
| Cancer | Cardiovascular | 39.81 | 49.17 | 1.24 | 1.08 | 1.39 | 58.55 | 63.29 | 1.08 | 1.00 | 1.15 | 75.14 | 80.49 | 1.07 | 1.02 | 1.12 |
| Cancer | Musculoskeletal | 38.87 | 41.53 | 1.07 | 0.93 | 1.23 | 52.63 | 58.44 | 1.11 | 1.02 | 1.20 | 64.05 | 67.97 | 1.06 | 0.99 | 1.13 |
| Cancer | Respiratory | 9.84 | 16.61 | 1.69 | 1.27 | 2.21 | 14.46 | 22.78 | 1.58 | 1.28 | 1.87 | 16.45 | 22.59 | 1.37 | 1.12 | 1.60 |
| Cancer | Stomach ulcer | 9.51 | 16.61 | 1.75 | 1.28 | 2.27 | 11.03 | 16.03 | 1.45 | 1.14 | 1.78 | 11.85 | 21.15 | 1.79 | 1.45 | 2.13 |
| Cancer | Diabetes | 8.49 | 14.62 | 1.72 | 1.27 | 2.27 | 16.95 | 17.93 | 1.06 | 0.85 | 1.28 | 21.39 | 30.60 | 1.43 | 1.24 | 1.63 |
| Cancer | Dementia | 0.90 | 1.00 | 1.11 | 0.00 | 1.84 | 1.60 | 2.53 | 1.58 | 0.73 | 2.71 | 4.79 | 4.93 | 1.03 | 0.63 | 1.53 |
| Dementia | Mental disorder | 75.75 | 78.38 | 1.03 | 0.83 | 1.22 | 72.57 | 72.94 | 1.01 | 0.86 | 1.14 | 67.42 | 72.29 | 1.07 | 0.96 | 1.18 |
| Dementia | Cardiovascular | 60.82 | 67.57 | 1.11 | 0.83 | 1.39 | 73.61 | 71.76 | 0.97 | 0.83 | 1.11 | 82.01 | 82.53 | 1.01 | 0.93 | 1.08 |
| Dementia | Musculoskeletal | 51.87 | 51.35 | 0.99 | 0.65 | 1.34 | 59.38 | 65.88 | 1.11 | 0.92 | 1.29 | 65.88 | 66.27 | 1.01 | 0.89 | 1.12 |
| Dementia | Respiratory | 20.15 | 18.92 | 0.94 | 0.35 | 1.81 | 19.44 | 28.24 | 1.45 | 0.95 | 2.06 | 18.27 | 18.07 | 0.99 | 0.69 | 1.34 |
| Dementia | Stomach ulcer | 14.93 | 21.62 | 1.45 | 0.59 | 2.57 | 14.35 | 10.59 | 0.74 | 0.31 | 1.29 | 13.38 | 19.88 | 1.49 | 1.02 | 1.99 |
| Dementia | Diabetes | 13.43 | 18.92 | 1.41 | 0.53 | 2.66 | 26.97 | 24.71 | 0.92 | 0.58 | 1.30 | 28.63 | 40.36 | 1.41 | 1.14 | 1.69 |
| Dementia | Cancer | 8.21 | 8.11 | 0.99 | 0.00 | 1.54 | 9.49 | 14.12 | 1.49 | 0.74 | 2.45 | 12.45 | 14.46 | 1.16 | 0.72 | 1.69 |

* p < 0.05; ** p < 0.01; *** p < 0.001

^a Probability of having condition 2 given that condition 1 is already present.

Abbreviations: RR = relative risk; CI = confidence interval

Table S7. Conditional probability (in percentages) ^a and relative risk of chronic disease combinations by immigrant status and origin country group among men

| Condition 1 | Condition 2 | Natives | Immigrants (by origin country) | | | | | | | | | | | | | | | | | | | |
|-----------------|-----------------|---------|--------------------------------|------|--------|--------------|-------|--------|------------------|------|--------|----------------|------|--------|--------------|------|--------|------|-------|------|------|------|
| | | | Africa | | | The Americas | | | Asia and Oceania | | | Eastern Europe | | | Other Europe | | | | | | | |
| | | | Prev. | RR | 95% CI | Prev. | RR | 95% CI | Prev. | RR | 95% CI | Prev. | RR | 95% CI | Prev. | RR | 95% CI | | | | | |
| Cardiovascular | Musculoskeletal | 27.82 | 36.05 | 1.30 | 1.27 | 1.32 | 27.49 | 0.95 | 0.93 | 0.97 | 29.42 | 0.98 | 0.96 | 1.00 | 35.32 | 1.15 | 1.13 | 1.17 | 31.92 | 1.03 | 1.02 | 1.05 |
| Cardiovascular | Mental disorder | 24.41 | 29.57 | 1.21 | 1.19 | 1.24 | 27.44 | 1.11 | 1.08 | 1.14 | 30.70 | 1.22 | 1.19 | 1.25 | 27.91 | 1.10 | 1.07 | 1.12 | 27.45 | 1.08 | 1.06 | 1.11 |
| Cardiovascular | Diabetes | 21.18 | 32.33 | 1.53 | 1.49 | 1.56 | 25.76 | 1.20 | 1.18 | 1.23 | 29.53 | 1.36 | 1.33 | 1.39 | 20.97 | 0.95 | 0.93 | 0.97 | 24.86 | 1.12 | 1.09 | 1.15 |
| Cardiovascular | Respiratory | 11.54 | 16.32 | 1.41 | 1.37 | 1.47 | 9.00 | 0.77 | 0.74 | 0.80 | 21.09 | 1.77 | 1.72 | 1.83 | 12.91 | 1.06 | 1.03 | 1.09 | 13.58 | 1.11 | 1.07 | 1.15 |
| Cardiovascular | Stomach ulcer | 8.86 | 9.03 | 1.02 | 0.98 | 1.06 | 3.84 | 0.42 | 0.40 | 0.45 | 15.56 | 1.68 | 1.63 | 1.74 | 15.93 | 1.68 | 1.62 | 1.75 | 9.89 | 1.04 | 1.00 | 1.08 |
| Cardiovascular | Cancer | 7.01 | 6.43 | 0.92 | 0.87 | 0.97 | 5.56 | 0.79 | 0.74 | 0.83 | 4.14 | 0.57 | 0.54 | 0.61 | 5.38 | 0.72 | 0.68 | 0.76 | 9.14 | 1.20 | 1.15 | 1.25 |
| Cardiovascular | Dementia | 2.30 | 2.11 | 0.92 | 0.83 | 1.00 | 1.59 | 0.68 | 0.61 | 0.75 | 1.77 | 0.73 | 0.67 | 0.81 | 2.08 | 0.82 | 0.74 | 0.90 | 2.74 | 1.02 | 0.94 | 1.11 |
| Musculoskeletal | Cardiovascular | 62.91 | 62.75 | 1.00 | 0.99 | 1.01 | 64.57 | 1.02 | 1.01 | 1.03 | 56.12 | 0.87 | 0.86 | 0.88 | 68.69 | 1.06 | 1.05 | 1.07 | 61.47 | 0.95 | 0.93 | 0.96 |
| Musculoskeletal | Mental disorder | 30.46 | 29.67 | 0.97 | 0.96 | 0.99 | 33.74 | 1.08 | 1.05 | 1.10 | 21.84 | 0.69 | 0.67 | 0.71 | 32.01 | 0.99 | 0.98 | 1.00 | 32.64 | 1.01 | 0.99 | 1.03 |
| Musculoskeletal | Diabetes | 18.22 | 29.60 | 1.62 | 1.58 | 1.67 | 16.93 | 0.90 | 0.87 | 0.92 | 22.52 | 1.16 | 1.13 | 1.19 | 20.61 | 1.04 | 1.02 | 1.07 | 23.60 | 1.18 | 1.15 | 1.21 |
| Musculoskeletal | Respiratory | 15.12 | 17.37 | 1.15 | 1.11 | 1.19 | 9.75 | 0.63 | 0.60 | 0.65 | 15.65 | 0.99 | 0.96 | 1.03 | 14.57 | 0.90 | 0.87 | 0.93 | 16.38 | 1.00 | 0.96 | 1.03 |
| Musculoskeletal | Stomach ulcer | 12.22 | 16.11 | 1.32 | 1.27 | 1.36 | 8.79 | 0.71 | 0.68 | 0.74 | 16.57 | 1.30 | 1.26 | 1.35 | 17.93 | 1.39 | 1.34 | 1.44 | 14.37 | 1.11 | 1.07 | 1.16 |
| Musculoskeletal | Cancer | 7.72 | 6.48 | 0.84 | 0.80 | 0.88 | 7.62 | 1.00 | 0.95 | 1.05 | 4.71 | 0.60 | 0.56 | 0.63 | 4.12 | 0.51 | 0.48 | 0.54 | 9.36 | 1.13 | 1.07 | 1.18 |
| Musculoskeletal | Dementia | 2.70 | 1.50 | 0.56 | 0.50 | 0.62 | 4.18 | 1.52 | 1.40 | 1.65 | 4.98 | 1.77 | 1.65 | 1.91 | 2.16 | 0.70 | 0.64 | 0.77 | 2.67 | 0.85 | 0.78 | 0.91 |
| Mental disorder | Cardiovascular | 61.87 | 62.02 | 1.00 | 0.99 | 1.01 | 51.32 | 0.82 | 0.81 | 0.83 | 62.34 | 0.98 | 0.97 | 0.99 | 71.13 | 1.11 | 1.10 | 1.12 | 60.35 | 0.94 | 0.94 | 0.95 |
| Mental disorder | Musculoskeletal | 34.08 | 35.89 | 1.05 | 1.03 | 1.07 | 26.82 | 0.75 | 0.73 | 0.76 | 27.74 | 0.75 | 0.73 | 0.76 | 41.92 | 1.09 | 1.08 | 1.11 | 37.74 | 0.98 | 0.96 | 0.99 |
| Mental disorder | Diabetes | 18.62 | 30.28 | 1.63 | 1.58 | 1.67 | 23.17 | 1.21 | 1.18 | 1.24 | 29.58 | 1.51 | 1.47 | 1.55 | 20.70 | 1.04 | 1.02 | 1.05 | 27.20 | 1.35 | 1.32 | 1.39 |
| Mental disorder | Respiratory | 15.77 | 16.68 | 1.06 | 1.02 | 1.09 | 12.50 | 0.77 | 0.74 | 0.80 | 27.97 | 1.69 | 1.65 | 1.74 | 16.19 | 0.96 | 0.93 | 0.99 | 16.65 | 0.97 | 0.94 | 1.00 |
| Mental disorder | Stomach ulcer | 13.23 | 11.85 | 0.90 | 0.86 | 0.93 | 9.45 | 0.68 | 0.66 | 0.71 | 20.06 | 1.40 | 1.36 | 1.44 | 19.32 | 1.32 | 1.28 | 1.36 | 16.30 | 1.11 | 1.09 | 1.13 |
| Mental disorder | Cancer | 8.84 | 11.12 | 1.26 | 1.20 | 1.31 | 5.74 | 0.63 | 0.60 | 0.66 | 6.70 | 0.72 | 0.69 | 0.76 | 7.33 | 0.77 | 0.73 | 0.81 | 10.08 | 1.04 | 1.02 | 1.06 |
| Mental disorder | Dementia | 4.70 | 3.03 | 0.64 | 0.60 | 0.69 | 7.32 | 1.53 | 1.44 | 1.62 | 4.08 | 0.83 | 0.78 | 0.87 | 3.27 | 0.63 | 0.58 | 0.67 | 6.23 | 1.13 | 1.07 | 1.20 |
| Diabetes | Cardiovascular | 77.73 | 69.09 | 0.89 | 0.88 | 0.90 | 76.87 | 0.99 | 0.98 | 0.99 | 68.93 | 0.88 | 0.87 | 0.89 | 86.42 | 1.09 | 1.08 | 1.10 | 72.71 | 0.92 | 0.91 | 0.92 |
| Diabetes | Musculoskeletal | 29.34 | 37.09 | 1.26 | 1.24 | 1.29 | 16.90 | 0.54 | 0.53 | 0.56 | 29.26 | 0.90 | 0.88 | 0.92 | 43.83 | 1.31 | 1.29 | 1.33 | 35.90 | 1.06 | 1.04 | 1.09 |
| Diabetes | Mental disorder | 26.54 | 30.22 | 1.14 | 1.11 | 1.16 | 39.56 | 1.45 | 1.42 | 1.48 | 34.11 | 1.23 | 1.21 | 1.25 | 33.74 | 1.19 | 1.16 | 1.21 | 36.11 | 1.28 | 1.26 | 1.31 |
| Diabetes | Respiratory | 13.16 | 17.15 | 1.30 | 1.26 | 1.35 | 15.42 | 1.14 | 1.10 | 1.18 | 16.68 | 1.24 | 1.20 | 1.28 | 17.60 | 1.26 | 1.22 | 1.30 | 13.45 | 0.93 | 0.89 | 0.96 |
| Diabetes | Stomach ulcer | 8.79 | 6.10 | 0.69 | 0.66 | 0.73 | 1.32 | 0.14 | 0.13 | 0.16 | 15.35 | 1.60 | 1.54 | 1.67 | 17.48 | 1.75 | 1.69 | 1.82 | 13.34 | 1.33 | 1.28 | 1.38 |
| Diabetes | Cancer | 7.35 | 4.11 | 0.56 | 0.52 | 0.59 | 6.39 | 0.84 | 0.81 | 0.88 | 0.98 | 0.13 | 0.11 | 0.14 | 7.39 | 0.92 | 0.88 | 0.96 | 8.50 | 1.03 | 0.98 | 1.09 |
| Diabetes | Dementia | 2.64 | 2.52 | 0.96 | 0.87 | 1.04 | 1.32 | 0.51 | 0.45 | 0.56 | 3.40 | 1.24 | 1.15 | 1.33 | 2.61 | 0.87 | 0.80 | 0.95 | 4.92 | 1.50 | 1.40 | 1.61 |
| Respiratory | Cardiovascular | 65.48 | 63.79 | 0.97 | 0.96 | 0.98 | 44.78 | 0.68 | 0.67 | 0.69 | 70.01 | 1.05 | 1.04 | 1.06 | 74.21 | 1.10 | 1.09 | 1.11 | 65.70 | 0.98 | 0.97 | 0.99 |
| Respiratory | Musculoskeletal | 37.96 | 36.66 | 0.97 | 0.95 | 0.98 | 11.58 | 0.29 | 0.28 | 0.30 | 28.41 | 0.69 | 0.68 | 0.71 | 43.81 | 1.04 | 1.02 | 1.05 | 41.05 | 0.96 | 0.95 | 0.97 |
| Respiratory | Mental disorder | 35.66 | 30.91 | 0.87 | 0.85 | 0.88 | 37.68 | 1.03 | 1.01 | 1.05 | 45.00 | 1.22 | 1.20 | 1.24 | 36.05 | 0.96 | 0.95 | 0.98 | 37.52 | 1.00 | 0.98 | 1.01 |
| Respiratory | Diabetes | 20.41 | 31.26 | 1.53 | 1.49 | 1.57 | 23.97 | 1.14 | 1.12 | 1.17 | 23.18 | 1.10 | 1.07 | 1.14 | 25.14 | 1.17 | 1.14 | 1.20 | 22.01 | 0.99 | 0.97 | 1.01 |
| Respiratory | Stomach ulcer | 14.58 | 17.46 | 1.20 | 1.16 | 1.23 | 3.31 | 0.22 | 0.21 | 0.23 | 12.56 | 0.81 | 0.79 | 0.84 | 22.61 | 1.43 | 1.39 | 1.48 | 13.62 | 0.87 | 0.84 | 0.90 |
| Respiratory | Cancer | 9.48 | 11.29 | 1.19 | 1.15 | 1.24 | 33.79 | 3.58 | 3.45 | 3.70 | 2.41 | 0.25 | 0.23 | 0.26 | 7.45 | 0.74 | 0.71 | 0.78 | 13.88 | 1.37 | 1.31 | 1.42 |

