

主論文の要旨

Differences by sex in the prevalence of diabetes mellitus, impaired fasting glycaemia and impaired glucose tolerance in sub-Saharan Africa: a systematic review and meta-analysis

サブサハラ・アフリカにおける 糖尿病・空腹時血糖異常・耐糖能異常の有病率の男女差：システマティックレビューおよびメタアナリシス

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Introduction

Diabetes mellitus is one of the most prominent of the noncommunicable diseases that are threatening the health of the people in sub-Saharan Africa and placing additional burdens on health systems that are often already resource-poor.

Gender differences in lifestyle may lead to gender differences in the risk of developing diabetes mellitus, impaired fasting glycaemia and impaired glucose tolerance and, in consequence, to gender differences in the prevalence of these conditions. Although a recent meta-analysis of West African data and other narrative review articles have documented wide variations in the gender distribution of the three conditions, the possible causes of this heterogeneity in much of sub-Saharan Africa have yet to be reviewed.

The main aims of this study were to examine gender differences in the prevalences of diabetes mellitus, impaired fasting glycaemia and impaired glucose tolerance in eastern, central and southern sub-Saharan Africa, and to explore the possible causes of any variation that was observed.

Methods

In September 2011, the PubMed and Web of Science databases were searched for community-based, cross-sectional studies providing sex-specific prevalences of any of the three study conditions among adults living in parts of sub-Saharan Africa (i.e. in Eastern, Middle and Southern Africa according to the United Nations subregional classification for African countries -Table 1). The medical subject headings (MeSH) and search terms used are described in Box 1.

After reading each article that appeared relevant and met the inclusion criteria, relevant data were extracted for analysis. Quality appraisal of included studies was done. Odds ratios (OR) were used as “effect estimates”, to quantify the relationship between gender and the prevalences of diabetes mellitus, impaired fasting glycaemia and impaired glucose tolerance. The DerSimonian and Laird random-effects model was used to estimate mean OR for all of the studies included in the meta-analysis.

Statistical heterogeneity across the studies was evaluated using both the Q and I^2 statistics. Subgroup analyses and random-effects univariate meta-regression analysis were performed to assess the potential influence of selected study-level covariates on the OR for any gender-specific differences. Publication bias was assessed using a funnel plot and Begg and Mazumdar’s rank-correlation test. Duval and Tweedie’s “trim and fill” analysis was used to assess the impact that publication bias might have on the effect size.

Results

Although the literature search identified a total of 5133 reports (5129 from search engines and 4 from other sources) as potentially useful, the meta-analysis included data from only 29 reports that, together, covered 36 studies in which cross-sectional data were collected (Fig. 1). Table 2

provides detailed descriptive information for the 36 studies included in the meta-analysis. These studies involved a total of 75 928 subjects and were conducted, between 1983 and 2009.

The prevalence of diabetes mellitus among the men was not significantly different from that among the women (OR: 1.01; 95% CI: 0.91–1.11). However, impaired fasting glycaemia appeared to be significantly more common among the men than among the women (OR: 1.56; 95% CI: 1.20–2.03) whereas impaired glucose tolerance appeared to be significantly less common among the men than among the women (OR: 0.84; 95% CI: 0.72–0.98) (Fig. 2). A moderate to substantial level of between-study heterogeneity was detected in the data for diabetes mellitus ($I^2 = 54.62\%$; $P < 0.001$ in Q -test), impaired fasting glycaemia ($I^2 = 85.38\%$; $P < 0.001$ in Q -test) and impaired glucose tolerance ($I^2 = 74.13\%$; $P < 0.001$ in Q -test).

Table 3 summarizes the results of the subgroup analyses. Significant heterogeneity in the OR for diabetes mellitus, impaired fasting glycaemia, was observed by area of residence (i.e. urban or rural), region of sub-Saharan Africa, ethnicity of the study subjects, and income level of country – each of which gave a P -value of < 0.01 in a Q -test. Significant heterogeneity in the OR for impaired fasting glycaemia was observed by region of sub-Saharan Africa ($P = 0.02$) and income level of country ($P = 0.006$). With impaired glucose tolerance, significant heterogeneity in the OR was observed by area of residence ($P < 0.001$), region of sub-Saharan Africa ($P = 0.001$), ethnicity ($P = 0.002$), and income level of country ($P = 0.03$). The univariate random-effects meta-regression revealed similar associations – between the OR and study-level covariates – as seen in the subgroup analyses.

The funnel plots for diabetes mellitus and impaired fasting glycaemia were asymmetric, indicating possible publication bias. However, the corresponding results from Begg and Mazumdar's rank-correlation tests – P -values of 0.93 and 0.64, respectively – were not statistically significant. There were no indications of publication bias in the data on impaired glucose tolerance.

Discussion

In the present study, impaired fasting glucose was found to be significantly more common among men than among women, irrespective of the subgroup that was investigated. One possible explanation for this gender difference is that men tend to have lower hepatic sensitivity to insulin and may, in consequence, have generally higher fasting levels of plasma glucose. Another possible explanation or contributing factor is that, within sub-Saharan Africa, men are more likely to smoke than women and smoking appears to increase the risk of impaired fasting glucose, by decreasing insulin sensitivity.

In earlier research, impaired glucose tolerance has generally been found to be more common among women than among men. The same gender difference was detected in most of the subgroups that were investigated in the present meta-analysis. In general, women have a smaller mass of muscle than men and therefore less muscle available for the uptake of the fixed glucose

load (75 g) used in the oral glucose-tolerance test. Women also have relatively high levels of estrogen and progesterone, both of which can reduce whole-body insulin sensitivity.

The gender differences seen in the distributions of both impaired fasting glycaemia and impaired glucose tolerance in sub-Saharan Africa need to be considered by those evaluating the probability that individuals will develop diabetes mellitus and by those trying to prevent diabetes mellitus. Impairments in glucose tolerance and fasting glycaemia are not equivalent metabolically, and there are differences in the people categorized as having each condition. If screening programmes were based only on the measurement of “fasting plasma glucose”, most individuals with impaired glucose tolerance would go undetected and there might be a men-biased selection of the at-risk population. Screening for both impaired fasting glycaemia and impaired glucose tolerance might eliminate most gender bias in the identification of those who are at risk of developing diabetes mellitus. Even then, the dose of glucose used in the oral glucose-tolerance test may have to be made lower for women than for men to allow for the lower mean muscle mass in women and so prevent the over-diagnosis of impaired glucose tolerance in women.

In the present study, the overall prevalence of diabetes mellitus in men was found to be very similar to that in women. However, subgroup analyses revealed that diabetes mellitus was more common in the men who lived in the Central and Eastern Regions of sub-Saharan Africa than in the women who lived in the same regions, while the women who lived in the Southern Region were more likely to have diabetes mellitus than their male counterparts. Such gender differences were not seen in the earlier study on diabetes mellitus in West Africa.

Conclusion

Our meta-analysis demonstrated that, compared with the corresponding women, the men in the Eastern, Central and Southern Regions of sub-Saharan Africa had a significantly higher prevalence of impaired fasting glycaemia and a lower prevalence of impaired glucose tolerance. Although the overall prevalence of diabetes mellitus did not significantly differ by gender, the prevalence of diabetes mellitus was found to be lower or higher in women than in men when analysed by region. Our observations may help in the targeting of appropriate – and perhaps gender-oriented – interventions to prevent diabetes mellitus in sub-Saharan Africa.