# Ethnic differences in the prevalence of overweight and obesity

*A quantitative analysis of overweight and obesity in later life for individuals with a migration background and non-migrants in the Netherlands, and the role of socioeconomic factors and physical activity*

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Abstract

In the Netherlands, overweight and obesity are unequally distributed over different ethnic groups. To investigate why these ethnic differences occur, this thesis investigates the extent to which three known overweight and obesity risk factors - education, employment, and sports participation – can explain these inequalities. The relationship between ethnicity and overweight/obesity among people aged 55 and over is unclear as few studies have been conducted to describe this. However, the older population is increasing and so are the overweight and obesity percentage.

The relationship between the variables and the prevalence of overweight and obesity in later life is analyzed in this thesis. This study provides an investigation into the combination of these factors, thereby improving the possibilities for prevention programs of overweight and obesity among older people from different migration backgrounds in the Netherlands. This is achieved by answering the research question, "are there differences in the prevalence of later life overweight and obesity between older migrants of Moroccan, Turkish, Surinamese, and Antillean origin and their native Dutch counterparts, and if so, to what extent are these differences attributable to education, employment, and sports participation?"

Data from the survey on the Integration of Minorities (2015) was used to perform a logistic regression analysis and mediation analysis (Karlson-Holm-Breen method). Models were used to examine the relationship between ethnicity and overweight/obesity. In addition, a mediation analysis was conducted for education and employment because these variables were found to be statistically significant predictors of overweight/obesity from the logistic regression analysis. The sample included 1,110 individuals aged 55 and over from Moroccan, Turkish, Surinamese, and Antillean backgrounds and their native Dutch counterparts. The percentage of overweight individuals was highest (82.3%) in the Turkish group, followed by the Moroccan (74.2%), Antillean (70.5%), Surinamese (63.8%), and the native Dutch (59.8%) group. For obesity, the range was from 48.4% for the Turkish group to 14.8% for the native Dutch group.

Moroccan, Turkish, and Antillean migration backgrounds were significant predictors of overweight/obesity. The difference in Moroccan overweight compared to the native Dutch can be partially explained by education level. The differences between Moroccan, Turkish, and Antillean individuals were not attributable to employment and sports participation. Surinamese individuals with a migration background were not significant predictors of overweight and obesity.

Preventive programs, such as education programs, should be implemented. Whereby, the accessibility for older migrants should be easy, for example, language.

**Keywords:** overweight, obesity, non-Western migrants, ethnicity, Moroccan, Turkish, Surinamese, Antillean, native Dutch, education level, employment, sports participation, SIM 2015, the Netherlands.

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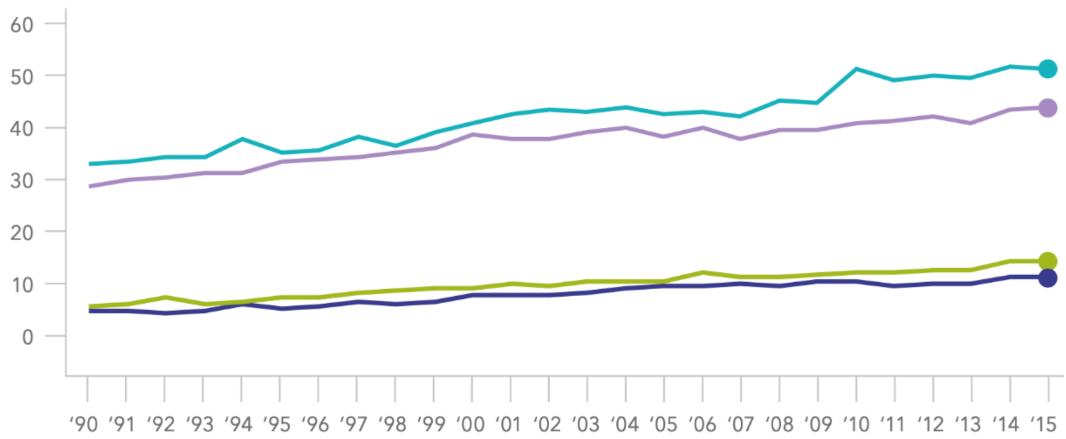
# 1. Introduction

Globally, the prevalence of overweight and obesity is increasing (Roberto et al., 2015). In 2015, the total measured world population was 7,339 billion people (United Nations, n.d.). Of these, 2.2 billion children and adults were overweight, and 603.7 million adults were obese worldwide (Global Burden of Disease (GBD) 2015 Obesity Collaborators, 2017). The National Institutes of Health defines overweight and obesity in terms of body mass index (BMI), which is weight in kilograms divided by the square of the height in meters. Statistics Netherlands (2016) and the World Health Organization (WHO) (2018) consider both men and women to be overweight if their BMI is greater than or equal to 25. The BMI threshold for obesity is 30. Excess body weight contributed to 4 million deaths and 120 million disability-adjusted life years worldwide in 2015 (GBD 2015 Obesity Collaborators, 2017). Disability-adjusted life years was developed by the WHO as a measure of the total burden created by disease: not only the number of people who die prematurely, but also the number of years people live with disabilities, due to disease (Murray & Acharya, 1997; WHO, 2021). The Netherlands is also struggling with large numbers of overweight and obese people; the percentage of overweight and obesity increased between 1990 and 2015, as shown in Figure 1.

***Figure 1.*** Overweight and obesity among adult women and men between 1990 and 2015.



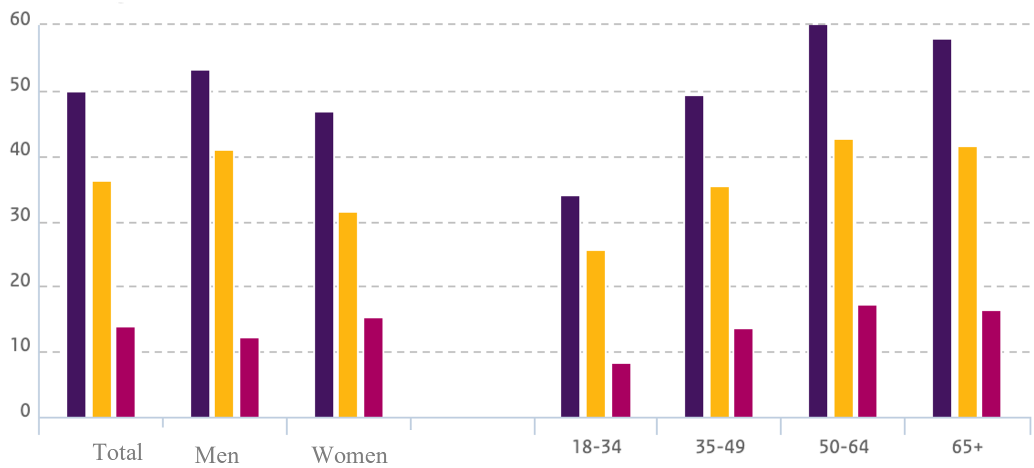

*Notes:* This figure demonstrates the trend of overweight and obesity between 1990 and 2015 for people living in the Netherlands and aged 18 and above. The y-axis shows the percentages of overweight and obesity and on the x-axis the years are presented.

