Estimation of diabetes prevalence among immigrants from the Middle East in Sweden by using three different data sources

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Abstract
Aims. – To estimate diabetes prevalence in immigrants from the Middle East in Sweden compared with Swedish-born subjects. This group accounts for around 15% of Sweden’s non-European immigrants.

Methods. – Three samples were used: self-reported diabetes in a random sample (SALLS sample) of subjects aged 35–64 years in Sweden (n = 22,032); known diabetes among patients aged 35–64 years in primary care (PC) at four primary healthcare centers in Stockholm County (n = 30,679); and known and newly diagnosed diabetes in a random population sample of subjects aged 60 years in Stockholm County (n = 4106).

Results. – The odds ratio (OR) for subjects from the Middle East was: 1.69 (95% confidence interval [CI] 0.96–2.99) in the SALLS sample; 4.43 (95% CI 3.38–5.56) in the PC sample; and 3.96 (95% CI 1.98–7.92) in the age-60 sample, compared with native Swedes. Subjects from European and other Organization for Economic Cooperation and Development (OECD) countries showed an excess risk only in the SALLS sample (1.43, 95% CI 1.11–1.83).

Conclusions. – Immigrants from the Middle East showed a four-fold higher risk of diabetes compared with Swedish-born subjects in two of the three data sources. More studies are needed to confirm these results, but the findings call for targeted preventative strategies in this population group.

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Résumé
Évaluation de la prévalence du diabète sucré chez des immigrants du Moyen-Orient en Suède à partir de trois sources différentes de données.

Cette étude transversale avait pour but d’évaluer la prévalence du diabète sucré chez des sujets originaires du Moyen-Orient vivant en Suède, menée dans trois échantillons, le premier pris au hasard parmi la population suédoise âgée de 35 à 64 ans au cours des années 1998–2005 (n = 22,032), le deuxième parmi la population âgée de 35 à 64 ans de quatre centres de santé primaires du département de Stockholm (n = 30,679) et le troisième pris au hasard dans la population générale âgée de 60 ans du département de Stockholm (n = 4106). Les sujets atteints de diabète sucré ont été identifiés dans le premier échantillon par autodéclaration, dans le deuxième parmi la population âgée de 35 à 64 ans, dans le troisième par dosages au laboratoire. La prévalence du diabète sucré était élevée chez les sujets originaires du Moyen-Orient, avec dans le premier échantillon un rapport de cote [odds ratio (OR)] de 1,69 (IC à 95 % 0,96–2,99), dans le deuxième de 4,43 (IC 95 % 3,38–5,56) et dans le troisième de 3,96 (IC 95 % 1,98–7,92). En conclusion, la prévalence du diabète sucré est plus élevée en Suède chez les immigrants venus des pays du Moyen-Orient par comparaison à la population née en Suède.

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Mots clés : Diabète sucré ; Épidémiologie ; Migrants ; Étude transversale ; Immigration ; Prévalence ; Suède

1. Introduction
Diabetes prevalence differs among ethnic groups, with a higher prevalence among some immigrant groups in European
countries, such as South Asian immigrants in the UK [1,2], immigrants from Surinam, Turkey and Morocco in the Netherlands [3,4], and Lebanese and Turkish immigrants in Denmark [5]. In a review by Misra and Ganda, it was suggested that environmental factors played a critical role in conferring an increased risk of obesity and, thus, type-2 diabetes as well [6]. The important contributory factors to this phenomenon are urbanization, mechanization, and changes in nutrition and lifestyle behaviors, with an uncertain role for stress and other possible factors.

Foreign-born residents in Sweden now comprise 12% of the Swedish population [7]. A large proportion (41%) of immigrants in Sweden are of non-European origin, and those from the Middle East — in particular, Turkey, Lebanon, Syria, Iraq and Iran — constitute 15% of all foreign-born citizens and is the largest group of non-European immigrants in Sweden. A higher prevalence of diabetes among immigrants of non-European origin has recently been described [8–10]. In addition, an increased rate of self-reported diabetes has been seen in Turkish-born women [11].