| | | | | | | | | | | | | | | | | | | | | | | |
|---------------|-----------------|-------|--------|------|------|------|--------|------|------|------|-------|------|------|------|-------|------|------|------|-------|------|------|------|
| Respiratory | Dementia | 3.37 | 4.03 | 1.20 | 1.11 | 1.29 | 0.00 | 0.00 | 0.00 | 0.00 | 1.20 | 0.34 | 0.31 | 0.38 | 2.86 | 0.76 | 0.70 | 0.82 | 3.09 | 0.80 | 0.74 | 0.86 |
| Stomach ulcer | Cardiovascular | 62.26 | 55.05 | 0.88 | 0.87 | 0.89 | 60.36 | 0.95 | 0.94 | 0.96 | 65.14 | 1.02 | 1.01 | 1.03 | 63.03 | 0.97 | 0.96 | 0.98 | 58.69 | 0.90 | 0.89 | 0.91 |
| Stomach ulcer | Musculoskeletal | 37.83 | 51.34 | 1.36 | 1.33 | 1.38 | 60.36 | 1.53 | 1.51 | 1.56 | 35.97 | 0.88 | 0.87 | 0.89 | 37.22 | 0.89 | 0.88 | 0.91 | 44.41 | 1.07 | 1.05 | 1.08 |
| Stomach ulcer | Mental disorder | 36.90 | 33.26 | 0.90 | 0.88 | 0.92 | 77.38 | 2.00 | 1.97 | 2.03 | 41.88 | 1.06 | 1.04 | 1.07 | 30.06 | 0.75 | 0.73 | 0.76 | 44.09 | 1.10 | 1.08 | 1.12 |
| Stomach ulcer | Respiratory | 18.04 | 27.36 | 1.52 | 1.48 | 1.56 | 17.65 | 0.94 | 0.91 | 0.97 | 15.81 | 0.83 | 0.80 | 0.85 | 15.94 | 0.82 | 0.79 | 0.84 | 17.06 | 0.87 | 0.85 | 0.90 |
| Stomach ulcer | Diabetes | 16.92 | 19.46 | 1.15 | 1.12 | 1.19 | 8.82 | 0.50 | 0.48 | 0.52 | 27.04 | 1.48 | 1.44 | 1.52 | 16.01 | 0.85 | 0.82 | 0.88 | 26.81 | 1.39 | 1.36 | 1.43 |
| Stomach ulcer | Cancer | 9.21 | 8.40 | 0.91 | 0.87 | 0.96 | 8.82 | 0.95 | 0.91 | 1.00 | 8.18 | 0.86 | 0.82 | 0.90 | 8.29 | 0.83 | 0.79 | 0.86 | 12.67 | 1.25 | 1.21 | 1.30 |
| Stomach ulcer | Dementia | 3.07 | 2.94 | 0.96 | 0.89 | 1.03 | 8.82 | 2.59 | 2.44 | 2.77 | 2.58 | 0.76 | 0.70 | 0.82 | 3.15 | 0.85 | 0.79 | 0.92 | 4.18 | 1.13 | 1.05 | 1.21 |
| Cancer | Cardiovascular | 61.05 | 47.50 | 0.78 | 0.77 | 0.79 | 28.94 | 0.47 | 0.46 | 0.48 | 69.85 | 1.13 | 1.12 | 1.14 | 55.70 | 0.89 | 0.88 | 0.90 | 64.35 | 1.02 | 1.01 | 1.03 |
| Cancer | Mental disorder | 30.83 | 42.20 | 1.37 | 1.34 | 1.40 | 21.98 | 0.70 | 0.68 | 0.72 | 60.91 | 1.93 | 1.89 | 1.96 | 28.90 | 0.91 | 0.89 | 0.93 | 32.47 | 1.02 | 1.00 | 1.04 |
| Cancer | Musculoskeletal | 29.45 | 32.78 | 1.11 | 1.09 | 1.13 | 13.85 | 0.47 | 0.45 | 0.48 | 31.13 | 1.00 | 0.98 | 1.02 | 22.15 | 0.70 | 0.69 | 0.72 | 35.07 | 1.09 | 1.07 | 1.12 |
| Cancer | Diabetes | 17.66 | 12.45 | 0.71 | 0.68 | 0.73 | 11.74 | 0.63 | 0.61 | 0.65 | 3.31 | 0.18 | 0.17 | 0.19 | 20.22 | 1.05 | 1.02 | 1.09 | 20.17 | 1.04 | 1.01 | 1.07 |
| Cancer | Respiratory | 15.03 | 28.46 | 1.89 | 1.84 | 1.94 | 31.02 | 2.08 | 2.02 | 2.14 | 26.47 | 1.74 | 1.68 | 1.79 | 13.87 | 0.88 | 0.85 | 0.91 | 19.21 | 1.22 | 1.18 | 1.26 |
| Cancer | Stomach ulcer | 11.10 | 13.52 | 1.22 | 1.18 | 1.26 | 2.41 | 0.21 | 0.20 | 0.23 | 21.20 | 1.84 | 1.78 | 1.90 | 25.15 | 2.06 | 2.00 | 2.13 | 13.35 | 1.10 | 1.06 | 1.14 |
| Cancer | Dementia | 2.78 | 2.21 | 0.79 | 0.73 | 0.87 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.10 | 1.04 | 0.96 | 1.12 | 2.00 | 0.66 | 0.60 | 0.72 |
| Dementia | Cardiovascular | 69.61 | 100.00 | 1.44 | 1.43 | 1.45 | 26.47 | 0.38 | 0.37 | 0.39 | 32.56 | 0.46 | 0.45 | 0.46 | 66.77 | 0.93 | 0.92 | 0.93 | 60.96 | 0.85 | 0.84 | 0.86 |
| Dementia | Mental disorder | 59.15 | 82.35 | 1.39 | 1.38 | 1.41 | 100.00 | 1.66 | 1.65 | 1.68 | 65.65 | 1.07 | 1.06 | 1.08 | 48.53 | 0.77 | 0.76 | 0.79 | 65.22 | 1.04 | 1.03 | 1.05 |
| Dementia | Musculoskeletal | 36.98 | 45.59 | 1.23 | 1.21 | 1.26 | 26.47 | 0.69 | 0.67 | 0.70 | 78.89 | 2.00 | 1.97 | 2.03 | 44.45 | 1.04 | 1.03 | 1.06 | 32.65 | 0.80 | 0.79 | 0.82 |
| Dementia | Diabetes | 21.18 | 77.94 | 3.68 | 3.60 | 3.76 | 8.82 | 0.42 | 0.40 | 0.43 | 22.90 | 1.02 | 1.00 | 1.04 | 12.48 | 0.52 | 0.50 | 0.53 | 40.81 | 1.61 | 1.58 | 1.65 |
| Dementia | Respiratory | 19.30 | 54.04 | 2.80 | 2.73 | 2.87 | 0.00 | 0.00 | 0.00 | 0.00 | 6.62 | 0.35 | 0.34 | 0.36 | 20.61 | 1.01 | 0.98 | 1.04 | 14.04 | 0.71 | 0.69 | 0.74 |
| Dementia | Stomach ulcer | 13.42 | 13.24 | 0.99 | 0.95 | 1.02 | 8.82 | 0.55 | 0.53 | 0.58 | 44.54 | 3.00 | 2.92 | 3.08 | 44.12 | 2.85 | 2.78 | 2.92 | 17.87 | 1.22 | 1.18 | 1.25 |
| Dementia | Cancer | 9.76 | 8.82 | 0.90 | 0.87 | 0.94 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 9.84 | 0.95 | 0.92 | 0.98 | 6.99 | 0.69 | 0.66 | 0.72 |