— Overweight men
— Overweight women
— Obese men
— Obese women

*Volksgezondheidenzorg (2021a).*

As shown in Figure 2, the total prevalence of overweight in the Dutch population was 50% in 2020. Figure 2 is divided into age categories on the right-hand side, revealing that the percentages of overweight and obesity increase with age. From the age of 65, these percentages slightly decrease (Volksgezondheidenzorg, 2021b).

***Figure 2.*** Overweight and obesity in 2020 in the Netherlands.




*Notes:* This figure shows the prevalence of overweight and obesity for Dutch adults (aged 18 years and older) in 2020. On the y-axis the percentages are presented. On the left side of the figure the prevalence of overweight and obesity among men and women is presented and on the right side the prevalence of overweight and obesity among the different age groups.

— Overweight BMI ≥25

— Moderately overweight BMI 25-30

— Obesity BMI ≥ 30

*Volksgezondheidenzorg (2021b).*

The increase in the overweight population has coincided with an increase in population growth. Over the past half century, the population of the Netherlands has gradually grown (Garssen, 2011). The migration balance, or the number of immigrants minus the number of emigrants, is often held responsible for this growth; however, natural growth, or the number of births minus the number of deaths, was much more significant between 1960 and 2010 (Garssen, 2011). The population is aging, and the proportion of older people in the total population is increasing (*Centraal Bureau voor Statistiek* (CBS), 2020).

In addition to age, is migration background an important factor for overweight and obesity. At the beginning of 2018, the Netherlands had a total of 840,000 migrants aged 55 and above, according to the CBS. The largest groups were people with a Surinamese (83,000), Turkish (52,000), Moroccan (50,000), or Antillean (24,000) background (Conkova & Lindenberg, 2018, p. 224). A Dutch study of 77,058 children carried out in 2015 by De Wilde et al. revealed that the overweight prevalence rate among children with a Turkish and Moroccan migration background was 27.1% and 22.1%, respectively, while the childhood overweight prevalence rate among Dutch children without a migration background was 9.7% (2018). This difference in overweight and obesity between the non-Western migrants and native Dutch individuals also occurs in the older population. An extensive Dutch study performed in 2001 compared the health of non-Western migrants to that of native Dutch individuals and showed that approximately 80% of Turkish men and women over the age of 35 had a BMI greater than 25. Among the Moroccans, this percentage was 60% for women and 85% for men. However, among the native Dutch, about 50% of the over-35 age group were overweight in 2001 (Van Leest et al., 2002). Van Leest et al. (2002) thus concluded that the prevalence of overweight and obesity is higher among these migrant groups than the native Dutch population. These studies imply that there are ethnic differences in the prevalence of overweight and obesity, not only among children but also across the older population.

To explain reported ethnic differences in the prevalence of overweight and obesity, the authors of one study evaluated genetic, socioeconomic, and cultural factors (for example food habits) (Cornelisse-Vermaat & Maassen van den Brink, 2007, p. 483). The focus of the present study is on socioeconomic mechanisms because biological factors cannot be influenced by policies. Policies focus, for example, on prevention of overweight by stimulating a healthy environment and financing programs which provide information about the consequences of overweight and obesity (*Ministerie van Algemene Zaken*, 2018). Moreover, food habits, a variable used by Cornelisse-Vermaat and Maassen van den Brink (2007), were not included in the questionnaire used for this thesis. Lifestyle factors, such as physical activity, have also been investigated because they seem to influence the prevalence of later life overweight and obesity (Roda et al., 2016) and these can be changed through policies.

Klokgieters et al. (2018) discussed how older migrants from Turkish and Moroccan origin have more health problems than the native Dutch of the same age group and suggested that being seriously overweight was mainly attributable to socioeconomic factors. Both low education levels and low income levels result in a higher chance of being overweight. In the present thesis, the income level is replaced with being employed or not and the variable sports participation is included. Sports participation was chosen because Cornelisse-Vermaat et al. (2003) indicate that reduced sports participation in later life could be seen as a cause of the prevalence of overweight among older people. People tend to maintain the same diet while burning less. The current research may lead to new policies being created to encourage sports participation. Furthermore, education and employment are considered socioeconomic factors, and a link with overweight/obesity is also found for these variables in the literature (Cornelisse-Vermaat et al., 2003; Klokgieters et al., 2018).

Overweight and obesity are major health risks and leading causes of disease (Government of the Netherlands, 2019). Increased body weight can introduce or aggravate chronic health diseases, including cardiovascular disease, diabetes mellitus, chronic kidney disease, and several types of cancer (GBD 2015 Obesity Collaborators, 2017; Houston et al., 2009, p. 1887; Singh et al., 2013). Given the associations of overweight and obesity with a range of chronic health conditions and symptoms, research into causes and prevention is urgently required. While some studies have highlighted ethnic differences in the prevalence of childhood overweight and obesity, there is a lack of research concerning these differences among older individuals, even though the prevalence among this age group is a current problem. The number of older migrants will increase in the coming years due to the aging of the population and, as mentioned earlier, older migrants are at greater risk than the native Dutch of becoming overweight. Similarly, the CBS found that people with a Moroccan, Turkish, Surinamese, or Antillean migration background are more likely to be seriously overweight than native Dutch individuals (CBS, 2018). In the long term, this can lead to other health conditions and increased health costs (Wong et al., 2008). This disparity could be seen as a problem.

Lehnert et al. (2013) discussed the relationship between excess weight and medical expenditures, and their empirical research indicate a positive association between excess weight and medical expenditures. As BMI values increase, so do health care costs, principally among individuals with obesity. Hence, when the proportion of obese individuals increases, a larger share of the total annual national health care budget is spent on care for obesity and obesity-related health problems (Lehnert et al., 2013). Production costs and costs for providing medical services lead to a high level of health care expenditure (Lehnert et al., 2013). Because of the health-related problems, it is assumed that people with excess weight are, in general, more often ill than people who are not overweight. Since the literature discussed above shows that obesity is predominantly present among migrants, it is important to know whether information provision among migrants needs to improve in order to reduce future expenditure. Decreasing differences in overweight and obesity between the non-Dutch-ethnic groups and native Dutch is beneficial because it can not only reduce health care costs but also enhance the wellbeing of migrants in general (Doll et al., 2000).

## 1.1 Research objective

Socioeconomic factors and physical activity may both play a role in explaining the differences in overweight between the migrant groups, Moroccan, Turkish, Surinamese, and Antillean, and the native Dutch (Cornelisse-Vermaat & Maassen van den Brink, 2007, p. 483). According to these scholars, education and physical activity are main determinants of overweight. Martin et al. (2008) pointed out that employment also plays a role: people who work are less likely to be overweight. The relatively few studies analyzing the prevalence of overweight in older migrants have left room for further research. The purpose of this thesis is to study whether Moroccan, Turkish, Surinamese, and Antillean and native Dutch have a different prevalence of overweight in later life and determine the extent to which socioeconomic factors and physical activity influence this possible difference.

Given the information that socioeconomic factors and physical activity influence overweight, this study seeks to provide insights into the following main question: Are there differences in the prevalence of later life obesity and overweight between older migrants of Moroccan, Turkish, Surinamese, and Antillean origin and their native Dutch counterparts, and if so, to what extent are these differences attributable to education, employment, and sports participation?