Diabetes prevalence can be assessed in several ways. The diagnosis may be self-reported to estimate diabetes prevalence in countries [12] or ethnic groups [13]. This, however, will underestimate the true burden of diabetes [14]. Another way is through healthcare sources such as primary-care physicians [15], or by combining primary-care and secondary-care source data [16]. However, simply using record-linking will again underestimate the prevalence compared with the use of capture–recapture methods [16]. A third way is to carry out population-based screening, either in whole countries [17] or in specific regions of countries [18]. This allows subjects with an unknown diagnosis of diabetes to also be identified — which comprises around half of all cases [19]. Yet other ways include the use of data based on prescriptions of antidiabetic drugs [20], although this, too, will underestimate the true prevalence of diabetes by not including unknown or undiagnosed cases.

The aim of this study was to estimate the prevalence of diabetes among immigrants from the Middle East compared with Swedish-born subjects, using different study populations. A secondary aim was to compare the results derived from different data sources.

2. Methods

2.1. Study populations

The first study source population was a simple random sample of 22,032 men and women, aged 35–64 years, who had participated in the Swedish Annual Level of Living Survey (SALLS), 1998–2005. The age interval was used to match the second sample. The participants were interviewed face-to-face by trained interviewers about their living conditions, including detailed information on social, lifestyle and health indicators. The mean response rate was 79% for the Swedish-born subjects and 68% for the immigrants, with small variations among the various immigrant groups. Of the immigrant non-responders, about half refused to participate, while the other half could not be located.

The second source of diabetic patients, age 35–64 years, had participated in the primary care (PC) study of 2001 [21]. Subjects were recruited from four primary healthcare centres (PHCC) in the Metropolitan Stockholm area, and were chosen to reflect local differences in terms of demographic and socioeconomic factors. On 31st December 2000, the population in this age group in the catchment areas of these PHCC comprised 30,679 subjects — 15,314 men and 15,365 women — 4% of the total population in Stockholm County.

The third group was taken from a population-based study of subjects aged 60 years in Stockholm County, called here “the 60-year cohort”. From August 1997 to March 1999, every third man and woman living in Stockholm County born between 1st July 1937 and 30th June 1938 was randomly selected and invited to participate in a thorough health-screening study. A total of 5460 subjects — 2779 men and 2681 women — were invited to participate, and 4228 of them (77%) — 2036 men (73%) and 2192 women (82%) — did so. The response rate among immigrants was somewhat lower (68%). For 4106 subjects (1973 men and 2133 women), their country of origin was known and a fasting serum glucose value was available, so these subjects were included in the present study. Immigrants constituted 18.9% (n = 777) of this sample, which closely reflected the proportion of immigrants in Stockholm County (19.5%). Available data also included their body mass index (BMI), educational level, employment, physical activity, smoking habits, alcohol intake and dietary factors.

2.2. Diabetes diagnosis

Diabetes was defined in different ways. In the first source population, diabetes was defined as self-reported. In the second group, diabetic patients were identified through a diagnosis of diabetes in the electronic patient record (EPR) at PHCC. All EPR with a diagnosis of diabetes were reviewed one by one of the present study authors to confirm that this was a correct diagnosis to avoid excess reporting of diabetes. The type of diabetes was based on the clinical data. In the third group, the 60-year cohort, the diagnosis of diabetes was either self-reported, including what medication was being taken for diabetes or the result of a laboratory finding of a fasting serum glucose greater or equal to 7.0 mmol/L.

2.3. Region of origin

In the first study population, the country of origin was obtained from the national immigrant register in Sweden. In the second group, foreign-born subjects were identified by country, or region, of origin extracted from the EPR. However, a specific country of origin was not always available for subjects from the Middle East as some ethnic groups such as the Kurds or Assyrian-Syrian subjects, may originate from other countries. The country of origin of those in the 60-year cohort was obtained from a questionnaire.