* p < 0.05; ** p < 0.01; *** p < 0.001

^a Probability of having condition 2 given that condition 1 is already present.

Note: Values are age-standardized using the 2013 European standard population.

Abbreviations: Prev. = prevalence (estimated as the conditional probability); RR = relative risk; CI = confidence interval

Table S8. Conditional probability (in percentages) ^a and relative risk of chronic disease combinations by immigrant status and origin country group among women

| Condition 1 | Condition 2 | Natives | Immigrants (by origin country) | | | | | | | | | | | | | | | | | | | |
|-----------------|-----------------|---------|--------------------------------|------|--------|--------------|-------|--------|------------------|------|--------|----------------|------|--------|--------------|------|--------|------|-------|------|------|------|
| | | | Africa | | | The Americas | | | Asia and Oceania | | | Eastern Europe | | | Other Europe | | | | | | | |
| | | | Prev. | RR | 95% CI | Prev. | RR | 95% CI | Prev. | RR | 95% CI | Prev. | RR | 95% CI | Prev. | RR | 95% CI | | | | | |
| Cardiovascular | Musculoskeletal | 46.56 | 60.96 | 1.31 | 1.29 | 1.33 | 49.90 | 1.04 | 1.02 | 1.05 | 49.13 | 1.00 | 0.98 | 1.01 | 52.45 | 1.05 | 1.04 | 1.07 | 51.85 | 1.04 | 1.03 | 1.06 |
| Cardiovascular | Mental disorder | 40.44 | 56.48 | 1.40 | 1.37 | 1.42 | 43.39 | 1.06 | 1.04 | 1.08 | 38.55 | 0.92 | 0.91 | 0.94 | 43.72 | 1.04 | 1.02 | 1.06 | 42.53 | 1.01 | 1.00 | 1.03 |
| Cardiovascular | Diabetes | 18.29 | 27.90 | 1.53 | 1.48 | 1.56 | 19.24 | 1.03 | 0.99 | 1.06 | 30.75 | 1.63 | 1.59 | 1.67 | 26.24 | 1.38 | 1.35 | 1.42 | 18.51 | 0.97 | 0.94 | 1.00 |
| Cardiovascular | Respiratory | 11.86 | 14.53 | 1.23 | 1.18 | 1.27 | 11.23 | 0.93 | 0.89 | 0.96 | 17.17 | 1.37 | 1.32 | 1.42 | 15.75 | 1.24 | 1.20 | 1.29 | 16.05 | 1.26 | 1.21 | 1.30 |
| Cardiovascular | Stomach ulcer | 8.54 | 12.92 | 1.51 | 1.45 | 1.58 | 11.15 | 1.24 | 1.20 | 1.30 | 14.89 | 1.62 | 1.56 | 1.69 | 17.33 | 1.83 | 1.76 | 1.90 | 11.58 | 1.20 | 1.15 | 1.25 |
| Cardiovascular | Cancer | 8.07 | 8.45 | 1.05 | 1.00 | 1.09 | 9.69 | 1.16 | 1.11 | 1.22 | 8.00 | 0.93 | 0.89 | 0.97 | 9.45 | 1.07 | 1.03 | 1.12 | 10.13 | 1.12 | 1.08 | 1.17 |
| Cardiovascular | Dementia | 2.21 | 1.43 | 0.65 | 0.58 | 0.72 | 3.15 | 1.42 | 1.29 | 1.55 | 2.13 | 0.93 | 0.85 | 1.02 | 2.38 | 1.02 | 0.93 | 1.11 | 2.29 | 0.91 | 0.83 | 1.00 |
| Musculoskeletal | Cardiovascular | 57.95 | 56.94 | 0.98 | 0.97 | 1.00 | 48.81 | 0.83 | 0.82 | 0.84 | 56.71 | 0.96 | 0.95 | 0.97 | 71.55 | 1.20 | 1.19 | 1.21 | 57.68 | 0.97 | 0.96 | 0.98 |
| Musculoskeletal | Mental disorder | 46.96 | 57.65 | 1.23 | 1.21 | 1.25 | 51.01 | 1.07 | 1.06 | 1.09 | 40.60 | 0.85 | 0.84 | 0.86 | 51.72 | 1.07 | 1.05 | 1.10 | 48.76 | 1.01 | 1.01 | 1.02 |
| Musculoskeletal | Diabetes | 14.73 | 21.46 | 1.46 | 1.41 | 1.50 | 16.85 | 1.12 | 1.09 | 1.16 | 24.27 | 1.61 | 1.57 | 1.66 | 23.97 | 1.59 | 1.54 | 1.64 | 13.65 | 0.89 | 0.85 | 0.92 |
| Musculoskeletal | Respiratory | 13.74 | 14.74 | 1.07 | 1.03 | 1.11 | 16.92 | 1.21 | 1.17 | 1.25 | 16.34 | 1.14 | 1.10 | 1.17 | 17.25 | 1.19 | 1.15 | 1.22 | 17.19 | 1.17 | 1.13 | 1.21 |
| Musculoskeletal | Stomach ulcer | 10.79 | 14.51 | 1.34 | 1.30 | 1.39 | 11.84 | 1.08 | 1.03 | 1.12 | 22.60 | 2.03 | 1.96 | 2.10 | 19.89 | 1.73 | 1.67 | 1.79 | 14.25 | 1.22 | 1.18 | 1.27 |
| Musculoskeletal | Cancer | 9.02 | 8.35 | 0.93 | 0.88 | 0.97 | 10.24 | 1.12 | 1.07 | 1.17 | 6.99 | 0.75 | 0.72 | 0.79 | 9.56 | 1.00 | 0.96 | 1.05 | 10.79 | 1.09 | 1.05 | 1.14 |
| Musculoskeletal | Dementia | 2.22 | 0.61 | 0.27 | 0.24 | 0.32 | 2.63 | 1.19 | 1.09 | 1.30 | 1.45 | 0.64 | 0.57 | 0.72 | 2.75 | 1.18 | 1.08 | 1.29 | 2.27 | 0.91 | 0.84 | 1.00 |
| Mental disorder | Cardiovascular | 57.11 | 56.46 | 0.99 | 0.98 | 1.00 | 48.32 | 0.84 | 0.82 | 0.85 | 55.79 | 0.95 | 0.94 | 0.96 | 69.96 | 1.18 | 1.17 | 1.20 | 58.43 | 0.99 | 0.98 | 1.00 |
| Mental disorder | Musculoskeletal | 53.05 | 61.39 | 1.16 | 1.14 | 1.17 | 58.10 | 1.06 | 1.05 | 1.08 | 50.90 | 0.91 | 0.90 | 0.92 | 60.16 | 1.06 | 1.05 | 1.07 | 59.72 | 1.05 | 1.04 | 1.07 |
| Mental disorder | Diabetes | 14.98 | 19.21 | 1.28 | 1.25 | 1.32 | 16.48 | 1.08 | 1.04 | 1.12 | 22.09 | 1.41 | 1.37 | 1.45 | 25.34 | 1.61 | 1.57 | 1.66 | 14.80 | 0.92 | 0.89 | 0.95 |
| Mental disorder | Respiratory | 13.97 | 14.64 | 1.05 | 1.01 | 1.08 | 12.54 | 0.87 | 0.84 | 0.91 | 20.66 | 1.39 | 1.35 | 1.44 | 18.86 | 1.25 | 1.22 | 1.29 | 18.82 | 1.24 | 1.20 | 1.28 |
| Mental disorder | Stomach ulcer | 11.25 | 13.02 | 1.16 | 1.11 | 1.20 | 17.21 | 1.50 | 1.45 | 1.56 | 21.77 | 1.85 | 1.80 | 1.91 | 19.65 | 1.62 | 1.57 | 1.68 | 16.36 | 1.32 | 1.28 | 1.37 |
| Mental disorder | Cancer | 9.56 | 11.03 | 1.15 | 1.10 | 1.21 | 11.66 | 1.18 | 1.14 | 1.23 | 10.75 | 1.07 | 1.04 | 1.10 | 10.10 | 0.98 | 0.94 | 1.02 | 11.64 | 1.09 | 1.05 | 1.14 |
| Mental disorder | Dementia | 3.31 | 2.21 | 0.67 | 0.61 | 0.73 | 3.82 | 1.19 | 1.10 | 1.28 | 1.99 | 0.61 | 0.56 | 0.66 | 3.78 | 1.13 | 1.05 | 1.21 | 3.36 | 0.95 | 0.88 | 1.02 |
| Diabetes | Cardiovascular | 78.63 | 72.85 | 0.93 | 0.92 | 0.93 | 68.38 | 0.86 | 0.85 | 0.86 | 81.12 | 1.01 | 1.01 | 1.02 | 90.08 | 1.12 | 1.11 | 1.13 | 80.85 | 1.01 | 1.00 | 1.01 |
| Diabetes | Musculoskeletal | 50.73 | 60.24 | 1.19 | 1.17 | 1.20 | 58.59 | 1.13 | 1.12 | 1.14 | 56.93 | 1.08 | 1.07 | 1.09 | 59.78 | 1.12 | 1.11 | 1.13 | 53.45 | 0.99 | 0.98 | 1.00 |
| Diabetes | Mental disorder | 45.23 | 50.86 | 1.12 | 1.10 | 1.14 | 49.29 | 1.08 | 1.06 | 1.09 | 41.00 | 0.87 | 0.86 | 0.89 | 54.10 | 1.15 | 1.13 | 1.17 | 46.67 | 0.98 | 0.97 | 1.00 |
| Diabetes | Respiratory | 15.37 | 6.62 | 0.43 | 0.41 | 0.45 | 3.51 | 0.22 | 0.20 | 0.23 | 22.14 | 1.34 | 1.31 | 1.38 | 21.60 | 1.29 | 1.26 | 1.33 | 22.03 | 1.32 | 1.28 | 1.36 |
| Diabetes | Stomach ulcer | 9.76 | 17.95 | 1.84 | 1.77 | 1.91 | 4.18 | 0.40 | 0.38 | 0.43 | 23.54 | 2.23 | 2.15 | 2.30 | 18.39 | 1.66 | 1.60 | 1.72 | 14.05 | 1.23 | 1.19 | 1.27 |
| Diabetes | Cancer | 8.87 | 11.75 | 1.32 | 1.27 | 1.38 | 20.56 | 2.22 | 2.14 | 2.30 | 7.23 | 0.76 | 0.73 | 0.80 | 10.21 | 1.04 | 1.00 | 1.09 | 10.08 | 0.99 | 0.96 | 1.03 |
| Diabetes | Dementia | 2.91 | 0.00 | 0.00 | 0.00 | 0.00 | 1.39 | 0.48 | 0.43 | 0.54 | 3.81 | 1.26 | 1.16 | 1.36 | 3.30 | 1.04 | 0.96 | 1.12 | 3.98 | 1.19 | 1.10 | 1.28 |
| Respiratory | Cardiovascular | 63.53 | 65.31 | 1.03 | 1.02 | 1.04 | 45.47 | 0.71 | 0.70 | 0.72 | 68.32 | 1.04 | 1.03 | 1.05 | 74.56 | 1.14 | 1.13 | 1.15 | 68.26 | 1.04 | 1.03 | 1.05 |
| Respiratory | Musculoskeletal | 59.10 | 70.71 | 1.20 | 1.18 | 1.21 | 68.79 | 1.13 | 1.12 | 1.15 | 56.26 | 0.90 | 0.89 | 0.91 | 60.68 | 0.96 | 0.95 | 0.97 | 66.21 | 1.05 | 1.04 | 1.06 |
| Respiratory | Mental disorder | 53.42 | 66.43 | 1.24 | 1.23 | 1.26 | 46.79 | 0.86 | 0.85 | 0.87 | 54.80 | 0.99 | 0.97 | 1.00 | 56.47 | 1.01 | 1.00 | 1.03 | 59.10 | 1.06 | 1.05 | 1.07 |
| Respiratory | Diabetes | 18.96 | 11.61 | 0.61 | 0.59 | 0.63 | 4.14 | 0.21 | 0.20 | 0.22 | 32.59 | 1.62 | 1.59 | 1.67 | 29.00 | 1.44 | 1.40 | 1.47 | 21.00 | 1.04 | 1.01 | 1.07 |
| Respiratory | Stomach ulcer | 13.49 | 10.69 | 0.79 | 0.76 | 0.82 | 14.63 | 1.07 | 1.03 | 1.10 | 31.90 | 2.28 | 2.22 | 2.35 | 24.85 | 1.75 | 1.70 | 1.80 | 19.22 | 1.32 | 1.28 | 1.36 |
| Respiratory | Cancer | 10.22 | 15.81 | 1.55 | 1.49 | 1.61 | 5.11 | 0.48 | 0.46 | 0.51 | 9.25 | 0.86 | 0.83 | 0.90 | 13.15 | 1.22 | 1.17 | 1.26 | 16.03 | 1.44 | 1.39 | 1.48 |