This thesis begins with an overview of the theoretical frameworks before introducing the hypotheses. A description of the methods of data collection follows, as well as the operationalization and data analysis methods. Subsequently, the results of the analyses are presented, followed by a discussion of this research and its conclusions.

## 2. Theoretical framework

This chapter details the relationship of migration background with overweight and obesity as well as the roles of education, employment, and sports participation. Identifying the mechanisms underlying this relationship can help clarify the relationships of the Moroccan, Turkish, Surinamese, and Antillean migrant groups and native Dutch individuals with overweight and obesity. However, before these factors are discussed, the concept of migration background and its impact on later life overweight/obesity are explored.

In this thesis, specific ethnic groups within the Netherlands were studied, with a focus on the native Dutch population and people with a Moroccan, Turkish, Surinamese, or Antillean background aged 55 and above. These migrant groups were chosen because they are the largest non-Western ones in the Netherlands (CBS, 2021). Additionally, because high rates of overweight and obesity among older migrants have been reported in the literature, this study focuses on older populations (Cornelisse-Vermaat & Maassen van den Brink, 2007; De Wilde et al., 2015; Klokgieters et al., 2018; Turner et al., 2015). Peeters et al. (2003, pp. 24-32) analyzed the patterns of change in BMI values among people in different age groups and indicate that BMI values increase with age. For example, in a study performed by Cornelisse-Vermaat and Maassen van den Brink (2007, p. 486), individuals over the age of 45 with a Turkish migration background were found to have the highest rate of overweight (71.1%), followed by the Moroccans (63.2%), Surinamese/Antilleans (56.3%), and the native Dutch respondents had the lowest BMI of the four groups (49.1%). This thesis investigates whether the same findings are obtained for older people within the chosen research population by testing the first hypothesis of this study:

Hypothesis 1 (H1): *Individuals aged 55 years and above with a Moroccan, Turkish, Surinamese, or Antillean migration background are more likely to be overweight or obese than their native Dutch counterparts.*

H1 functions as the basis for subsequent hypotheses regarding the extent to which these differences can be attributed to socioeconomic factors and physical activity.

## 2.1 Socioeconomic factors and later-life overweight and obesity

Socioeconomic factors are the combined economic and sociological measures of an individual's social position based on, for example, income, education level, and employment (Pampel et al., 2012; Zhang et al., 2017). The most commonly used term is socioeconomic status (SES). In developed countries, overweight and obesity are widely regarded as conditions which are more prevalent among people with lower SES than among those with high SES (Wang & Beydoun, 2007). Many recent studies, including that by Pampel et al. (2012), state that these differences in BMI cannot be fully explained by an individual's SES. Other major factors include lifestyle factors, such as sports participation (Pampel et al., 2012). Subsequent sections of this paper explain the impact of sports participation on overweight and obesity. Factors indicated by the general literature to contribute to differences in the prevalence of overweight and obesity were applied in this thesis to the specific case of older migrants and non-migrants.

Education is the most used indicator of SES (Ball & Crawford, 2005). Researchers have theorized that a good education is important for a healthy lifestyle, because it results in individuals being better informed (Raghupathi et al., 2020). Raghupathi et al. (2020) proposed that well-educated people have lower levels of morbidity, mortality, and disability than their less-educated counterparts. Cornelisse-Vermaat and Maassen van den Brink (2007) found that the native Dutch and Surinamese/Antillean populations generally have higher education levels than Moroccan and Turkish populations. The results of their analysis indicated that people with lower education levels have higher BMI values (Cornelisse-Vermaat & Maassen van den Brink, 2007). Thus, in addition to ethnicity, education level has been proven to play a role in the prevalence of overweight.

The aforementioned findings indicate that overweight and obesity are more common among people with a relatively low education level. A 2018 Dutch study performed by CBS (2018) reported that men aged 45–64 who were lower educated were more likely to be obese (20.0%) than men in the same age group (11.1%) who were highly educated. For people over the age of 65, these percentages were 19.9% and 10.9%, respectively. The same pattern was also observed in women. Women aged 45–64 with a low education level (25.1%) were more likely to be obese than their highly educated counterparts (13.9%). For women over the age of 65, these percentages were 23.0% and 7.4%, respectively.

One possible cause of overweight and obesity among people with lower education levels is relatively low levels of health knowledge. Cornelisse-Vermaat et al. (2003) stated that schooling promotes healthy behaviors and increases individuals' health knowledge, and that this health knowledge contributes to a better health status. People with a higher education level may also be more aware of health problems associated with overweight and obesity (Sobal, 1991). A study conducted in 2018 in the Netherlands revealed that 58% of Dutch people aged 45–75 without a migration background had a relatively high education level (bachelor’s degree or higher), whereas this proportion was 45%, 55%, 57%, and 51% among Moroccan, Turkish, Surinamese, and Antillean migrants, respectively (CBS, 2018). These findings may suggest that, due to their lower education level, Moroccan, Turkish, Surinamese, and Antillean migrants have lower levels of health knowledge than native Dutch people. These lower levels of health knowledge can be the cause of the higher prevalence of overweight and obesity among these migrant groups, compared to their native Dutch counterparts. Thus, the second hypothesis is as follows:

Hypothesis 2 (H2): *Differences in the likelihood of being overweight or obese between Moroccan, Turkish, Surinamese, and Antillean migrants and their native Dutch counterparts can be partially explained by the education level.*

Employment is also regarded as an indicator of SES. Little literature has been published on the effect of employment on the likelihood of excess weight. Studies have reported that an inverse relationship exists between obesity and employment (Martin et al., 2008; Entrala-Bueno et al., 2003). Employed persons are those whose main income originates from paid work (for example, someone employed as a member of staff, employed abroad, self-employed, or otherwise employed). Income can also come from receiving benefits. These can only be acquired under certain circumstances, such as disability or unemployment. Individuals without a source of income are defined as those who receive no income from employment, benefits, pensions, or scholarships. Smaller proportions of Moroccan, Turkish, Surinamese, and Antillean migrants are employed than are immigrants from countries in the European Union (CBS, 2018). Moreover, non-Western migrants are more likely to be unemployed and therefore live in poverty than native Dutch people (RIVM, n.d.). Among men aged 20–65 with a Turkish or Moroccan background, 66% had a paid job or owned a business that provided their main source of income in 2016. Among men with an Antillean or Surinamese background, this percentage was slightly lower, at approximately 60%. Among women, the percentage of employed was lower, especially among Turkish (43%) and Moroccan (39%) women. Approximately 25% to 32% of men and women in the four largest non-Western groups are dependent on benefits. In 2017, 57% of people in these migrant groups were in paid employment, whereas this percentage was 68% among people with a Dutch background. Among the non-Western groups, people with a Surinamese background were most likely to be in paid employment (62%), and people with a Moroccan background were least likely (54%) (CBS, 2018).