The group called “Sweden” included individuals born in Sweden (including second-generation immigrants). The group called “Europe + OECD” included individuals from Organization for
Table 1
Demographic data across the three study samples

<table>
<thead>
<tr>
<th></th>
<th>SALLS, Sweden (age 35–64 years)</th>
<th>Primary Care, Stockholm County (age 35–64 years)</th>
<th>Population sample, Stockholm County (age 60 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 22,032</td>
<td>n = 30,679</td>
<td>n = 4106</td>
</tr>
<tr>
<td>Men</td>
<td>10,824 (49.1%)</td>
<td>15,314 (49.9%)</td>
<td>1973 (48.1%)</td>
</tr>
<tr>
<td>Age 35–44 years</td>
<td>7,624 (34.6%)</td>
<td>10,840 (35.3%)</td>
<td>–</td>
</tr>
<tr>
<td>Age 45–54 years</td>
<td>7,645 (34.7%)</td>
<td>10,191 (33.2%)</td>
<td>–</td>
</tr>
<tr>
<td>Age 55–64 years</td>
<td>6,763 (30.7%)</td>
<td>9,648 (31.4%)</td>
<td>–</td>
</tr>
<tr>
<td>Age 60 years</td>
<td>–</td>
<td>–</td>
<td>4106 (100%)</td>
</tr>
<tr>
<td>Region of birth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweden</td>
<td>19,209 (87.2%)</td>
<td>23,092 (75.2%)</td>
<td>3329 (81.1%)</td>
</tr>
<tr>
<td>Europe + OECD</td>
<td>1,910 (8.7%)</td>
<td>4,223 (13.8%)</td>
<td>662 (16.1%)</td>
</tr>
<tr>
<td>Middle East</td>
<td>414 (1.9%)</td>
<td>1,773 (5.8%)</td>
<td>48 (1.2%)</td>
</tr>
<tr>
<td>Rest of the world</td>
<td>499 (2.3%)</td>
<td>1,591 (5.2%)</td>
<td>67 (1.6%)</td>
</tr>
</tbody>
</table>

OECD: Organization for Economic Cooperation and Development.

Economic Cooperation and Development (OECD) countries and Eastern Europe, including Russia. The group referred to as “Middle East” included people from Turkey, Syria, Iran, Iraq and Lebanon (no immigrants from any other Middle Eastern countries were registered). The last group, called “Rest of the world”, included countries that were not mentioned in the previous categories.

2.4. Ethics

The three source studies used in the present study were approved by the Research Ethics Committee of the Karolinska Institutet (Numbers 00:049, 96–938 and 00:011, respectively).

2.5. Statistics

The estimation of prevalence was based on raw data from the three source studies. The third sample showed both known diabetes — self-reported and including data on medication — and newly diagnosed diabetes, based on a laboratory investigation and defined as a fasting serum glucose greater or equal to 7.0 mmol/L on one occasion. From the SALLS and PC study samples, an age-standardized prevalence was determined using the total Swedish population aged 35–64 years as the reference.

Stata version 9 [22] and SAS version 9.2 [23] were used for the statistical analyses. Fisher’s exact test was used to compare the frequency of type-1 diabetes between groups in the PC sample. Unconditional logistic regression was used [24] to calculate odds ratios (OR) with 95% confidence intervals (CI) for diabetes. The following reference categories were chosen: region of origin (Swedish-born people); aged 45–54 years (age) and women (gender). The 45–54 age group was chosen as the reference group for statistical reasons because of the too-low number of diabetic patients in those aged 35–44 years. The reference groups had an OR of 1.

