Public Health 232 (2024) 45–51

Contents lists available at ScienceDirect

Public Health

journal homepage: www.elsevier.com/locate/puhe

Original Research

Estimating the contribution of overweight and obesity to ethnic inequalities in cardio-metabolic diseases in the Netherlands: a simulation study

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ARTICLE INFO

Article history:
Received 21 November 2023
Received in revised form
29 March 2024
Accepted 8 April 2024

Keywords:
Overweight and obesity
Ethnicity
Health inequalities
Cardiovascular disease
Diabetes mellitus
Simulation modelling

ABSTRACT

Objectives: Overweight and obesity (OWOB) starts in childhood, influences adult cardiovascular risk, and is not equally distributed across ethnic groups. It is unclear which effects can be expected from reductions in OWOB across the life course on inequalities in cardio-metabolic diseases in a multi-ethnic population. This study aims to estimate the effects of three scenarios of changes in OWOB (the Normal-Weight-for-All scenario, the No-Ethnic-Difference-over-the-Life-Course scenario, the and No-Ethnic-Differences-in-Childhood scenario).
Study design: A simulation study.
Methods: We combine data from multiple data sources and use the Dynamic Modeling for Health Impact Assessment (DYNAMO-HIA) model to estimate the effects of three scenarios on the cumulative incidence of diabetes mellitus, ischaemic heart disease (IHD) and stroke between 18 and 70 years in the five largest ethnic groups in the Netherlands.
Results: In the scenario where all individuals have normal weight, the cumulative incidence decreased in all ethnic minority groups for all diseases, with largest decreases among South-Asian Surinamese, where the reduction of diabetes incidence exceeded 50%. In the scenario where the prevalence of OWOB in each ethnic-minority group was reduced to the current level among the Dutch-origin population, ethnic inequalities in cardio-metabolic diseases were substantially reduced, particularly when lowered prevalence of OWOB persisted across the lifespan. Reductions were the largest for diabetes and for the Asian Surinamese population.
Conclusions: A substantial part of the well-known ethnic inequalities in incidence of diabetes, IHD, and stroke can be attributed to OWOB. Interventions aimed at reducing OWOB have clear potential to reduce the health inequalities in these outcomes, especially for diabetes, in particular when they have an impact across the lifespan.

Introduction

Cardio-metabolic diseases are highly prevalent in countries with low mortality. Overweight and obesity (OWOB) is an important risk factor for these conditions. Globally, disability-adjusted life years (DALYs) attributed to high body mass index (BMI) are the highest for three cardio-metabolic diseases: diabetes mellitus, ischaemic heart disease (IHD), and stroke. For diabetes mellitus, 26.0% of DALYs was attributable to a high BMI; for stroke, 24.5%; and for IHD, 22.7%.[1]

In high-income countries, OWOB is more prevalent among people who have migrated from low- and middle-income countries as well as among their offsprings than among the host population. In the Netherlands, OWOB prevalence is higher among the largest ethnic minority groups, including those of Turkish, Moroccan, and Surinamese origins.[2,3] Incidence and prevalence of cardio-metabolic diseases also vary between different ethnic groups, but the patterns vary more between the groups. The incidence of acute myocardial infarction (AMI) is higher in Surinamese men and women and Turkish men than in the Dutch-origin population but not among the Moroccan-origin population.[4] For all stroke subtypes, Surinamese have higher and Moroccans lower incidence, and among other groups, the excess/lower incidence depends on the stroke subtype and sex.[5] Diabetes prevalence is higher in all major

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https://doi.org/10.1016/j.puhe.2024.04.015

ethnic groups than in the host population, with particularly high levels among the South-Asian Surinamese.[6]

OWOB starts already early in life and influences cardiovascular risk across the life course.[7,8] Many studies show the persistence of childhood obesity into adulthood BMI.[8] There is increasing emphasis on interventions to reduce childhood OWOB that focus on ethnic groups where OWOB prevalence is relatively high.[9] While it is clear that reductions in OWOB reduce the occurrence of cardio-metabolic diseases, the extent of this reduction remains largely unknown, in particular regarding variations between different ethnic groups (Appendix 1). This uncertainty arises from the fact that the modelling approaches that are required to quantify these effects, such as the Obesity-Policy model[10] and the DYNAMO-HIA model,[11,12] do not incorporate ethnic inequalities in prevalence of OWOB or the incidence of cardio-metabolic diseases and mortality. Estimating input data for these models by ethnic group is challenging and requires multiple data sources.