Martin et al. (2008) examined the role of employment on the incidence of overweight in Spanish adults. They discovered that the prevalence rate of overweight was higher among retired people (28.4%) and people who worked from home (26.7%) than among people who were actively employed in on-site (15.9%). The Health and Europe Centre (2019) also suggested that unemployment coincides with a higher prevalence of overweight. This could be linked to the physical activity at work and its influence on the prevalence of overweight and obesity (Entrala-Bueno et al., 2003; Martin et al., 2008). Moris (2006) studied the effect of obesity on employment, and the results indicated that people with obesity are less likely to be employed. This finding may be attributable to workplace discrimination (Cawley, 2004; Morris 2006). To examine the impact of employment on overweight and obesity, the third hypothesis was formulated as follows:

Hypothesis 3 (H3): *Differences in the likelihood of being overweight or obese between Moroccan, Turkish, Surinamese, and Antillean migrants and their native Dutch counterparts can be partially explained by employment status.*

Since employment can decrease overweight and obesity prevalence, the unemployment of migrants can be a reason for the relationship between ethnicity and overweight/obesity.

## 2.2 Physical activity and later life overweight and obesity

The third variable tested is sports participation, which the WHO identified as an important factor for health (WHO, 2010). Public health recommendations for physical activity are 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity physical activity per week (Van Leest et al., 2002; Blair et al., 2004). Globally, around 28% and 23% of people aged 18 and above were not active enough in 2016 and 2010, respectively (WHO, 2020; Lera-López & Marco, 2017). The percentage of physically inactive U.S. adults aged 50 and above was 28% in 2014 (Keadle et al., 2016). This means they were not meeting the global recommendations of 30 minutes of moderate-intensity activity each day for a minimum of five days per week, or 15 minutes of vigorous-intensity activity for a minimum of five days per week. Higher levels of physical activity improve sleep and reduce risk of cardiovascular disease mortality, incident hypertension, and cognitive and mental health, and they may contribute to the prevention of overweight and obesity (Van Leest et al., 2002; WHO, 2020).

The effect of less physical activity on excess weight has been investigated in several studies. One study conducted between 1986 to 1994 evaluated the relationship between physical activity and overweight (Lindström et al., 2003). The authors observed a correlation between an increasing prevalence of physical inactivity and higher BMI values. From 1986 to 1994, the proportion of people who were physically inactive increased from 14.7% to 18.1% among men and 19.4% to 26.7% among women. An increase in the prevalence of overweight and obesity was also observed in both groups. The researchers concluded that the proportion of the population with overweight and obesity increased significantly, and that physical inactivity seemed to be a key factor contributing to this result (Lindström et al., 2003).

A study conducted in the United States revealed that environmental factors play a major role in physical activity and that people with low SES are less likely to have access to physical activity facilities (Gordon-Larsen, 2006; Turner et al., 2015). In turn, this lack of access was associated with lower physical activity levels and a higher prevalence of overweight in this population (Schoeppe & Braubach, 2007; Wang & Beydoun, 2007). A more recent study indicated that individuals with high SES tend to have healthier lifestyles, such as engaging in more leisure-time sports and having a lower fat intake (healthier food) (Gutiérrez-Fisac et al., 2011). Additionally, results from a study by Kanters et al. (2012) showed that ethnicity influenced sports participation among students, as students with a migration background were less likely to participate in sports.

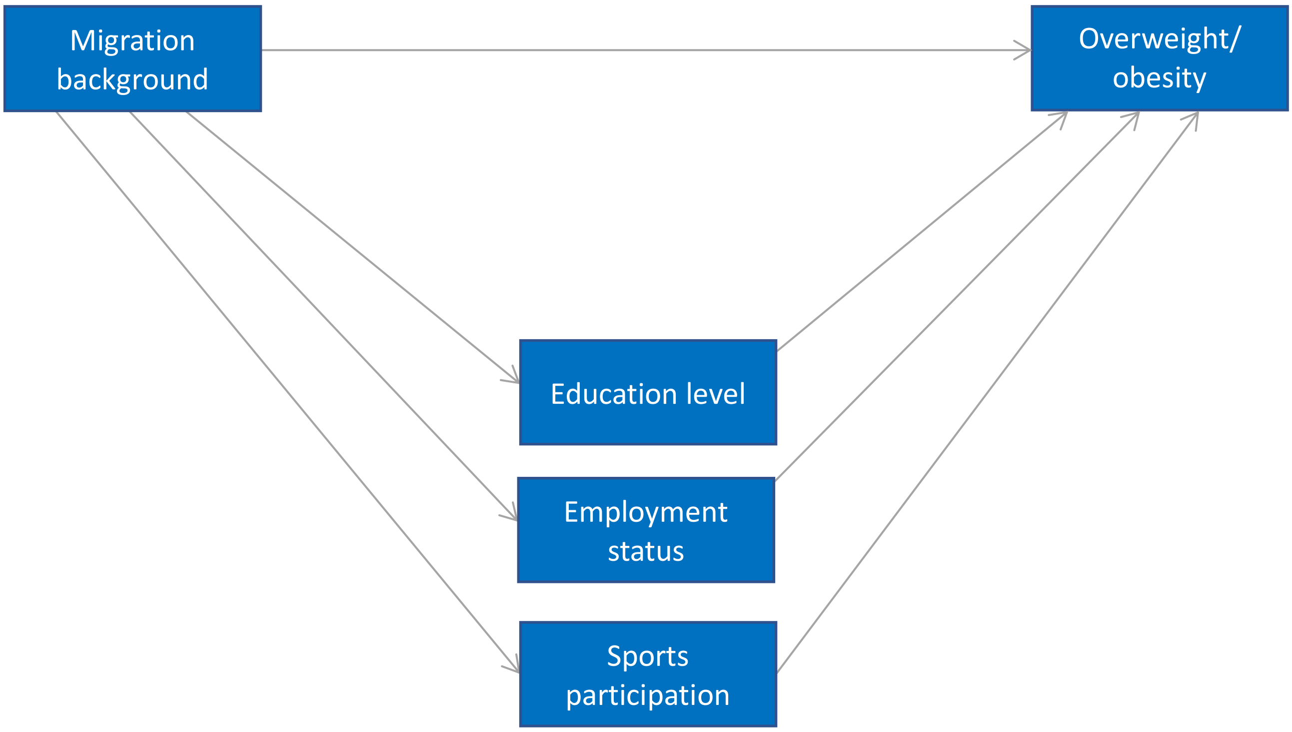
A Dutch study collected data on Moroccan, Turkish, Surinamese, and Antillean migrants and the native Dutch people. In each first-generation migrant group, 10% of the respondents participated in a sport at least once per week. Among the native Dutch respondents, this percentage was 26%. These results indicate that members of these migrant groups tend to be less active in sports activities (Van Leest et al., 2002). Since physical inactivity can be a cause of overweight and obesity, the following hypothesis was formulated:

Hypothesis 4 (H4): *Differences in the likelihood of being overweight or obese between Moroccan, Turkish, Surinamese, and Antillean migrants and their native Dutch counterparts can be partially explained by sports participation.*

Better physical activity does not only improve health status but provides people with a better quality of life (Engström, 2008).

The hypotheses are summarized in the conceptual model, shown in Figure 3 for this research. This conceptual model was developed to show a possible relationship between migration background and overweight/obesity, which can be explained by the variables education, employment, and sports participation. Moroccan, Turkish, Surinamese, and Antillean migrants are expected to have higher BMI values than those of native Dutch individuals. This expectation is based on the findings of the studies outlined above, which reported that these migrant groups generally have lower education levels, are less likely to be employed, and have lower levels of sports participation.