| | | | | | | | | | | | | | | | | | | | | | | |
|---------------|-----------------|-------|--------|------|------|------|--------|------|------|------|-------|------|------|------|-------|------|------|------|-------|------|------|------|
| Respiratory | Dementia | 2.98 | 0.66 | 0.22 | 0.19 | 0.26 | 3.18 | 1.02 | 0.94 | 1.12 | 1.89 | 0.62 | 0.57 | 0.67 | 4.01 | 1.25 | 1.17 | 1.33 | 2.39 | 0.71 | 0.65 | 0.77 |
| Stomach ulcer | Musculoskeletal | 62.75 | 74.82 | 1.19 | 1.18 | 1.20 | 54.13 | 0.85 | 0.84 | 0.86 | 78.26 | 1.21 | 1.20 | 1.22 | 67.88 | 1.04 | 1.03 | 1.05 | 68.18 | 1.04 | 1.03 | 1.05 |
| Stomach ulcer | Cardiovascular | 61.97 | 64.79 | 1.05 | 1.04 | 1.06 | 50.18 | 0.79 | 0.78 | 0.80 | 59.99 | 0.94 | 0.93 | 0.95 | 80.97 | 1.25 | 1.24 | 1.27 | 61.95 | 0.96 | 0.95 | 0.97 |
| Stomach ulcer | Mental disorder | 58.11 | 64.59 | 1.11 | 1.10 | 1.12 | 71.16 | 1.23 | 1.22 | 1.24 | 59.50 | 1.02 | 1.01 | 1.03 | 57.80 | 0.98 | 0.97 | 1.00 | 63.64 | 1.07 | 1.06 | 1.09 |
| Stomach ulcer | Respiratory | 18.23 | 11.80 | 0.65 | 0.63 | 0.67 | 15.62 | 0.86 | 0.83 | 0.88 | 31.99 | 1.72 | 1.68 | 1.77 | 24.31 | 1.31 | 1.27 | 1.34 | 23.83 | 1.25 | 1.22 | 1.29 |
| Stomach ulcer | Diabetes | 16.54 | 33.60 | 2.03 | 1.97 | 2.09 | 6.11 | 0.36 | 0.34 | 0.37 | 36.32 | 2.09 | 2.04 | 2.14 | 25.44 | 1.43 | 1.39 | 1.47 | 17.03 | 0.93 | 0.91 | 0.96 |
| Stomach ulcer | Cancer | 11.12 | 15.75 | 1.42 | 1.37 | 1.47 | 11.44 | 1.01 | 0.97 | 1.05 | 8.64 | 0.76 | 0.73 | 0.79 | 10.12 | 0.88 | 0.84 | 0.92 | 16.92 | 1.43 | 1.38 | 1.48 |
| Stomach ulcer | Dementia | 2.99 | 0.00 | 0.00 | 0.00 | 0.00 | 3.11 | 1.04 | 0.96 | 1.11 | 4.24 | 1.41 | 1.31 | 1.52 | 3.89 | 1.19 | 1.10 | 1.28 | 1.61 | 0.47 | 0.43 | 0.52 |
| Cancer | Cardiovascular | 54.05 | 53.85 | 1.00 | 0.98 | 1.01 | 56.07 | 1.02 | 1.01 | 1.03 | 42.12 | 0.75 | 0.74 | 0.77 | 76.58 | 1.36 | 1.35 | 1.38 | 56.55 | 1.00 | 0.99 | 1.02 |
| Cancer | Musculoskeletal | 48.47 | 55.81 | 1.15 | 1.13 | 1.17 | 58.47 | 1.18 | 1.17 | 1.20 | 35.47 | 0.71 | 0.70 | 0.72 | 57.39 | 1.13 | 1.12 | 1.13 | 54.15 | 1.05 | 1.03 | 1.06 |
| Cancer | Mental disorder | 45.24 | 70.36 | 1.56 | 1.53 | 1.58 | 61.30 | 1.33 | 1.31 | 1.35 | 41.14 | 0.89 | 0.87 | 0.90 | 51.56 | 1.10 | 1.08 | 1.12 | 47.30 | 1.00 | 1.00 | 1.00 |
| Cancer | Diabetes | 14.03 | 27.27 | 1.94 | 1.88 | 2.00 | 33.26 | 2.29 | 2.22 | 2.35 | 14.70 | 1.00 | 0.97 | 1.02 | 25.21 | 1.68 | 1.63 | 1.73 | 12.98 | 0.84 | 0.81 | 0.88 |
| Cancer | Respiratory | 12.64 | 21.85 | 1.73 | 1.68 | 1.79 | 8.16 | 0.63 | 0.60 | 0.65 | 13.32 | 1.01 | 0.98 | 1.05 | 22.33 | 1.68 | 1.63 | 1.74 | 20.69 | 1.53 | 1.48 | 1.58 |
| Cancer | Stomach ulcer | 10.23 | 20.08 | 1.96 | 1.90 | 2.04 | 15.16 | 1.44 | 1.39 | 1.50 | 13.72 | 1.30 | 1.25 | 1.35 | 18.00 | 1.67 | 1.61 | 1.72 | 18.34 | 1.65 | 1.59 | 1.72 |
| Cancer | Dementia | 2.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.66 | 1.22 | 1.11 | 1.33 | 3.09 | 1.28 | 1.17 | 1.40 |
| Dementia | Mental disorder | 72.47 | 100.00 | 1.38 | 1.37 | 1.39 | 86.76 | 1.21 | 1.21 | 1.22 | 50.00 | 0.70 | 0.68 | 0.71 | 78.57 | 1.08 | 1.07 | 1.09 | 70.15 | 0.95 | 0.94 | 0.96 |
| Dementia | Cardiovascular | 68.12 | 61.40 | 0.90 | 0.89 | 0.91 | 100.00 | 1.42 | 1.41 | 1.43 | 89.02 | 1.25 | 1.24 | 1.26 | 81.75 | 1.15 | 1.14 | 1.15 | 64.49 | 0.89 | 0.88 | 0.90 |
| Dementia | Musculoskeletal | 54.95 | 24.34 | 0.44 | 0.43 | 0.45 | 73.53 | 1.29 | 1.28 | 1.30 | 50.00 | 0.86 | 0.84 | 0.87 | 69.98 | 1.18 | 1.16 | 1.19 | 58.45 | 0.97 | 0.96 | 0.98 |
| Dementia | Diabetes | 20.72 | 0.00 | 0.00 | 0.00 | 0.00 | 6.62 | 0.31 | 0.30 | 0.33 | 50.00 | 2.26 | 2.21 | 2.30 | 31.43 | 1.36 | 1.33 | 1.39 | 25.45 | 1.11 | 1.08 | 1.13 |
| Dementia | Respiratory | 17.84 | 8.46 | 0.47 | 0.46 | 0.49 | 26.47 | 1.36 | 1.32 | 1.39 | 10.98 | 0.58 | 0.55 | 0.60 | 30.34 | 1.50 | 1.46 | 1.53 | 15.59 | 0.77 | 0.74 | 0.79 |
| Dementia | Stomach ulcer | 12.86 | 0.00 | 0.00 | 0.00 | 0.00 | 47.06 | 3.50 | 3.40 | 3.59 | 35.98 | 2.63 | 2.55 | 2.71 | 29.95 | 1.86 | 1.81 | 1.92 | 7.85 | 0.50 | 0.48 | 0.52 |
| Dementia | Cancer | 9.22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 8.62 | 0.86 | 0.84 | 0.88 | 16.29 | 1.49 | 1.44 | 1.55 |