This study raises to this challenge of estimating input data for modelling the effects of OWOB on cardio-metabolic disease for different ethnic groups. We include four ethnic groups in the Netherlands: individuals of Moroccan, Turkish, African-Surinamese, and South-Asian-Surinamese origins. To assess the potential health benefits of preventing overweight of obesity, we compare the outcomes for these groups to those of the host population, namely individuals of Dutch origin. We use the DYNAMO-HIA model to estimate the effect of changes in OWOB on the incidence of diabetes mellitus, IHD, and stroke in adulthood (18–70 years) for each group.

Our study aims to estimate the extent to which cumulative incidence of diabetes, IHD, and stroke in adult ages (18–70) in each ethnic group would be reduced

1) if all individuals in all ethnic groups had normal weight (NW) between ages of 18 and 70. This indicates the maximum health improvement attainable for all ethnic groups through the prevention of OWOB.
2) if the prevalence of OWOB at age 18 in each ethnic minority group were reduced to the current level of the Dutch-origin population. We make two separate estimates. In the first, transitions between NW, overweight (OW), and obesity (OB) after age 18 are unaffected, offering insight into the effects of interventions in childhood that have no longer-lasting effect in adulthood. This scenario demonstrates the potential health improvement for ethnic minority populations if we succeed in eliminating ethnic inequalities in OWOB during childhood. In the second, also transitions between NW, OW, and OB between ages of 18 and 70 are made equal to those of the Dutch-origin population, giving insight into the effects of childhood interventions with long-lasting changes. This scenario illustrates the potential health improvement for ethnic minority populations in the absence of ethnic inequalities in OWOB throughout their lifetimes.

Methods

We used the DYNAMO-HIA model to quantify the impact of changes in OWOB at childhood ages (modelled by their cumulative effect at age 18) and adult ages (18–70 years), on the incidence of three cardio-metabolic diseases (diabetes mellitus, IHD, and stroke) among adults for five ethnic groups. Appendix 2 includes information on the migration history of the ethnic minority groups.

DYNAMO-HIA quantifies the impact of user-specified risk-factor changes on multiple diseases and in turn on overall population health, comparing one reference scenario with one or more intervention scenarios. DYNAMO-HIA combines the micro-simulation of risk factor (exposure) information with the macro-simulation of diseases and survival. DYNAMO-HIA uses a Markov-based modelling approach that allows for explicit risk-factor states and simulation of a real-life population. The model projects the future prevalence of disease states (state occupancy) by repeatedly applying a matrix of transition probabilities to the vector of current state occupancy.

DYNAMO-HIA simulates OWOB trajectories over the life course and uses a standard epidemiological model (calculating incidence in OW and OB persons by multiplying the incidence NW persons with a relative risk).[13]

Diabetes mellitus was included in the modelling as an intermediate risk factor that is associated with OWOB and increases the risk of IHD and stroke. Separate models were created for each ethnic group, defined by country of birth and country of birth of the parents (migrants and their offspring). More details on the DYNAMO-HIA model are given in refs 13,14 and Appendix 3.

The model requires data on current OWOB, disease incidence, prevalence and mortality, and population and mortality data. Additionally, data regarding relative risks related to diabetes, IHD and stroke incidence associated with OWOB, and IHD and stroke incidence associated with diabetes, all specified by age, sex, and ethnic group are needed. These data were not readily available. Therefore, we estimated the input data by consolidating various sources from the Netherlands and information from scientific literature. Separate models were created per ethnic group since the groups differ with respect to most input of the DYNAMO-HIA model, including: population size, mortality, incidence, prevalence and excess mortality of cardio-metabolic diseases, and OWOB. Data sources from the Netherlands encompass readily available data from websites and publications, along with new analyses using the baseline data from the HEalthy LIfe in an Urban Setting (HELIUS) study.[15,16] For a summary of data and methods used to derive all input by one-year age, sex, and ethnic group, we refer to Appendix 4. In the following, we provide a brief summary.