***Figure 3.*** Directed Acyclic Graph.




*Notes:* This conceptual model illustrates the possible relationships between the independent variables (migrant, education level, employment status, and sports participation) and the dependent variable (overweight or obesity). The variables education level, employment status, and sports participation serve as mediators in this model. An arrow between two blocks represents a potential causal pathway.

# 3. Methodology

## 3.1 Dataset

This thesis analyzed secondary, quantitative data published by the Social and Cultural Planning Office (2015). Data on four migrant groups in the Netherlands was obtained. TNS NIPO/Veldkamp collaborated with Labyrinth to conduct the Survey on the Integration of Minorities (SIM) in 2015. The survey sample was provided by the CBS. The SIM fieldwork was conducted from January 29 to July 15, 2015.

The following groups were interviewed for the SIM: Dutch natives, first- and second-generation migrants from Turkey, Morocco, Suriname, and the former Netherlands Antilles, including Aruba (the four largest non-Western migrant groups), and individuals of Somali and Polish origins. The present research did not include the data obtained from Somali and Polish respondents, focusing instead on the four largest non-Western migrant groups in the Netherlands. A total of 15,028 participants were registered, of whom 6,829 responded, yielding a response rate of 45%. The number of enrolled participants who were not Somali or Polish was 10,581, of whom 5,074 responded, yielding a response rate of 48%. Since this thesis focuses on individuals aged 55 and older, all respondents younger than 55 years were removed from the dataset, resulting in 3,937 removed observations. Next, respondents with erroneous data were excluded, namely those below 100 cm and above 230 cm in height (0 respondents), those below 30 kg in weights (2 respondents), and those with a BMI value exceeding 99 (1 respondents). Finally, respondents who were second-generation migrants were excluded (17 respondents), as were participants who did not report education level data (7 respondents), yielding a final data set consisting of data from 1,110 respondents. Distinguishing between first- and second-generation migrants is imperative because these groups can differ in numerous ways, such as in terms of education level (Van Leest et al., 2002).

To prepare the Dutch questionnaires, eight respondents were interviewed: four native Dutch, two Surinamese, and two Antillean individuals. Of these, four were men and four were women, and four were employed and four were unemployed. The survey questions concerned education, work, social contacts, cultural integration, religion, perceptions of health status, and sports participation. The respondents completed the questionnaire using a computer and were asked to think out loud. After each section of questions, the respondents were asked by a TNS NIPO/Veldkamp employee what they thought about the questions and which questions were difficult to answer. In a separate room, the client and other TNS NIPO/Veldkamp employees observed this process using closed-circuit video. A computer monitor was also present in the viewing room so that respondents' answers could be observed in real time. Following the eight interviews, the TNS NIPO/Veldkamp employees formulated a list of comments. Based on the comments, the questionnaire was adjusted and retested. The next step was to translate the questionnaire into Turkish and Moroccan Arabic. Two respondents from each group were interviewed, and the questionnaire was again adjusted based on the comments provided in the pilot test.

The SIM data was collected through a mixed-mode strategy: computer-assisted web interviewing (CAWI) supplemented by computer-assisted personal interviewing (CAPI) performed by bilingual interviewers. Respondents filled in the questionnaire through one of two methods: more than 50% of the native Dutch (75%), Surinamese (52%), and Antillean (54%) individuals used CAWI, whereas more than 50% of the Turkish (59%) and Moroccan (56%) respondents used CAPI. Respondents were approached on January 29, 2015, with a first invitation to complete the questionnaire. They were approached eight times. Four weeks after the start of the online questionnaires, those who had not yet responded were approached by the interviewers. The interviewer read out the questions, which were answered by the respondent. After five weeks of face-to-face fieldwork, a significantly high response rate was observed among certain groups, particularly native Dutch, Surinamese, and Antillean individuals. Ultimately, the response rate was much higher than the number the NIPO/Veldkamp had expected to achieve had all respondents been approached according to the original strategy. Due to budgetary reasons, the approach was adjusted: native Dutch and Surinamese individuals were no longer permitted to participate over the internet and were approached a maximum of four times instead of eight. Those individuals who had not yet been approached through CAPI were not contacted again. After applying the modified strategy, 243 Antilleans withdrew from the interviews. In addition, the start of Ramadan, on June 18, 2015, is believed to have affected response rates (decreasing response rate) among Muslim populations.

All successful interviews conducted using CAWI and CAPI were reviewed to ensure that the suitable individuals had been interviewed in terms of sex, age, and national origin. Age was checked using the age entered in the questionnaire and the year of birth from the sample file. National origin was checked according to the country of birth entered in the questionnaire. The following rules were followed during the verification process: individuals with an age difference of two or more years were rejected, except when the number was reversed (e.g., 67 instead of 76); individuals were approved if only the gender was incorrect (a one-year age difference was also permitted); individuals were approved if their national origin was different, but the open answer indicated the correct country.

To ensure that the survey results were recorded accurately and completely, the questionnaire was checked once more automatically, using mock data. This process involved inputting fake information from 100 interviews and checking whether the data had been accurately recorded, that the routing number was correct, and that all questions had been completed correctly. Using dummy data for the testing phase enabled the number of respondents per question to be simulated. Only after the dataset was checked did online fieldwork commenced.  After the first day, the output from the questionnaire was checked again. During the fieldwork, the results were monitored and checked weekly. The steps outlined above were taken to check on the validity and reliability of the survey.

After the field work had been completed, the different data files were merged (output CAWI and CAPI systems outputs, export field work application Labyrinth, export interview reports of the TNS NIPO/Veldkamp interviewers). During this process, duplicate records, inconsistencies between samples and questionnaires, and the minimum and maximum values of the variables were checked.

## 3.2 Measures

In this section, the concepts of this research are operationalized.

### 3.2.1 Overweight and obese variables

Overweight and obese statuses were defined according to BMI value, which is calculated as an individual's weight, in kilograms, divided by the square of their height, in meters ($kg/m^2$) (Al-Hanawi et al., 2020). In this thesis, BMI values were computed using the self-reported weights and heights of the individuals in the sample. Subsequently, two variables were created: overweight and obese. Based on the BMI threshold for overweight, BMIs from 10 to 24.999 were categorized as "not overweight" and values of 25 or higher as "overweight". The same step was applied for obesity. Individuals with a BMI of 30 or higher were classed as "obese", and those with a BMI value below 30 were considered "not obese".

### 3.2.2 Ethnicity

During the survey, the following question was asked: "Where were you born?". The answer options were Morocco, Turkey, the former Netherlands Antilles or Aruba, Suriname, the Netherlands, Poland, Somalia, and "other, namely". Since this study focused on Turkish, Moroccan, Surinamese, Antillean, and native Dutch populations, individuals from other ethnic groups were disregarded.