* p < 0.05; ** p < 0.01; *** p < 0.001

^a Probability of having condition 2 given that condition 1 is already present.

Note: Values are age-standardized using the 2013 European standard population.

Abbreviations: Prev. = prevalence (estimated as the conditional probability); RR = relative risk; CI = confidence interval

Table S9. Conditional probability (in percentages) ^a and relative risk of chronic disease combinations by immigrant status and receiving country group among men

| Condition 1 | Condition 2 | Eastern Europe | | | | Northern Europe | | | | Southern Europe | | | | Western Europe | | | | | | | |
|-----------------|-----------------|----------------|---------|------|--------|-----------------|---------|-------|--------|-----------------|---------|-------|--------|----------------|---------|------|--------|-------|------|------|------|
| | | Nat. | Immigr. | RR | 95% CI | Nat. | Immigr. | RR | 95% CI | Nat. | Immigr. | RR | 95% CI | Nat. | Immigr. | RR | 95% CI | | | | |
| Cardiovascular | Musculoskeletal | 32.85 | 38.45 | 1.17 | 1.15 | 1.19 | 30.93 | 29.01 | 0.94 | 0.92 | 0.96 | 23.89 | 19.75 | 0.83 | 0.80 | 0.85 | 31.55 | 35.00 | 1.11 | 1.09 | 1.13 |
| Cardiovascular | Mental disorder | 23.41 | 29.80 | 1.27 | 1.25 | 1.30 | 20.79 | 28.72 | 1.38 | 1.35 | 1.42 | 21.20 | 23.49 | 1.11 | 1.08 | 1.14 | 30.68 | 28.73 | 0.94 | 0.92 | 0.96 |
| Cardiovascular | Diabetes | 22.61 | 20.64 | 0.91 | 0.89 | 0.94 | 18.47 | 26.63 | 1.44 | 1.41 | 1.48 | 23.02 | 25.96 | 1.13 | 1.10 | 1.15 | 21.07 | 26.10 | 1.24 | 1.21 | 1.27 |
| Cardiovascular | Respiratory | 11.66 | 14.08 | 1.21 | 1.17 | 1.25 | 12.05 | 10.84 | 0.90 | 0.87 | 0.93 | 10.76 | 12.55 | 1.17 | 1.12 | 1.21 | 12.96 | 14.75 | 1.14 | 1.10 | 1.18 |
| Cardiovascular | Stomach ulcer | 11.25 | 17.69 | 1.57 | 1.52 | 1.63 | 7.14 | 14.05 | 1.97 | 1.88 | 2.06 | 9.18 | 7.90 | 0.86 | 0.82 | 0.90 | 8.46 | 9.99 | 1.18 | 1.13 | 1.24 |
| Cardiovascular | Cancer | 6.68 | 4.94 | 0.74 | 0.70 | 0.78 | 8.44 | 8.79 | 1.04 | 1.00 | 1.08 | 5.50 | 7.20 | 1.31 | 1.24 | 1.39 | 8.86 | 8.11 | 0.92 | 0.87 | 0.96 |
| Cardiovascular | Dementia | 2.83 | 1.99 | 0.70 | 0.64 | 0.77 | 1.82 | 4.72 | 2.59 | 2.38 | 2.82 | 2.19 | 2.84 | 1.30 | 1.19 | 1.42 | 2.59 | 2.07 | 0.80 | 0.73 | 0.88 |
| Musculoskeletal | Cardiovascular | 69.84 | 70.39 | 1.01 | 1.00 | 1.01 | 58.61 | 55.69 | 0.95 | 0.94 | 0.96 | 65.84 | 62.04 | 0.94 | 0.93 | 0.95 | 61.09 | 61.52 | 1.01 | 1.00 | 1.02 |
| Musculoskeletal | Mental disorder | 28.30 | 34.70 | 1.23 | 1.20 | 1.25 | 23.71 | 23.79 | 1.00 | 0.98 | 1.02 | 30.11 | 29.41 | 0.98 | 0.96 | 1.00 | 37.42 | 30.92 | 0.83 | 0.81 | 0.84 |
| Musculoskeletal | Diabetes | 21.21 | 20.15 | 0.95 | 0.92 | 0.98 | 14.54 | 20.32 | 1.40 | 1.35 | 1.44 | 22.00 | 21.41 | 0.97 | 0.95 | 1.00 | 17.91 | 24.84 | 1.39 | 1.35 | 1.42 |
| Musculoskeletal | Stomach ulcer | 15.48 | 20.42 | 1.32 | 1.29 | 1.35 | 7.45 | 17.32 | 2.32 | 2.24 | 2.43 | 13.67 | 12.61 | 0.92 | 0.89 | 0.96 | 11.78 | 13.69 | 1.16 | 1.12 | 1.21 |
| Musculoskeletal | Respiratory | 14.63 | 15.43 | 1.06 | 1.02 | 1.09 | 15.04 | 10.42 | 0.69 | 0.67 | 0.72 | 16.06 | 18.50 | 1.15 | 1.12 | 1.19 | 16.66 | 15.84 | 0.95 | 0.92 | 0.98 |
| Musculoskeletal | Cancer | 6.82 | 3.47 | 0.51 | 0.48 | 0.54 | 8.52 | 10.23 | 1.20 | 1.15 | 1.26 | 6.60 | 7.37 | 1.12 | 1.06 | 1.17 | 9.48 | 8.10 | 0.85 | 0.81 | 0.89 |
| Musculoskeletal | Dementia | 3.36 | 2.08 | 0.62 | 0.57 | 0.67 | 2.16 | 3.02 | 1.40 | 1.28 | 1.54 | 3.08 | 5.81 | 1.89 | 1.77 | 2.02 | 2.68 | 1.96 | 0.73 | 0.66 | 0.81 |
| Mental disorder | Cardiovascular | 71.00 | 71.42 | 1.01 | 1.00 | 1.01 | 55.20 | 57.13 | 1.03 | 1.02 | 1.05 | 66.54 | 62.81 | 0.94 | 0.94 | 0.95 | 59.48 | 60.81 | 1.02 | 1.01 | 1.03 |
| Mental disorder | Musculoskeletal | 40.25 | 44.76 | 1.11 | 1.09 | 1.13 | 32.84 | 26.07 | 0.79 | 0.78 | 0.81 | 33.85 | 25.82 | 0.76 | 0.75 | 0.78 | 37.53 | 38.09 | 1.01 | 1.00 | 1.03 |
| Mental disorder | Diabetes | 21.37 | 20.49 | 0.96 | 0.93 | 0.99 | 15.89 | 26.25 | 1.65 | 1.60 | 1.70 | 22.48 | 24.66 | 1.10 | 1.07 | 1.12 | 17.84 | 27.52 | 1.54 | 1.50 | 1.59 |
| Mental disorder | Stomach ulcer | 18.99 | 20.10 | 1.06 | 1.03 | 1.09 | 9.55 | 19.33 | 2.02 | 1.95 | 2.10 | 15.14 | 13.53 | 0.89 | 0.86 | 0.92 | 12.25 | 15.55 | 1.27 | 1.23 | 1.31 |
| Mental disorder | Respiratory | 14.98 | 17.80 | 1.19 | 1.15 | 1.23 | 17.21 | 4.63 | 0.27 | 0.25 | 0.28 | 16.65 | 15.05 | 0.90 | 0.88 | 0.93 | 16.92 | 18.93 | 1.12 | 1.09 | 1.15 |
| Mental disorder | Cancer | 8.97 | 7.04 | 0.79 | 0.75 | 0.82 | 7.88 | 10.41 | 1.32 | 1.27 | 1.38 | 8.33 | 7.29 | 0.88 | 0.83 | 0.92 | 10.32 | 10.15 | 0.98 | 0.95 | 1.03 |
| Mental disorder | Dementia | 6.45 | 3.03 | 0.47 | 0.44 | 0.50 | 3.59 | 6.25 | 1.74 | 1.64 | 1.86 | 5.56 | 10.19 | 1.83 | 1.75 | 1.93 | 4.35 | 4.06 | 0.93 | 0.87 | 0.99 |
| Diabetes | Cardiovascular | 83.46 | 89.68 | 1.07 | 1.07 | 1.08 | 79.00 | 82.92 | 1.05 | 1.04 | 1.06 | 74.34 | 74.26 | 1.00 | 0.99 | 1.01 | 78.21 | 70.98 | 0.91 | 0.90 | 0.91 |
| Diabetes | Musculoskeletal | 36.53 | 47.64 | 1.30 | 1.28 | 1.33 | 33.03 | 33.67 | 1.02 | 1.00 | 1.04 | 25.56 | 19.36 | 0.76 | 0.74 | 0.78 | 34.19 | 38.70 | 1.13 | 1.11 | 1.15 |
| Diabetes | Mental disorder | 25.85 | 37.90 | 1.47 | 1.44 | 1.50 | 26.38 | 40.70 | 1.54 | 1.51 | 1.57 | 22.85 | 26.44 | 1.16 | 1.13 | 1.19 | 33.56 | 35.10 | 1.05 | 1.03 | 1.06 |
| Diabetes | Respiratory | 12.83 | 19.25 | 1.50 | 1.45 | 1.55 | 12.80 | 6.18 | 0.48 | 0.46 | 0.51 | 13.05 | 16.17 | 1.24 | 1.20 | 1.28 | 15.26 | 14.91 | 0.98 | 0.95 | 1.01 |
| Diabetes | Stomach ulcer | 10.01 | 14.87 | 1.49 | 1.43 | 1.55 | 7.99 | 26.18 | 3.28 | 3.16 | 3.40 | 9.97 | 8.79 | 0.88 | 0.85 | 0.92 | 9.06 | 12.42 | 1.37 | 1.32 | 1.42 |
| Diabetes | Cancer | 7.46 | 6.82 | 0.91 | 0.87 | 0.96 | 8.22 | 3.77 | 0.46 | 0.43 | 0.49 | 5.91 | 8.95 | 1.51 | 1.44 | 1.60 | 9.67 | 6.75 | 0.70 | 0.67 | 0.73 |
| Diabetes | Dementia | 3.23 | 2.11 | 0.65 | 0.60 | 0.71 | 1.89 | 4.28 | 2.27 | 2.06 | 2.48 | 2.97 | 6.07 | 2.04 | 1.91 | 2.19 | 2.68 | 3.32 | 1.24 | 1.14 | 1.35 |
| Respiratory | Cardiovascular | 74.08 | 69.35 | 0.94 | 0.93 | 0.94 | 58.54 | 55.71 | 0.95 | 0.94 | 0.96 | 67.21 | 70.34 | 1.05 | 1.04 | 1.06 | 64.17 | 67.64 | 1.05 | 1.04 | 1.06 |
| Respiratory | Musculoskeletal | 43.59 | 41.69 | 0.96 | 0.94 | 0.97 | 38.40 | 28.66 | 0.75 | 0.73 | 0.76 | 36.29 | 33.76 | 0.93 | 0.92 | 0.95 | 42.58 | 41.31 | 0.97 | 0.95 | 0.99 |
| Respiratory | Mental disorder | 31.67 | 36.66 | 1.16 | 1.14 | 1.18 | 31.72 | 12.45 | 0.39 | 0.38 | 0.40 | 33.76 | 32.29 | 0.96 | 0.94 | 0.98 | 43.37 | 41.80 | 0.96 | 0.95 | 0.98 |
| Respiratory | Diabetes | 22.15 | 22.00 | 0.99 | 0.97 | 1.02 | 14.53 | 10.03 | 0.69 | 0.66 | 0.71 | 25.41 | 31.51 | 1.24 | 1.21 | 1.27 | 20.45 | 24.92 | 1.22 | 1.20 | 1.24 |
| Respiratory | Stomach ulcer | 17.10 | 22.71 | 1.33 | 1.29 | 1.37 | 12.78 | 16.63 | 1.30 | 1.26 | 1.35 | 16.22 | 11.50 | 0.71 | 0.69 | 0.73 | 14.39 | 14.52 | 1.01 | 0.97 | 1.04 |
| Respiratory | Cancer | 9.52 | 8.02 | 0.84 | 0.81 | 0.88 | 7.97 | 10.47 | 1.31 | 1.27 | 1.36 | 8.18 | 16.73 | 2.05 | 1.96 | 2.14 | 11.81 | 12.47 | 1.06 | 1.02 | 1.09 |
| Respiratory | Dementia | 4.47 | 2.05 | 0.46 | 0.42 | 0.50 | 1.91 | 0.82 | 0.43 | 0.37 | 0.49 | 2.38 | 6.42 | 2.70 | 2.51 | 2.92 | 4.43 | 2.38 | 0.54 | 0.50 | 0.58 |