We categorised OWOB into three groups using the standard WHO cut-offs for BMI: NW (>18.5 and < 25kg/m2), OW (≥25 and <30 kg/m2), and OB (≥30 kg/m2).[9,17] Notably, for the South-Asian Surinamese group, we used the specific recommendations for Asian populations setting the threshold at 23 instead of 25 and 27.5 instead of 30, as per WHO guidelines.[17] To obtain the prevalence of OWOB by ethnic background, age, and sex, we relied on measured height and weight data from the HELIUS study (Appendix 5).[15,16]

For IHD incidence and prevalence, we used data from three sources. First, we used national data on IHD incidence and prevalence for the entire Dutch population by age and sex from the Global Burden of Disease (GBD) study[18] for the years 2015–2019. Second, we used national data on the incidence of AMI by ethnic group[4] from the period 2005–2010 in order to estimate IHD by ethnic group. Because incidence and prevalence have changed over time and data were only available for broad age groups, we did not use these rates directly but used them to calculate the ratio's (relative risks) between ethnic groups (Appendix 6). Third, to distinguish South-Asian and African Surinamese, we used relative risks for cardiovascular diseases based on a linkage of the HELIUS study to hospital admission (provided by the author of an earlier paper).[19] For diabetes and stroke, we followed a similar approach, albeit based on less detailed data. The ratios were based on the HELIUS study linked to health insurance data (provided by the author of an earlier paper).[20] Regarding stroke, the ratios were based on age-standardised incidence rates from the period 1989–2010[21] but without distinction between South-Asian and African Surinamese.

We calculated disease-specific mortality (excess mortality) based on the incidence and prevalence rates. For each age, we calculated excess mortality required to obtain the prevalence at the next higher age, given the incidence under some restrictions (e.g. ensuring it is

positive). In cases where restrictions were applied, we adjusted the incidence to ensure consistency between prevalence, incidence, and mortality (see Appendix 4 for details). Consistent incidence, prevalence, and mortality rates are presented in Appendix 7.

Population and mortality data by ethnic group were obtained from Statistics Netherlands. Since these data did not differentiate between South-Asian and African Surinamese, we additionally used older data from 2005–2014[22] to make this distinction.

We used relative risks based on the GBD study to quantify the effect of OWOB on each of the diseases.[23] By using different cut-offs for OWOB for those of South-Asian Surinamese origin, we acknowledge that BMI underestimates the cardio-metabolic disease risks in this group.[17] Relative risks for the effect of diabetes on IHD and stroke as well as relative risks of OWOB on total mortality were obtained from the DYNAMO-HIA website[24] (Appendix 8). For sensitivity analysis, we also used relative risks exclusively from DYNAMO-HIA.

Scenarios

We defined three scenarios, namely 'Normal-Weight-for-All' scenario, the 'No-Ethnic-Difference-Over-the-Life-Course' scenario, and the 'No-Ethnic-Differences-in-Childhood' scenario. The 'Normal-Weight-for-All' scenario was designed to estimate the extent to which the cumulative incidence of diabetes, IHD, and stroke in adults aged 18–70 in each group could be attributed to OWOB. This scenario represents the maximal achievable benefits of interventions targeting OWOB. In this scenario, all individuals had NW at age 18 and remained in that category through successive ages until age 70. The No-Ethnic-Difference-over-the-Life-Course scenario modelled the situation where each ethnic minority group has the same prevalence of OWOB at age 18 as the Dutch-origin population and experienced the same development of OWOB between ages 18 and 70 (using the same transition rates between NW, OW, and OB as for the Dutch-origin population). The No-Ethnic-Differences-in-Childhood scenario similarly modelled the situation where each ethnic minority group had the same prevalence of OWOB at age 18 as the population of Dutch origin. However, between the ages 18 and 70, they followed their own ethnic-group-specific transition rates between NW, OW, and OB (the same transitions as the reference scenario). This scenario provides insights into the effects of changes during childhood that do not persist over the life course. Table 1 summarises the specifications for each scenario.