We also estimated diabetes prevalence in Iran and in Konya, Turkey, using data from published studies [25,26], with direct standardization to the Swedish population. Konya is the place of origin of many of the Turkish immigrants in Sweden, especially those in Stockholm County. In the Iranian study, diabetes prevalence was estimated in men and women combined. In the Turkish study, the age groups were different from those in the Swedish samples, which is why these figures had to be extrapolated.

3. Results

Demographic data from the three studies are shown in Table 1 by area of origin and gender. The age-standardized prevalence of diabetes is shown in Table 2. In total, the age-standardized prevalence was 2.8% in the SALLS sample, 2.3% in the PC sample and in the 60-year cohort, 4.5% for known diabetes and 7.3% for all diabetes. Altogether, 45 patients were classified as type-1 diabetes (6.8%) in the PC sample, with 38 in the Swedish-born group (8.9%), four in the Europe + OECD (4.8%), none in the Middle East group and three in the Rest of the world (4.5%) ($P = 0.006$).

Results of logistic regression, with adjustment for age and gender, are shown in Table 3. Men showed a higher risk of diabetes than women. The European group showed an excess risk in the SALLS sample (OR 1.43), but not in the PC sample or 60-year cohort. The Middle East group showed a significant excess risk in both the PC sample (OR 4.43) and 60-year cohort (OR 4.74 for known diabetes, OR 3.96 for all diabetes), but not in the SALLS sample (OR 1.69). The Rest of the world group showed a significant excess risk in the PC (OR 3.47) and SALLS (OR 1.98) samples, but not in the 60-year cohort (OR 1.71 for known diabetes, OR 1.44 for all diabetes). As for the Middle East group in the 60-year cohort, after adjustment for BMI and socioeconomic and lifestyle factors, the OR decreased to 2.17 (95% CI 0.94–5.01).

The estimated diabetes prevalence in Iran [25], standardized to the Swedish population and in men and women combined, was 7% for known diabetes in the age group 35–64 years, 11% for known diabetes and 16% for all diabetes in those aged 60 years. Estimated diabetes prevalence for men in Konya, Turkey, was 11% for known diabetes in the age group 35–64 years, and 17% for known diabetes and 25% for all diabetes in those aged 60 years; in women, the rates were
8% for known diabetes in those aged 35–64 years, and 13% for known diabetes and 18% for all diabetes in the age-60 cohort.

4. Discussion and conclusion

A higher prevalence of diabetes was found among immigrants from the Middle East in the PC sample and 60-year cohort. In the SALLS sample, a slightly higher, non-significant, prevalence was found.

These findings are supported by other studies, such as the Danish study reporting a five-fold greater prevalence of diabetes among immigrants from Lebanon and Turkey in Denmark [5], and an earlier Swedish study showing a three-fold higher prevalence of diabetes among female immigrants from Turkey [11]. In addition, in Sweden, diabetes is known to be most prevalent in women from the Middle East [8].

Diabetes prevalence is especially high in some Middle Eastern countries, such as Lebanon [27] and Turkey [28], and only moderately high in others, such as Iran [29]. As for immigrants from this region and in other European populations, studies from the Netherlands [3,4], Denmark [5] and Sweden [11] have found an excess risk among those from Turkey, as well as, in Lebanese immigrants in Denmark [5], but less is known of immigrants from other countries in the Middle East. In Sweden, people from the Middle Eastern region (mostly from Iran, Iraq, Lebanon, Syria and Turkey) account for 15% of all foreign-born individuals and constitute the largest non-European group in that country.

The known diabetes prevalence in Iran was similar to that in the SALLS and PC samples, but lower than that in the 60-year cohort [25], whereas the prevalence in Konya, Turkey, was higher than in the SALLS and PC samples, but similar to that in the 60-year cohort [26].
We also found a higher prevalence among men across nearly all study populations except for the Middle East sample with known diabetes. The diabetes prevalence worldwide is reported to be higher among men, yet the number of women with diabetes exceeds that of men, depending on the age distribution [30]. One review reported a 20th century trend away from a female preponderance to either an equal distribution or even a slight male predominance [31].