| | | | | | | | | | | | | | | | | | | | | | |
|---------------|-----------------|-------|-------|------|------|------|-------|-------|------|------|------|-------|-------|------|------|------|-------|-------|------|------|------|
| Stomach ulcer | Cardiovascular | 66.94 | 64.02 | 0.96 | 0.95 | 0.97 | 63.91 | 56.78 | 0.89 | 0.88 | 0.90 | 63.40 | 54.02 | 0.85 | 0.84 | 0.86 | 61.68 | 59.84 | 0.97 | 0.96 | 0.98 |
| Stomach ulcer | Musculoskeletal | 42.83 | 40.80 | 0.95 | 0.94 | 0.97 | 35.66 | 40.67 | 1.14 | 1.12 | 1.16 | 33.95 | 27.54 | 0.81 | 0.80 | 0.83 | 44.26 | 45.58 | 1.03 | 1.01 | 1.04 |
| Stomach ulcer | Mental disorder | 37.17 | 29.74 | 0.80 | 0.78 | 0.81 | 32.85 | 46.57 | 1.42 | 1.39 | 1.45 | 33.36 | 33.49 | 1.00 | 0.99 | 1.02 | 46.68 | 43.55 | 0.93 | 0.92 | 0.95 |
| Stomach ulcer | Diabetes | 16.68 | 12.72 | 0.76 | 0.74 | 0.79 | 16.73 | 31.38 | 1.88 | 1.82 | 1.92 | 21.17 | 21.28 | 1.01 | 0.98 | 1.03 | 17.48 | 26.91 | 1.54 | 1.50 | 1.58 |
| Stomach ulcer | Respiratory | 16.08 | 16.92 | 1.05 | 1.02 | 1.09 | 23.89 | 17.34 | 0.73 | 0.71 | 0.75 | 17.94 | 13.65 | 0.76 | 0.74 | 0.79 | 21.19 | 19.26 | 0.91 | 0.88 | 0.94 |
| Stomach ulcer | Cancer | 7.63 | 6.78 | 0.89 | 0.85 | 0.93 | 12.13 | 11.82 | 0.97 | 0.94 | 1.01 | 8.86 | 14.70 | 1.66 | 1.59 | 1.73 | 11.69 | 11.93 | 1.02 | 0.98 | 1.06 |
| Stomach ulcer | Dementia | 3.36 | 3.58 | 1.07 | 0.99 | 1.15 | 3.03 | 1.02 | 0.34 | 0.30 | 0.38 | 3.43 | 3.62 | 1.05 | 0.98 | 1.14 | 3.57 | 4.09 | 1.15 | 1.07 | 1.24 |
| Cancer | Cardiovascular | 69.29 | 56.84 | 0.82 | 0.81 | 0.83 | 58.49 | 56.39 | 0.96 | 0.95 | 0.98 | 59.53 | 56.59 | 0.95 | 0.94 | 0.96 | 60.57 | 59.15 | 0.98 | 0.97 | 0.99 |
| Cancer | Musculoskeletal | 32.83 | 21.70 | 0.66 | 0.65 | 0.68 | 30.93 | 35.64 | 1.15 | 1.14 | 1.17 | 26.01 | 19.62 | 0.75 | 0.74 | 0.77 | 32.75 | 33.35 | 1.02 | 1.00 | 1.04 |
| Cancer | Mental disorder | 30.74 | 34.76 | 1.13 | 1.11 | 1.15 | 18.71 | 39.85 | 2.13 | 2.08 | 2.18 | 28.22 | 23.40 | 0.83 | 0.81 | 0.85 | 37.29 | 34.02 | 0.91 | 0.90 | 0.93 |
| Cancer | Diabetes | 21.55 | 19.95 | 0.93 | 0.90 | 0.95 | 13.90 | 7.00 | 0.50 | 0.48 | 0.53 | 19.96 | 24.12 | 1.21 | 1.17 | 1.24 | 18.22 | 17.71 | 0.97 | 0.94 | 1.00 |
| Cancer | Respiratory | 16.12 | 20.28 | 1.26 | 1.22 | 1.30 | 10.46 | 9.12 | 0.87 | 0.84 | 0.91 | 14.32 | 24.89 | 1.74 | 1.69 | 1.79 | 16.83 | 19.96 | 1.19 | 1.15 | 1.22 |
| Cancer | Stomach ulcer | 12.32 | 28.30 | 2.30 | 2.23 | 2.36 | 9.56 | 17.23 | 1.80 | 1.73 | 1.87 | 14.31 | 15.83 | 1.11 | 1.07 | 1.14 | 10.81 | 12.58 | 1.16 | 1.12 | 1.21 |
| Cancer | Dementia | 3.79 | 2.16 | 0.57 | 0.52 | 0.62 | 1.68 | 3.17 | 1.88 | 1.71 | 2.07 | 3.10 | 4.00 | 1.29 | 1.21 | 1.38 | 2.59 | 1.53 | 0.59 | 0.53 | 0.65 |
| Dementia | Cardiovascular | 79.64 | 70.44 | 0.88 | 0.88 | 0.89 | 69.60 | 66.46 | 0.95 | 0.95 | 0.96 | 63.49 | 45.21 | 0.71 | 0.70 | 0.72 | 69.07 | 70.90 | 1.03 | 1.02 | 1.04 |
| Dementia | Mental disorder | 64.03 | 40.69 | 0.64 | 0.63 | 0.65 | 53.12 | 42.44 | 0.80 | 0.79 | 0.81 | 60.25 | 72.07 | 1.20 | 1.18 | 1.21 | 61.91 | 73.15 | 1.18 | 1.17 | 1.19 |
| Dementia | Musculoskeletal | 46.08 | 51.63 | 1.12 | 1.10 | 1.14 | 38.79 | 16.80 | 0.43 | 0.42 | 0.44 | 34.09 | 37.25 | 1.09 | 1.07 | 1.12 | 37.82 | 38.23 | 1.01 | 0.99 | 1.03 |
| Dementia | Diabetes | 25.31 | 11.13 | 0.44 | 0.43 | 0.45 | 17.92 | 14.13 | 0.79 | 0.76 | 0.81 | 27.28 | 41.33 | 1.51 | 1.48 | 1.54 | 19.04 | 47.47 | 2.49 | 2.44 | 2.55 |
| Dementia | Respiratory | 20.91 | 11.90 | 0.57 | 0.55 | 0.59 | 13.08 | 2.11 | 0.16 | 0.15 | 0.17 | 10.61 | 22.09 | 2.08 | 2.01 | 2.16 | 24.92 | 17.10 | 0.69 | 0.67 | 0.71 |
| Dementia | Stomach ulcer | 14.48 | 56.41 | 3.90 | 3.79 | 4.01 | 14.70 | 2.11 | 0.14 | 0.13 | 0.15 | 13.87 | 11.77 | 0.85 | 0.82 | 0.88 | 15.40 | 25.14 | 1.63 | 1.58 | 1.68 |
| Dementia | Cancer | 10.42 | 7.88 | 0.76 | 0.72 | 0.79 | 9.19 | 5.79 | 0.63 | 0.60 | 0.66 | 8.53 | 8.86 | 1.04 | 0.99 | 1.09 | 10.08 | 6.76 | 0.67 | 0.64 | 0.70 |

* p < 0.05; ** p < 0.01; *** p < 0.001

^a Probability of having condition 2 given that condition 1 is already present.