We present results for different scenarios using age-standardised prevalence of OWOB, based on the European standard population[25] and cumulative incidence defined as the total number of incident cases between age of 18 and 70 years per 1000 18-year-olds.

Results

Prevalence of OWOB

As seen in Fig. 1 and Appendix 9 (Table 9-1), the prevalence of NW between age of 18 and 70 was the highest among the Dutch-origin population (57% in men and 67% in women) and lower in all ethnic minority groups. Men and women with South-Asian Surinamese or Turkish origins and women with Moroccan origin had a prevalence of NW of less than 30%. The prevalence of OB exceeded 40% in Moroccan and Turkish women, compared to 9% among individuals of Dutch origin.

These ethnic differences were already evident at age 18, with the lowest prevalence of NW among the South-Asian Surinamese. OB prevalence was 9% or higher among the ethnic minority groups, as compared to 2–3% among Dutch-origin individuals.

Scenario normal weight for all

Cumulative incidence of cardio-metabolic diseases

In Fig. 2, the total column (sum of orange and green parts) represents the cumulative number of incident cases between ages of 18 and 70 in the reference scenario per 1000 18-year-olds. For the Dutch-origin population, the number of incidence cases of diabetes was 161 (men) and 123 (women) per 1000 18-year-olds (Appendix 9, Table 9-2). The number of incident diabetes cases was higher among all ethnic minority groups, with the highest incidence among South-Asian Surinamese men and women (401 and 481 per 1000 respectively), followed by the Turkish group (344 and 440 per 1000, respectively), and the lowest among the African-Surinamese group (205 and 364 per 1000, respectively). IHD incidence was higher for all ethnic minority groups except for Moroccan men who had similar incidence as Dutch-origin men (223 and 227 per 1000s, respectively). For stroke, incidence in the Dutch-origin population was between that of the Moroccan- and Turkish-origin groups (lowest), and both Surinamese groups (highest).

Contribution of OWOB to cumulative incidence of cardio-metabolic diseases

The orange bars in Fig. 2 depict the cumulative incidence estimates in the Normal-Weight-for-All scenario. The cumulative incidence in this scenario was substantially lower than the reference scenario for all three diseases and all ethnic groups for both sexes. Moreover, ethnic inequalities were notably smaller for diabetes and negligible or reversed for IHD and stroke. Only for the South-Asian group did the incidence of IHD remain higher than that of the Dutch-origin population.

The green bars represent the number of cases prevented in the situation with no OWOB. This was generally the lowest among the Dutch-origin population, with the lowest prevalence of OWOB, and highest among South-Asian Surinamese men and women, followed by Turkish men. For women, the cumulative incidence of diabetes showed relatively little variation between ethnic minority groups. For diabetes in both men and women as well as IHD and stroke in Turkish men and women from all ethnic minority groups, at least half of the cases were attributable to OWOB.

No-ethnic-difference-over-the-Life-Course scenario

Fig. 3 and Appendix 9 (Table 9-3) show that when OWOB prevalence and transitions rates in all groups were the same as in

Table 1
Specifications for each scenario.

Scenario	Population of Dutch origin		Ethnic minority groups	
	Prevalence age: 18	Transitions	Prevalence age: 18	Transitions
Reference	Dutch origin	Dutch origin	Own ethnic group	Own ethnic group
Normal-Weight for All	All normal weight	No transitions	All normal weight	No transitions
No-Ethnic-Differences-in-Childhood	Dutch origin	Dutch origin	Dutch origin	Own ethnic group
No-Ethnic-Difference-Over the-Life-Course	Dutch origin	Dutch origin	Dutch origin	Dutch origin