### 3.2.3 Education level, employment status, and sports participation

The first mediation variable used was education level, which was measured according to individuals' education diplomas received in the Netherlands and abroad. First, this variable was renamed "education". The questionnaire included several questions about education, including education level, whether education was taken abroad or in the Netherlands, and whether a diploma was obtained. The answers to these questions are combined as obtained diploma and categorized into "no education diploma", "low", "middle", and "high". The questionnaires and dataset do not reflect the education levels from which these categories were drawn. Based on previous literature and the response options in the questionnaire, this study applied the following assumptions: no education diploma indicates primary education; low education diploma indicates prevocational secondary education or secondary general education (*middelbaar algemeen voortgezet onderwijs)*; middle education diploma indicates senior general vocational education (*middelbaar algemeen beroepsonderwijs)*, higher general and preparatory education (*hoger algemeen voortgezet onderwijs),* and secondary scientific education (*voortgezet wetenschappelijk onderwijs)*; and high education diploma indicates a bachelor's degree and higher (Volksgezondheidenzorg, 2020).

The second mediation variable, "employment", referred to paid work. The response categories were "yes, paid work" and "no".

The final variable was "sports participation". To operationalize this concept, the following question was asked: "How often have you exercised in the past 12 months?" The response options were "two or more times per week", "once per week", "once per month", "a couple of times per year", and "less than once per year/never". Since several respondents were excluded from the dataset due to failure to meet the inclusion criteria or missing data, a frequency table was first created for the number of respondents who provided each of the responses above to determine whether any of the responses could be merged. The responses "once per month" and "a couple of times per year" were combined into "a couple of times per year". The other responses remained unchanged.

*Table 1.* Distribution of the number of respondents by answer category in sports participation.

| | | N | % |
|---|---|---|---|
| **How often have you exercised in the past 12 months?** | Two or more times per week | 276 | 24.71 |
| | Once per week | 197 | 17.64 |
| | Once per month | 52 | 4.74 |
| | Couple of times per year | 78 | 6.98 |
| | Less than once per year/never | 507 | 45.93 |
| **Total** | | 1,110 | 100.00 |

*Notes:* Data are from the Survey on the Integration of Minorities 2015; N= 1,110.

### 3.2.4 Control variables: age and sex

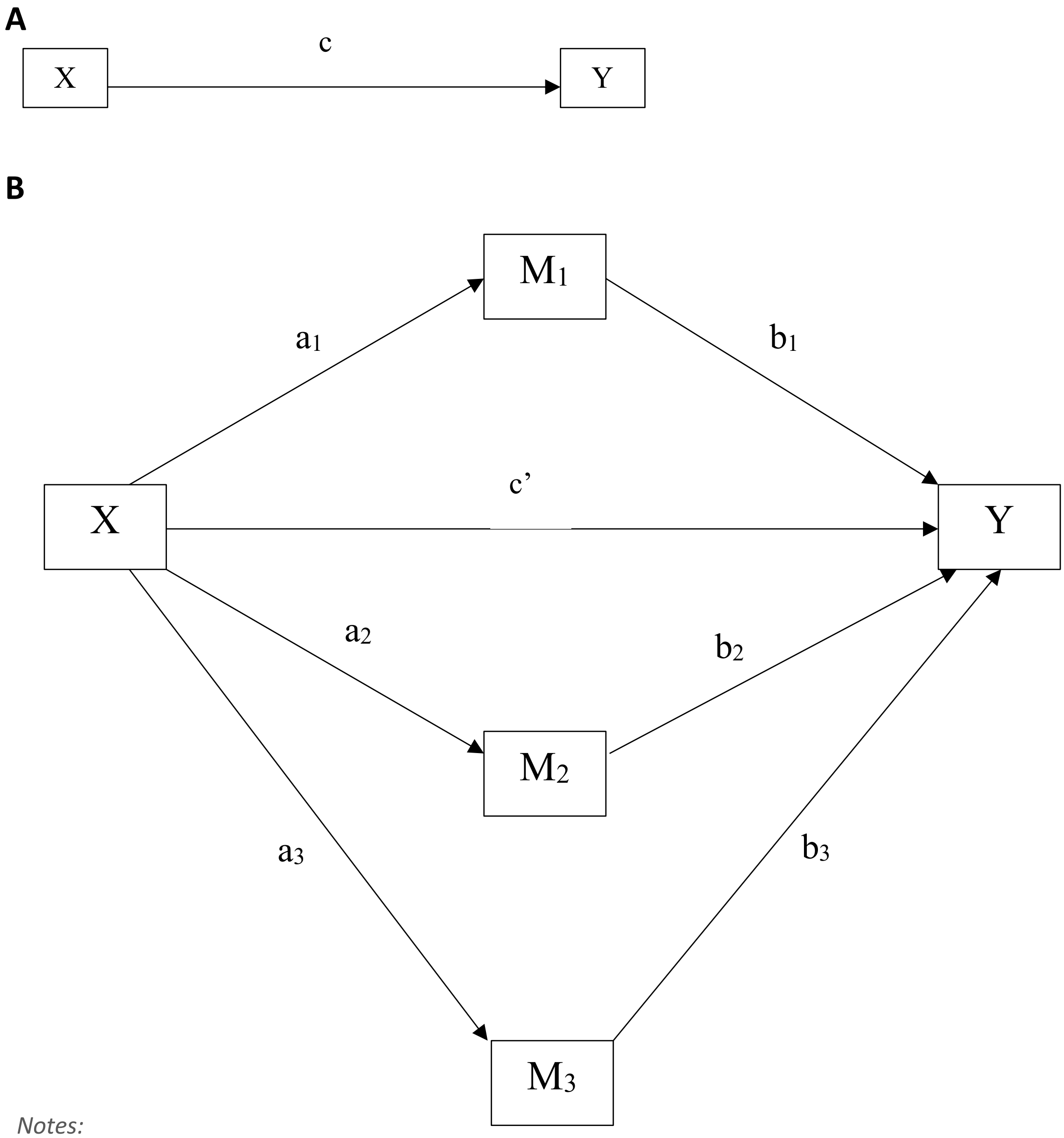
Finally, age and sex were examined since both are related to overweight and obesity. Therefore, age and sex were adopted as control variables. Age was measured in years and divided into the following categories in the dataset: "55–64", "65–74", and "75 and above". Sex consisted of "male" or "female".

## 3.3 Data analysis

In this research, due to the dichotomous dependent variable overweight/obesity and the multiple independent variables, a binary logistic regression analysis was preferred (Pallant, 2016, p. 169). A mediation analysis was also conducted to determine the effect of ethnicity and overweight/obesity, explained by education level, employment, and sports participation, in order to determine whether they mediate the relationship (Kohler et al., 2011; MacKinnon et al., 2007; Preacher & Hayes, 2008). Mediation analysis can determine whether there is a significant relationship between ethnicity and overweight/obesity and whether this relationship is negative or positive. In addition, it can establish whether the connection can be partially explained by the influence of the mediators. These relationships are described in the results. In this study, a significance level of 0.05 was used.

First, however, using a logistic regression model, differences between overweight and obese first-generation migrants and the native Dutch were tested. The first model included the control variables age and sex. Education level was added to Model 2. In Model 3, employment was added and in Model 4, sports participation, so all three mediation variables were included in the last model. The same was done for obesity, using obese as outcome variable. The different hypotheses were tested using stepwise regression and mediation analyses.

*Figure 4.* Directed Acyclic Graph with the direct and indirect effects.