Note: Values are age-standardized using the 2013 European standard population.

Abbreviations: Nat = natives; Immigr = immigrants; RR = relative risk; CI = confidence interval

Table S10. Conditional probability (in percentages) ^a and relative risk of chronic disease combinations by immigrant status and receiving country group among women

| Condition 1 | Condition 2 | Eastern Europe | | | | Northern Europe | | | | Southern Europe | | | | Western Europe | | | | | | | |
|-----------------|-----------------|----------------|---------|------|--------|-----------------|---------|-------|--------|-----------------|---------|-------|--------|----------------|---------|------|--------|-------|------|------|------|
| | | Nat. | Immigr. | RR | 95% CI | Nat. | Immigr. | RR | 95% CI | Nat. | Immigr. | RR | 95% CI | Nat. | Immigr. | RR | 95% CI | | | | |
| Cardiovascular | Musculoskeletal | 46.90 | 52.54 | 1.12 | 1.10 | 1.14 | 44.13 | 49.10 | 1.11 | 1.10 | 1.13 | 49.60 | 43.01 | 0.87 | 0.85 | 0.88 | 50.97 | 56.55 | 1.11 | 1.10 | 1.12 |
| Cardiovascular | Mental disorder | 39.19 | 45.15 | 1.15 | 1.13 | 1.17 | 33.80 | 37.42 | 1.11 | 1.09 | 1.12 | 40.31 | 33.11 | 0.82 | 0.81 | 0.84 | 47.37 | 47.98 | 1.01 | 1.00 | 1.03 |
| Cardiovascular | Diabetes | 21.01 | 26.78 | 1.27 | 1.24 | 1.31 | 14.88 | 17.16 | 1.15 | 1.12 | 1.19 | 20.29 | 19.75 | 0.97 | 0.95 | 1.00 | 16.45 | 22.50 | 1.37 | 1.33 | 1.41 |
| Cardiovascular | Respiratory | 12.18 | 15.77 | 1.29 | 1.25 | 1.34 | 14.43 | 21.83 | 1.51 | 1.46 | 1.56 | 10.20 | 10.79 | 1.06 | 1.02 | 1.10 | 13.88 | 16.33 | 1.18 | 1.14 | 1.22 |
| Cardiovascular | Stomach ulcer | 10.25 | 19.34 | 1.89 | 1.82 | 1.96 | 6.35 | 10.66 | 1.68 | 1.61 | 1.76 | 9.32 | 10.51 | 1.13 | 1.08 | 1.17 | 8.81 | 12.20 | 1.38 | 1.33 | 1.44 |
| Cardiovascular | Cancer | 7.31 | 9.02 | 1.23 | 1.17 | 1.29 | 10.11 | 10.37 | 1.03 | 0.99 | 1.06 | 7.70 | 8.84 | 1.15 | 1.09 | 1.20 | 10.08 | 10.41 | 1.03 | 1.00 | 1.07 |
| Cardiovascular | Dementia | 2.48 | 2.29 | 0.92 | 0.84 | 1.01 | 1.51 | 2.42 | 1.61 | 1.45 | 1.78 | 2.67 | 2.16 | 0.81 | 0.74 | 0.89 | 2.09 | 2.45 | 1.17 | 1.07 | 1.29 |
| Musculoskeletal | Cardiovascular | 70.61 | 74.18 | 1.05 | 1.04 | 1.06 | 48.19 | 57.29 | 1.19 | 1.17 | 1.21 | 60.48 | 59.98 | 0.99 | 0.98 | 1.00 | 52.90 | 56.94 | 1.08 | 1.06 | 1.09 |
| Musculoskeletal | Mental disorder | 46.09 | 53.90 | 1.17 | 1.15 | 1.19 | 37.40 | 45.06 | 1.20 | 1.18 | 1.23 | 46.32 | 43.24 | 0.93 | 0.92 | 0.95 | 53.28 | 51.21 | 0.96 | 0.95 | 0.97 |
| Musculoskeletal | Diabetes | 19.37 | 26.09 | 1.35 | 1.31 | 1.38 | 9.52 | 9.84 | 1.03 | 0.99 | 1.08 | 17.13 | 16.36 | 0.95 | 0.93 | 0.99 | 12.04 | 16.51 | 1.37 | 1.32 | 1.42 |
| Musculoskeletal | Respiratory | 14.77 | 17.75 | 1.20 | 1.16 | 1.24 | 16.88 | 22.96 | 1.36 | 1.32 | 1.40 | 11.79 | 12.84 | 1.09 | 1.05 | 1.13 | 14.97 | 16.82 | 1.12 | 1.09 | 1.16 |
| Musculoskeletal | Stomach ulcer | 13.42 | 22.10 | 1.65 | 1.59 | 1.70 | 8.20 | 13.20 | 1.61 | 1.54 | 1.68 | 11.82 | 13.29 | 1.12 | 1.08 | 1.17 | 10.25 | 15.04 | 1.47 | 1.42 | 1.53 |
| Musculoskeletal | Cancer | 8.24 | 9.53 | 1.16 | 1.11 | 1.22 | 11.41 | 11.44 | 1.00 | 0.97 | 1.04 | 7.70 | 7.00 | 0.91 | 0.86 | 0.95 | 10.82 | 10.79 | 1.00 | 0.96 | 1.04 |
| Musculoskeletal | Dementia | 2.71 | 2.67 | 0.99 | 0.92 | 1.06 | 1.33 | 1.76 | 1.32 | 1.18 | 1.49 | 2.65 | 1.86 | 0.70 | 0.64 | 0.77 | 2.03 | 2.31 | 1.14 | 1.04 | 1.26 |
| Mental disorder | Cardiovascular | 68.46 | 74.65 | 1.09 | 1.08 | 1.10 | 49.03 | 56.94 | 1.16 | 1.14 | 1.18 | 61.66 | 59.54 | 0.97 | 0.96 | 0.98 | 52.10 | 56.05 | 1.08 | 1.06 | 1.09 |
| Mental disorder | Musculoskeletal | 53.37 | 62.39 | 1.17 | 1.16 | 1.18 | 49.72 | 57.15 | 1.15 | 1.13 | 1.17 | 58.05 | 55.37 | 0.95 | 0.94 | 0.96 | 56.38 | 59.36 | 1.05 | 1.04 | 1.07 |
| Mental disorder | Diabetes | 18.70 | 26.57 | 1.42 | 1.39 | 1.46 | 10.64 | 11.76 | 1.10 | 1.07 | 1.14 | 18.70 | 18.84 | 1.01 | 0.97 | 1.04 | 12.43 | 16.55 | 1.33 | 1.29 | 1.38 |
| Mental disorder | Respiratory | 14.82 | 19.24 | 1.30 | 1.26 | 1.34 | 17.35 | 22.14 | 1.28 | 1.24 | 1.31 | 12.41 | 12.83 | 1.03 | 1.00 | 1.08 | 15.30 | 18.62 | 1.22 | 1.18 | 1.26 |
| Mental disorder | Stomach ulcer | 13.86 | 22.42 | 1.62 | 1.57 | 1.67 | 8.96 | 16.30 | 1.82 | 1.75 | 1.90 | 12.66 | 14.88 | 1.18 | 1.13 | 1.22 | 10.71 | 15.75 | 1.47 | 1.42 | 1.53 |
| Mental disorder | Cancer | 9.54 | 10.35 | 1.09 | 1.04 | 1.13 | 11.09 | 12.49 | 1.13 | 1.08 | 1.17 | 8.77 | 8.64 | 0.99 | 0.94 | 1.03 | 11.13 | 11.85 | 1.07 | 1.02 | 1.11 |
| Mental disorder | Dementia | 3.90 | 3.31 | 0.85 | 0.79 | 0.91 | 2.19 | 2.43 | 1.11 | 1.01 | 1.22 | 4.18 | 4.60 | 1.10 | 1.03 | 1.17 | 2.65 | 3.33 | 1.26 | 1.16 | 1.37 |
| Diabetes | Cardiovascular | 86.22 | 90.85 | 1.05 | 1.05 | 1.06 | 79.59 | 85.97 | 1.08 | 1.07 | 1.09 | 77.23 | 78.31 | 1.01 | 1.01 | 1.02 | 75.92 | 79.03 | 1.04 | 1.03 | 1.05 |
| Diabetes | Musculoskeletal | 52.68 | 62.39 | 1.18 | 1.17 | 1.20 | 46.73 | 43.03 | 0.92 | 0.91 | 0.94 | 53.00 | 46.09 | 0.87 | 0.85 | 0.88 | 53.59 | 57.66 | 1.08 | 1.06 | 1.09 |
| Diabetes | Mental disorder | 42.95 | 53.47 | 1.24 | 1.22 | 1.27 | 39.51 | 40.15 | 1.02 | 1.00 | 1.03 | 46.37 | 40.24 | 0.87 | 0.85 | 0.88 | 52.21 | 49.85 | 0.95 | 0.94 | 0.97 |
| Diabetes | Respiratory | 16.13 | 22.22 | 1.38 | 1.34 | 1.42 | 21.99 | 22.68 | 1.03 | 1.00 | 1.06 | 13.13 | 10.79 | 0.82 | 0.79 | 0.85 | 18.00 | 19.15 | 1.06 | 1.04 | 1.09 |
| Diabetes | Stomach ulcer | 11.63 | 21.70 | 1.87 | 1.81 | 1.93 | 9.85 | 15.38 | 1.56 | 1.50 | 1.63 | 9.69 | 12.10 | 1.25 | 1.20 | 1.30 | 10.86 | 13.88 | 1.28 | 1.23 | 1.32 |
| Diabetes | Cancer | 9.56 | 9.36 | 0.98 | 0.94 | 1.02 | 11.70 | 12.81 | 1.09 | 1.05 | 1.14 | 7.49 | 10.50 | 1.40 | 1.34 | 1.47 | 11.10 | 12.16 | 1.10 | 1.05 | 1.14 |
| Diabetes | Dementia | 2.99 | 3.59 | 1.20 | 1.11 | 1.30 | 1.98 | 2.58 | 1.30 | 1.18 | 1.43 | 4.05 | 2.77 | 0.68 | 0.63 | 0.74 | 2.26 | 3.18 | 1.41 | 1.29 | 1.54 |
| Respiratory | Cardiovascular | 74.84 | 78.72 | 1.05 | 1.04 | 1.06 | 54.57 | 70.11 | 1.28 | 1.27 | 1.30 | 68.31 | 68.94 | 1.01 | 1.00 | 1.02 | 60.05 | 63.84 | 1.06 | 1.06 | 1.07 |
| Respiratory | Musculoskeletal | 60.23 | 63.21 | 1.05 | 1.04 | 1.06 | 58.13 | 62.58 | 1.08 | 1.06 | 1.09 | 64.79 | 58.93 | 0.91 | 0.90 | 0.92 | 62.39 | 65.86 | 1.06 | 1.04 | 1.07 |
| Respiratory | Mental disorder | 52.46 | 58.88 | 1.12 | 1.12 | 1.12 | 44.90 | 47.97 | 1.07 | 1.05 | 1.08 | 54.65 | 46.42 | 0.85 | 0.84 | 0.86 | 60.68 | 62.80 | 1.03 | 1.02 | 1.05 |
| Respiratory | Diabetes | 24.03 | 31.59 | 1.31 | 1.29 | 1.34 | 15.45 | 14.00 | 0.91 | 0.88 | 0.94 | 23.03 | 17.37 | 0.75 | 0.73 | 0.77 | 16.49 | 21.23 | 1.29 | 1.25 | 1.33 |
| Respiratory | Stomach ulcer | 17.23 | 29.09 | 1.69 | 1.64 | 1.73 | 10.35 | 13.01 | 1.26 | 1.21 | 1.31 | 16.22 | 19.07 | 1.18 | 1.14 | 1.21 | 12.08 | 19.12 | 1.58 | 1.53 | 1.64 |
| Respiratory | Cancer | 9.89 | 12.05 | 1.22 | 1.17 | 1.27 | 11.97 | 19.48 | 1.63 | 1.57 | 1.68 | 9.31 | 15.41 | 1.65 | 1.59 | 1.72 | 11.64 | 14.03 | 1.20 | 1.16 | 1.25 |
| Respiratory | Dementia | 3.62 | 3.42 | 0.94 | 0.87 | 1.02 | 2.46 | 1.69 | 0.69 | 0.62 | 0.76 | 3.71 | 4.81 | 1.30 | 1.22 | 1.39 | 2.76 | 2.59 | 0.94 | 0.86 | 1.03 |