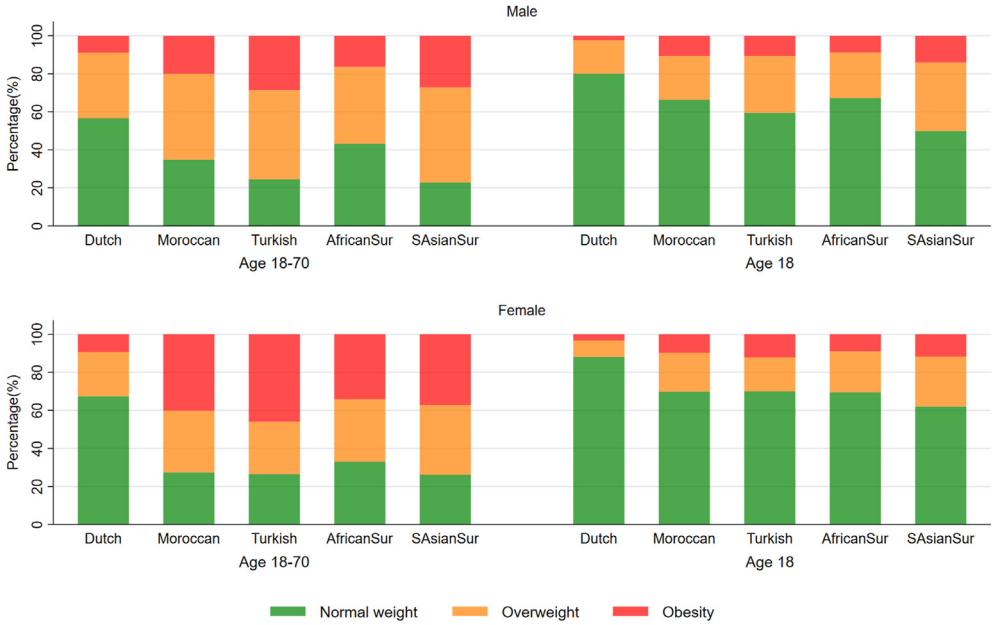

Fig. 1. Age-standardised prevalence of NW, OW, and OB between ages of 18 and 70, and at age of 18 in the reference scenario. Abbreviations: NW, normal weight; OB, obesity; OW, overweight.

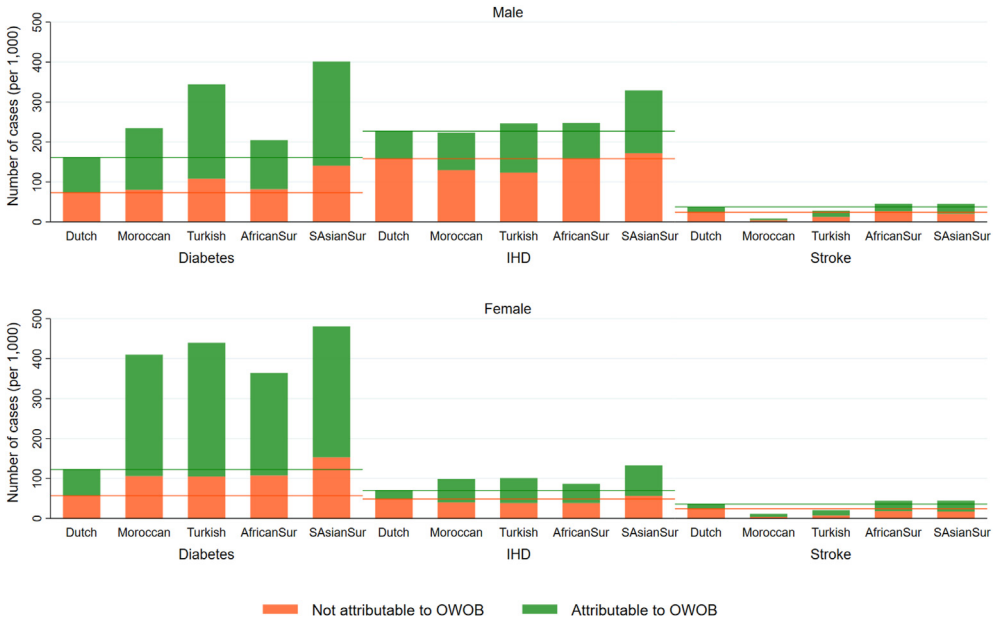

Fig. 2. Cumulative number of incident cases according to reference scenario, the Normal-Weight-for-All scenario and difference between both scenarios by gender and ethnic group. The horizontal line reflects the values for the population of Dutch origin.