*Notes:*

| | |
|---|---|
| **X** | Migration background |
| **Y** | Overweight/Obesity |
| **$M_1$** | Education level |
| **$M_2$** | Employment |
| **$M_3$** | Sports participation |
| **c** | Total effect |
| **c'** | Direct effect |
| **$a_{1,2,3}$** | Indirect effect |
| **$b_{1,2,3}$** | Indirect effect |

(A) Illustration of a direct effect. Migration background affects overweight/obesity.
(B) Illustration of a mediation design. Migration background is hypothesized to exert an indirect effect on overweight/obesity through education level, employment, sports participation.

Since the dependent variables are dichotomous, the performed mediation analysis was based on the Karlson-Holm-Breen (KHB) method, which enabled an assessment of the extent to which group differences in overweight or obesity were attributable to differences in education level, employment, and sports participation (Karlson et al., 2010; Karlson & Holm, 2011). That is, the degree to which $M_1$, $M_2$, $M_3$ mediated the relationship between X and Y. The authors further claimed that, with their method, the total effect of a variable can be broken down into its direct and indirect effect. Several conditions must be met to demonstrate a mediation relationship. First, there must be a correlation between the independent (migration background) and the dependent variable (overweight/obesity). This correlation is denoted by path c, or total effect. Second, the mediator must correlate with the independent variables, and the independent variable must also influence the mediator, path a. Third, the mediator must be shown to influence the dependent variable, path b. Fourth, to achieve full mediation, the significance of the independent variable on the dependent variable must eliminated when the mediator is included in the model, path c', or the indirect effect (Preacher & Hayes, 2008). If the latter is still significant, there is only partial mediation (Agler & De Boeck, 2017).

# 4. Results

The purpose of this study was to investigate whether SES and physical activity explain ethnic differences in later life overweight and obesity in the Netherlands. Logistic regression analyses and mediation analyses was conducted to test the hypotheses.

## 4.1 Descriptive statistics

***Table 2.*** Tested variables and body mass indices of the study population according to ethnic groups.

| | Native Dutch | Moroccan | Turkish | Surinamese | Antillean |
|---|---|---|---|---|---|
| | N = 418 | N = 128 | N = 124 | N = 240 | N = 200 |
| **Sex (%)** | | | | | |
| Men | 49.3 | 57.0 | 44.3 | 43.3 | 42.0 |
| Women | 50.7 | 43.0 | 55.6 | 56.7 | 58.0 |
| **Age (%)** | | | | | |
| 55–64 | 42.8 | 57.8 | 51.6 | 59.2 | 62.0 |
| 65–74 | 35.9 | 30.5 | 36.3 | 25.8 | 32.5 |
| >=75 | 21.3 | 11.7 | 12.1 | 15.0 | 5.5 |
| **Educational (%)** | | | | | |
| 1 none | 1.7 | 57.0 | 38.7 | 6.3 | 4.5 |
| 2 low | 51.7 | 26.6 | 46.8 | 43.3 | 46.5 |
| 3 middle | 20.8 | 7.8 | 12.1 | 27.9 | 33.0 |
| 4 high | 25.8 | 8.6 | 2.4 | 22.5 | 16.0 |
| **Employed (%)** | | | | | |
| Yes | 33.5 | 12.5 | 14.5 | 31.3 | 36.0 |
| No | 66.5 | 87.5 | 87.5 | 68.8 | 64.0 |
| **Sports participation (%)** | | | | | |
| 1 (two or more times per week) | 32.1 | 16.4 | 16.9 | 19.2 | 27.0 |
| 2 | 26.1 | 13.3 | 11.3 | 16.7 | 8.5 |
| 3 | 9.3 | 13.3 | 12.9 | 12.1 | 14.5 |
| 4 (less than once per week/never) | 32.5 | 57.0 | 58.9 | 52.1 | 50.0 |
| **Weight status (%)** | | | | | |
| Overweight | 59.8 | 74.2 | 82.3 | 63.8 | 70.5 |
| Obese | 14.8 | 20.3 | 48.4 | 18.3 | 40.5 |

*Notes:* Data are from the Survey on the Integration of Minorities 2015; N= 1,110.

To assess the relationship between migration background, overweight/obesity and the influence of education level, employment, and sports participation, cross tables were first analyzed. As shown in Table 2, overweight rates (including obesity) were higher among Turkish (82.3%), Moroccan (74.2%), Antillean (70.5%), and Surinamese (63.8%) individuals than native Dutch ones (59.8%). Obesity was similarly reported, although Antilleans indicated a higher prevalence of obesity than Moroccans. The percentages were as follows: Turkish 48.4%, Antillean 40.5%, Moroccan 20.3%, Surinamese 18.3%, and native Dutch 14.8%.

A closer inspection of Table 2 demonstrates that individuals in the migrant groups were, on average, younger than the native Dutch. The male-female ratio was approximately evenly distributed among all groups.

The native Dutch had the highest proportion of individuals with a low education level (51.7%) as well as the highest percentage of highly educated people (25.8%) of all the groups considered. The Moroccan group had the highest prevalence of primary education (no diploma) (57.0%) than all the other groups. The percentage of highly educated people was lowest among the Turkish migrant group (2.4%).

Non-employment was more prevalent among the Turkish and Moroccan groups than among the native Dutch, Surinamese, and Antillean groups. However, the percentages for the other groups were also above 50%, which may indicate that people had retired. When comparing age to employment, it is interesting to see that the native Dutch had the highest percentage of individuals aged 65 and above (57.2%), but not the highest percentage of non-employment. On the other hand, non-employment among the Turkish and Moroccans was the highest (87.5%), while 48.4% and 42.2%, respectively, of people were aged 65 and above.

Looking at the third variable, sports participation, the descriptive statistics show that this was lower in the four non-Western groups than in the native Dutch group. The native Dutch had the highest percentage of sports participation two or more times per week.

## 4.2 Analyses

Binary logistic regression analyses were performed to assess the impact of migrant groups (Turkish, Moroccan, Surinamese, and Antillean) on the likelihood of being overweight/obese. The analyses performed assessed the effect of ethnicity mediated by education level, employment, and sports participation on overweight/obesity. The first section of the results includes models focused on overweight, while the second presents the analyses performed on obesity.