The diverse results from our three samples illustrate the problems that arise when estimating the prevalence of diabetes using different methods. The SALLS sample used entirely self-reported diagnoses, which tends to underestimate prevalence [14,32]. Yet, the SALLS prevalence figures tally well with those of the Swedish MONICA study [8], suggesting validity. The PC sample used diagnoses certified by physicians, and these rates have also proved valid and are comparable with those in other European countries [33]. In those aged 35–64 years, 90–95% of all diabetes patients are type-2, with the majority being managed in primary care. As for the possible effect of the non-participants in the SALLS and 60-year cohort, it is unlikely that they would alter the results other than marginally.

The present study has a few limitations, however. The number of diabetic subjects in the Middle East group was small, which means that small errors could yield large differences in the prevalence rate, as reflected by the wide CI ranges. However, this group constitutes the largest non-European population in Sweden and however small the sample, it was still possible to perform the statistical analyses. Another factor is that immigrants from the Middle East are a heterogeneous group with differences in their genetic backgrounds, reasons for migration and socioeconomic status. There are, however, difficulties in separating some ethnic groups by country of origin — for example, Kurds may originate from Iraq, Iran, Turkey or Syria. There are also changes over time: the Iraqi, for instance, increased after the war in that country. However, as Misra and Ganda pointed out in their review, the most important contributory factors to the increased risk of obesity and diabetes associated with migration are urbanization, mechanization, and changes in nutrition and lifestyle behaviors; the role of stress remains to be determined [6].

As for the remaining non-European immigrants, we created a heterogeneous group called “Rest of the world”, in which the mix of immigrants differs between samples. Immigrants from the Indian subcontinent, sometimes called “South Asians”, are especially prone to type-2 diabetes [1,2], and constituted a fair mix of immigrants differs between samples. Immigrants from the Middle East are a heterogeneous group with differences in their genetic backgrounds, reasons for migration and socioeconomic status. There are, however, difficulties in separating some ethnic groups by country of origin — for example, Kurds may originate from Iraq, Iran, Turkey or Syria. There are also changes over time: the Iraqi, for instance, increased after the war in that country. However, as Misra and Ganda pointed out in their review, the most important contributory factors to the increased risk of obesity and diabetes associated with migration are urbanization, mechanization, and changes in nutrition and lifestyle behaviors; the role of stress remains to be determined [6].

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The diagnosis of diabetes was made by measures of fasting plasma glucose (FPG) and not the oral glucose tolerance test (OGTT), which is considered the “gold-standard” test [34]. FPG is thought to underestimate the true diabetes prevalence by around 30% by not identifying those who have a diabetic two hours glucose, yet a normal FPG [19,35]. However, FPG results are substantially more reproducible than those of OGTT [34], which means that testing only once is sufficient. Of those with a pathological two hours glucose initially, only 60% will remain abnormal on a second test [36]. In general, the FPG value appears to have greater specificity, while the two hours glucose value is apparently more sensitive [37]. A slight gender difference was also seen, with more men having a pathological FPG and more women having an abnormal two hours glucose, especially in those over 70 years of age [19].

In conclusion, in two of our three samples, we found a higher prevalence of diabetes among immigrants from the Middle East in Sweden. If this tendency is confirmed, it suggests a call for programmes of diabetes prevention and enhanced acculturation, especially among non-European immigrants in general. However, our findings must be interpreted with caution, given the low numbers of some groups and to other possible sources of error. Thus, further studies are also required at this time. One possible way to estimate diabetes prevalence in a population that includes different ethnic groups is to combine data from different registers, such as from primary and secondary care, with the use of capture–recapture techniques to identify the rate of “hidden diabetes” [16,38]. In addition, screening specific immigrant groups by OGTT will reveal not only those with undiagnosed diabetes, but also those who have impaired glucose tolerance.

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