the Dutch-origin population, the number of incidence cases was lower in all ethnic minority groups for all diseases. The largest reductions were generally observed for South-Asian Surinamese and Turkish men and women. The reductions were the smallest for the African Surinamese (except for stroke in women). For men, the reductions in the number of incident cases of diabetes and IHD were more similar, but for stroke, they were smaller, reflecting the small number of stroke cases in the reference scenario. The reduction in incidence cases was larger for diabetes than for IHD and stroke.

No ethnic-difference-in-childhood scenario

As expected, the changes in the No-Ethnic-Differences-in-Childhood scenario were generally smaller than those in the No-Ethnic-Difference-over-the-Life-Course scenario. However, this was not always the case, as in the case of African-Surinamese men, where the results for stroke for both scenarios were nearly the same. This similarity occurred because the increase in OWOB during adulthood in these groups was about equal to that in the Dutch-origin population. When comparing the groups,

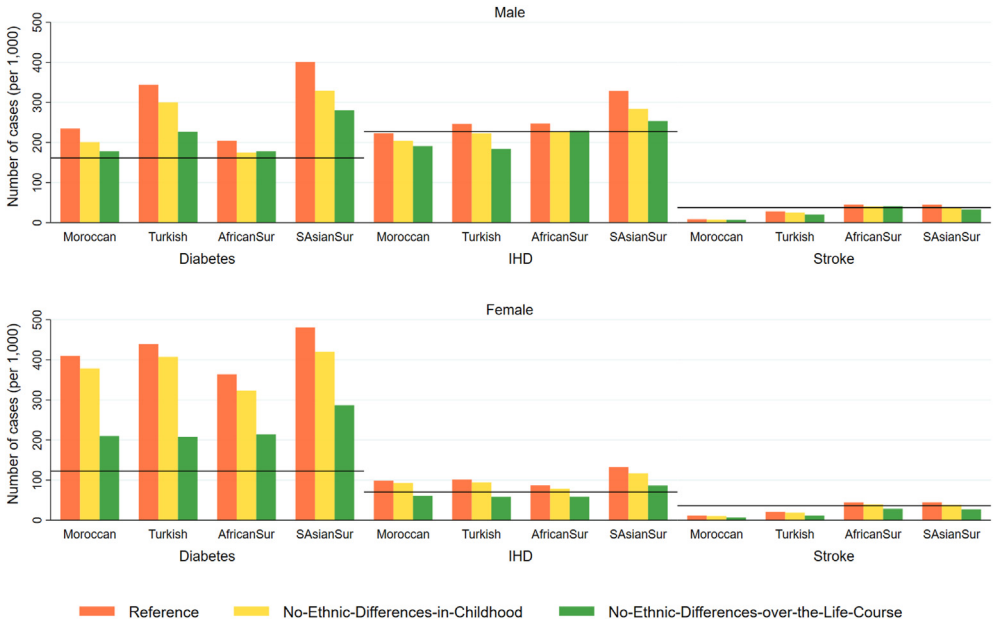

Fig. 3. The cumulative incidence of diabetes, IHD, and stroke for the ethnic minority groups in three scenarios: the reference scenario, the No-Ethnic-Differences-over-the-Life-Course scenario, and the No-Ethnic-Differences-in-Childhood scenario. The horizontal line in the figure indicates the reference scenario for the population of Dutch origin. Abbreviation: IHD, ischaemic heart disease.

it becomes evident that the largest reductions for both men and women in all three diseases were observed for South-Asian Surinamese, except for diabetes in women, where the reductions were most pronounced among women of Turkish origin.

Sensitivity analyses

Using relative risks from the DYNAMO-HIA database affected the quantification of disease attributed to OW or OB. Nevertheless, it did not alter the depiction of relative differences among ethnic (see Appendix 10).