| | | | | | | | | | | | | | | | | | | | | | |
|---------------|-----------------|-------|-------|------|------|------|-------|-------|------|------|------|-------|-------|------|------|------|-------|-------|------|------|------|
| Stomach ulcer | Cardiovascular | 70.11 | 82.90 | 1.18 | 1.17 | 1.19 | 56.73 | 61.94 | 1.09 | 1.08 | 1.10 | 61.93 | 62.18 | 1.00 | 0.99 | 1.01 | 60.46 | 61.50 | 1.02 | 1.01 | 1.03 |
| Stomach ulcer | Musculoskeletal | 60.79 | 66.69 | 1.10 | 1.09 | 1.11 | 67.50 | 68.96 | 1.02 | 1.01 | 1.03 | 63.92 | 57.76 | 0.90 | 0.90 | 0.91 | 67.90 | 73.74 | 1.09 | 1.08 | 1.10 |
| Stomach ulcer | Mental disorder | 54.33 | 58.62 | 1.08 | 1.06 | 1.09 | 55.15 | 66.11 | 1.20 | 1.19 | 1.21 | 54.91 | 49.19 | 0.90 | 0.88 | 0.91 | 67.24 | 67.25 | 1.00 | 0.99 | 1.01 |
| Stomach ulcer | Diabetes | 19.41 | 27.48 | 1.42 | 1.38 | 1.46 | 16.38 | 19.25 | 1.18 | 1.14 | 1.21 | 17.19 | 18.12 | 1.05 | 1.02 | 1.09 | 16.09 | 19.94 | 1.24 | 1.20 | 1.28 |
| Stomach ulcer | Respiratory | 19.15 | 24.99 | 1.31 | 1.28 | 1.34 | 24.56 | 25.60 | 1.04 | 1.02 | 1.07 | 15.86 | 18.40 | 1.16 | 1.12 | 1.20 | 19.16 | 24.14 | 1.26 | 1.23 | 1.29 |
| Stomach ulcer | Cancer | 10.72 | 8.47 | 0.79 | 0.75 | 0.82 | 11.17 | 21.02 | 1.88 | 1.82 | 1.95 | 9.39 | 14.65 | 1.56 | 1.50 | 1.62 | 13.97 | 15.94 | 1.14 | 1.11 | 1.17 |
| Stomach ulcer | Dementia | 3.26 | 3.96 | 1.22 | 1.13 | 1.31 | 2.83 | 3.26 | 1.15 | 1.07 | 1.25 | 3.23 | 1.00 | 0.31 | 0.28 | 0.35 | 2.96 | 2.28 | 0.77 | 0.70 | 0.84 |
| Cancer | Cardiovascular | 67.52 | 79.24 | 1.17 | 1.16 | 1.18 | 43.58 | 53.09 | 1.22 | 1.20 | 1.24 | 59.13 | 69.67 | 1.18 | 1.17 | 1.19 | 51.21 | 54.44 | 1.06 | 1.05 | 1.08 |
| Cancer | Mental disorder | 51.16 | 56.00 | 1.09 | 1.08 | 1.11 | 31.80 | 39.30 | 1.24 | 1.21 | 1.26 | 43.58 | 38.44 | 0.88 | 0.87 | 0.90 | 51.18 | 52.64 | 1.03 | 1.02 | 1.04 |
| Cancer | Musculoskeletal | 50.72 | 60.28 | 1.19 | 1.18 | 1.20 | 45.02 | 48.50 | 1.08 | 1.06 | 1.09 | 48.40 | 40.83 | 0.84 | 0.83 | 0.86 | 52.93 | 56.02 | 1.06 | 1.04 | 1.07 |
| Cancer | Diabetes | 21.80 | 25.72 | 1.18 | 1.15 | 1.21 | 9.58 | 10.82 | 1.13 | 1.09 | 1.18 | 15.55 | 20.63 | 1.33 | 1.29 | 1.37 | 12.30 | 18.03 | 1.47 | 1.42 | 1.52 |
| Cancer | Respiratory | 14.83 | 20.93 | 1.41 | 1.37 | 1.46 | 13.59 | 33.94 | 2.50 | 2.42 | 2.56 | 10.58 | 18.92 | 1.79 | 1.72 | 1.85 | 13.57 | 18.36 | 1.35 | 1.31 | 1.40 |
| Cancer | Stomach ulcer | 14.49 | 17.72 | 1.22 | 1.18 | 1.26 | 5.34 | 17.62 | 3.30 | 3.15 | 3.47 | 10.76 | 19.35 | 1.80 | 1.74 | 1.86 | 10.37 | 16.61 | 1.60 | 1.55 | 1.66 |
| Cancer | Dementia | 2.67 | 1.64 | 0.61 | 0.56 | 0.68 | 1.27 | 2.34 | 1.84 | 1.65 | 2.06 | 2.55 | 4.71 | 1.85 | 1.72 | 2.00 | 2.00 | 2.43 | 1.22 | 1.10 | 1.34 |
| Dementia | Cardiovascular | 75.54 | 82.17 | 1.09 | 1.08 | 1.10 | 63.16 | 81.21 | 1.29 | 1.27 | 1.30 | 74.56 | 46.38 | 0.62 | 0.61 | 0.63 | 63.72 | 78.52 | 1.23 | 1.22 | 1.24 |
| Dementia | Mental disorder | 72.71 | 70.13 | 0.96 | 0.96 | 0.97 | 59.05 | 54.53 | 0.92 | 0.91 | 0.93 | 75.64 | 70.88 | 0.94 | 0.93 | 0.95 | 72.52 | 86.15 | 1.19 | 1.18 | 1.20 |
| Dementia | Musculoskeletal | 56.16 | 66.82 | 1.19 | 1.18 | 1.20 | 48.85 | 49.23 | 1.01 | 0.99 | 1.02 | 60.38 | 34.62 | 0.57 | 0.56 | 0.58 | 60.18 | 66.05 | 1.10 | 1.09 | 1.11 |
| Dementia | Diabetes | 22.68 | 39.34 | 1.73 | 1.69 | 1.78 | 14.62 | 16.57 | 1.13 | 1.10 | 1.17 | 29.51 | 10.78 | 0.37 | 0.35 | 0.38 | 15.40 | 27.95 | 1.81 | 1.76 | 1.86 |
| Dementia | Respiratory | 19.88 | 30.06 | 1.51 | 1.47 | 1.55 | 28.88 | 16.57 | 0.57 | 0.56 | 0.59 | 16.68 | 25.58 | 1.53 | 1.49 | 1.58 | 19.45 | 18.42 | 0.95 | 0.92 | 0.97 |
| Dementia | Stomach ulcer | 14.14 | 31.43 | 2.22 | 2.16 | 2.29 | 13.93 | 18.98 | 1.36 | 1.32 | 1.41 | 13.86 | 1.96 | 0.14 | 0.13 | 0.15 | 14.77 | 11.38 | 0.77 | 0.74 | 0.80 |
| Dementia | Cancer | 8.07 | 5.06 | 0.63 | 0.59 | 0.66 | 11.53 | 16.57 | 1.44 | 1.39 | 1.49 | 8.51 | 17.23 | 2.03 | 1.94 | 2.11 | 12.15 | 12.49 | 1.03 | 0.99 | 1.07 |

* p < 0.05; ** p < 0.01; *** p < 0.001

^a Probability of having condition 2 given that condition 1 is already present.

Note: Values are age-standardized using the 2013 European standard population.

Abbreviations: Nat = natives; Immigr = immigrants; RR = relative risk; CI = confidence interval