Discussion

In this study, we examined the potential of reducing OWOB for decreasing inequalities in cardio-metabolic diseases between ethnic groups, using simulation modelling that incorporates ethnic-specific parameters. We found that inequalities between ethnic groups are most pronounced for diabetes where the proportion of cases attributed to OWOB is higher in non-Dutch origin groups than in the Dutch-origin population. Interventions targeting OWOB show promise in reducing health inequalities related to diabetes but will not be able to eradicate them. In the case of IHD and stroke, existing inequalities are less clear-cut. Particularly for stroke, our data suggest that the incidence is higher in the Dutch-origin population than in Turkish- or Moroccan-origin groups whereas roughly equal to that of Surinamese origin. In the case of IHD, the most pronounced health inequalities are observed among the South-Asian Suriname population, and our No-Ethnic-Difference-over-the-Life-Course scenario shows the greatest potential for reducing IHD in this group. For the other ethnic groups, this scenario reduces IHD incidence to a level around or below that of the Dutch-origin population. As expected, the effects are less pronounced in a scenario where OWOB progression in adulthood remains ethnic-specific (the No-Ethnic-Differences-in-Childhood scenario).

Strength and limitations

This is the first study to estimate the effect of changes in OWOB across the life course on the incidence of cardio-metabolic diseases in a multi-ethnic population. The strength of our study lies in its synthesis of evidence from multiple sources, including administrative data, the HELIUS study, and data from scientific literature to create models for multiple ethnic groups, which, to our knowledge, is a pioneering effort. Our modelling approach incorporates checks for input consistency. For instance, if prevalence increases with age, it should correspond to new cases arising, which means that incidence should be sufficiently high to deliver those cases.

The value of our calculations clearly depends on data quality. Data on ethnic groups are scarce and are not always representative. The HELIUS study, which delivered the prevalence of OWOB as well as the incidence of diabetes was limited to Amsterdam, which may not representative for the entire Dutch population. So although we targeted to simulate ethnic groups for the Netherlands as a whole, in some respect, the simulation might resemble the Amsterdam population more. Notably, the Dutch-origin population in the HELIUS study is more highly educated than the national average, which might have led to an underestimation of OWOB, and consequently effects of the two No-Ethnic-Differences scenarios on diseases may be smaller than we calculated. This may have had a particular impact on diabetes, given that the incidence of diabetes was also based on this source. Furthermore, data for distinguishing South-Asian Surinamese and the African Surinamese were lacking in several sources, so we had to use ad hoc solutions for quantifying some of the input data. Finally, the age patterns of the estimated excess mortality rates were not always plausible, but rates were very low in the age range of interest and are not likely to affect the main outcome of our study, with cumulative incidence between ages 18 and 70.

Interpretation

To the best of our knowledge, our work represents the first attempt to integrate ethnic inequalities into an established

simulation model used for the quantitative assessment of chronic disease incidence and the role of OWOB. We found large inequalities in incidence of the diseases under investigation between the ethnic groups. For instance, we observed a cumulative incidence of diabetes exceeding 400 cases per 1000 men in the South-Asian population, in contrast to approximately 150 cases in the host population. This underscores the critical point that if this type of models disregards the ethnic composition of the population, as is currently the case, it will lead to a significant underestimation of the anticipated burden of disease. This is particularly true if the majority of the population consists of people who have migrated from low- and middle-income countries and/or their offspring, as is the case in the city of Amsterdam.

The presence of large ethnic inequalities in diabetes,[26,27] cardiovascular diseases,[28] and OWOB as factors of contribution to these inequalities[29] is not unique to the Netherlands. Based on our study, it is expected that where ethnic groups have a higher incidence of diabetes and cardiovascular diseases than the host population, these inequalities will become substantially smaller in a situation where OWOB could be reduced to the level of the host population, with the largest reductions for diabetes. This finding suggests that in order for countries to reduce ethnic inequalities in cardio-metabolic diseases, and diabetes in particular, it is crucial to intensify efforts aimed at addressing inequalities in OWOB. It is important to note, however, that these efforts should not focus only on individual determinants such as knowledge or beliefs. Instead, the existence of inequalities in OWOB between ethnic groups underscores the significance of shared characteristics underlying these individual determinants, such as shared history, ancestry, and identity. Each of these dimensions could impact on health and thereby explain inequalities in health between ethnic groups. In addition to these so-called attributional dimensions, relational dimensions that capture the relationship between a certain group and the society in which groups live in could contribute to that explanation. Examples include exposure to discrimination and one's socioeconomic position.[16] It is through all these attributional and relational dimensions that the influence of ethnic background on health is expressed. Currently, we have very little insight into specific factors and mechanisms that are responsible for the high prevalence of OWOB in ethnic minority groups. However, at least a part of the observed ethnic inequalities likely reflects the lower socioeconomic position of the groups at stake, as compared to the population of Dutch origin. Further insight into these specific factors as well as the attributional and relational characteristics that shape those factors is imperative to address the increased risk of OWOB in these groups.

While our third scenario suggests that changes in OWOB in childhood ages that do not persist during adulthood can still have an impact on the disease burden in adult life, this potential impact was found to be lower than the scenario where the effect persisted into adulthood. The explanation for the difference between the two scenarios lies in the current increased risk of developing OWOB in adulthood among most ethnic minority groups. This finding indicates the importance of the intensification of prevention of OWOB across the entire lifespan, from childhood to adulthood. Such an approach necessitates a combination of prevention strategies that have been proven to be effective across the population, including multiple ethnic groups. Hereby, the focus should be on interventions taking an universal approach, aiming to make the environment less obesogenic.[30] The existing environments within a country (e.g., the built environment, transport systems, food prices) explain much of the differences in obesity prevalence between populations, and interventions targeting these environments hold most potential to reduce OWOB on the long term, including for ethnic minority groups.[30] Given the elevated prevalence of OWOB in these populations, it is imperative to combine this with a culturally adapted high-risk approach targeting unhealthy behaviours among individuals at an increased risk of diabetes within high-risk ethnic groups, such as the South Asians.[31]

Conclusion

Our simulation shows that the higher prevalence of OWOB in ethnic minority groups contributes substantially to the incidence of cardio-metabolic diseases between ages of 18 and 70. A substantial part of ethnic inequalities in incidence of diabetes mellitus, IHD, and stroke can be attributed to OWOB. Reducing the prevalence of OWOB in each ethnic minority group to the current level among the majority population substantially lowers the number of incidence cases for all ethnic minority groups for all diseases, and inequalities therein, with largest reductions for diabetes, and for South-Asian Surinamese. Interventions aimed at reducing OWOB have clear potential to reduce ethnic inequalities in these outcomes, especially for diabetes, but will not be able to eradicate them. The next step is to examine the effectiveness of interventions targeting OWOB for the different ethnic groups.

These findings underline the need for intensifying the prevention of OWOB in ethnic minority populations throughout the lifespan, in order for countries to reduce ethnic inequalities in cardio-metabolic diseases.

Author statements

Ethic approval

Ethics approval is not required for this study.

Funding

Netherlands Cardiovascular Research Initiative: An initiative with support of the Dutch Heart Foundation, ZonMw, CVON2016-07 LIKE.

Competing interests

We declare no competing interests.

Role of the funding source

The funders of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Data sharing

The HELIUS data are owned by the Academic Medical Center in Amsterdam, the Netherlands. Any researcher can request the data by submitting a proposal to the HELIUS Executive Board as outlined at http://www.heliusstudy.nl/en/researchers/collaboration. Requests for further information and proposals can be submitted to the scientific coordinator and data manager of HELIUS, at heliuscoordinator@amsterdamumc.nl. The HELIUS Executive Board will check proposals for compatibility with the general objectives, ethical approvals and informed consent forms of the HELIUS study, and potential overlap with ongoing work affiliated with HELIUS. There are no other restrictions to obtaining the data, and all data requests will be processed in the same manner. All the other data in this study are published in papers or on public websites.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.puhe.2024.04.015.

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