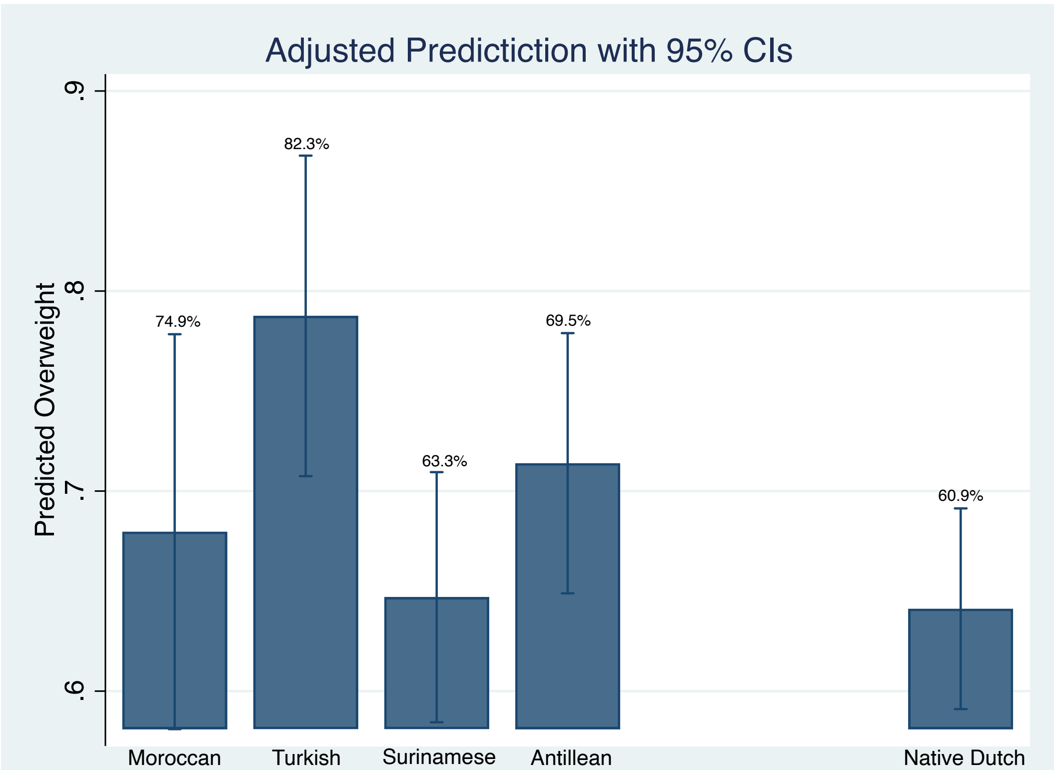
*Table 3.* Coefficient estimates from logistic regression analyses of overweight.

| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
|---|---|---|---|---|---|---|---|---|
| | Coeff. | [95% CI] | Coeff. | [95% CI] | Coeff. | [95% CI] | Coeff. | [95% CI] |
| Ethnicity: | | | | | | | | |
| Native Dutch | Ref. | | Ref. | | Ref. | | Ref. | |
| Moroccan | 0.652** | [0.205, 1.098] | 0.280 | [-0.239, 0.801] | 0.207 | [-0.320, 0.734] | 0.172 | [-0.358, 0.702] |
| Turkish | 1.091*** | [0.587, 1.594] | 0.812** | [0.279, 1.345] | 0.759** | [0.222, 1.296] | 0.730** | [0.189, 1.271] |
| Surinamese | 0.101 | [-0.232, 0.434] | 0.082 | [-0.254, 0.417] | 0.054 | [-0.283, 0.392] | 0.025 | [-0.318, 0.369] |
| Antillean | 0.378* | [0.009, 0.747] | 0.352 | [-0.020, 0.725] | 0.339 | [-0.034, 0.713] | 0.334 | [-0.047, 0.715] |
| Female | 0.392** | [0.136, 0.649] | 0.323* | [0.062, 0.585] | 0.287* | [0.022, 0.552] | 0.277* | [0.011, 0.543] |
| Age: | | | | | | | | |
| 55–64 | Ref. | | Ref. | | Ref. | | Ref. | |
| 65–74 | -0.184 | [-0.470, 0.103] | -0.225 | [-0.515, 0.065] | -0.366* | [-0.696, -0.037] | -0.363* | [-0.693, -0.033] |
| >=75 | -0.418* | [-0.786, -0.050] | -0.492* | [-0.866, -0.118] | -0.658** | [-1.075, -0.242] | -0.673** | [-1.094, -0.253] |
| Education level: | | | | | | | | |
| None | | | Ref. | | Ref. | | Ref. | |
| Low | | | -0.512 | [-1.037, 0.013] | -0.508 | [-1.035, 0.020] | -0.510 | [-1.040, 0.020] |
| Middle | | | -0.755** | [-1.326, -0.185] | -0.723* | [-1.305, -0.159] | -0.720* | [-1.299, -0.142] |
| High | | | -0.893** | [-1.475, -0.311] | -0.840** | [-1.426, -0.253] | -0.820** | [-1.415, -0.224] |
| Employed: | | | | | | | | |
| Yes | | | | | Ref. | | Ref. | |
| No | | | | | 0.317 | [0.024, 0.658] | 0.335 | [-0.007, 0.678] |
| Sports participation: | | | | | | | | |
| Two or more times per week | | | | | | | Ref. | |
| Once per week | | | | | | | 0.304 | [-0.090, 0.697] |
| Once per month | | | | | | | 0.355 | [-0.105, 0.815] |
| Less than once per year/never | | | | | | | 0.238 | [-0.090, 0.567] |
| (Constant) | 0.359* | [0.083, 0 .634] | 1.080*** | [0.477, 1.682] | 0.954** | [0.334, 1.573] | 0.754* | [0.096, 1.412] |
| Pseudo $R^2$ (McFadden) | 0.030 | | 0.038 | | 0.041 | | 0.043 | |
| $X^2$ | 42.91 (7) | | 54.19 (10) | | 57.51 (11) | | 61.16 (14) | |

*Notes:* Data are from the Survey on the Integration of Minorities 2015; N= 1,110; data are weighted; coefficient estimates with 95% confidence intervals in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Model 1 contains the variables used to test the influence of ethnicity on overweight, controlling for the variables sex and age to test the H1: *Individuals aged 55 and above with a Moroccan, Turkish, Surinamese, or Antillean migration background are more likely to be overweight or obese than their native Dutch counterparts.* Comprising all the predictors, Model 1 was statistically significant, $X^2$ (7, N = 1,110) = 42.91, $p < 0.001$, indicating that the model was able to distinguish between individuals who were overweight and those who were not. Model 1, as a whole, explained 3.0% of the variance in the overweight condition (McFadden's R-squared) and correctly classified 66.31% of the cases. As indicated in Model 1, five of the independent variables made a statistically significant contribution to the model (Turkish, Moroccan, Antillean, female, and age >=75). The coefficients of the Turkish, Moroccan, and Antillean variables were positive and significant, indicating that the individuals in these groups were more likely to be overweight than those in the reference group (the native Dutch). The influence of Moroccan ethnicity was approximately twice as great as that of Antillean ethnicity. In addition, the effect of being Turkish was almost twice as great as the effect of being Moroccan and nearly three times as great as the effect of being Antillean. The coefficient for Surinamese was not a significant predictor of overweight, indicating that being Surinamese is not associated with a higher likelihood of being overweight.

***Figure 5.*** Predicted probabilities of being overweight by ethnicities.




*Notes:* Data are from the Survey on the Integration of Minorities 2015; N= 1,110.

These relative differences between the migrant groups and native Dutch are visualized in Figure 5, which shows that the probability of being overweight is 60.9% for native Dutch, compared to 82.3% for Turkish, 74.9% for Moroccan, 63.3% for Surinamese, and 69.5% for Antillean people aged 55 and above. In conclusion, Turkish, Moroccan, and Antillean ethnicity are significant contributors to the predictive ability of Model 1 on later life overweight. Therefore, H1, *Individuals aged 55 years and above with a Moroccan, Turkish, Surinamese, or Antillean migration background are more likely to be overweight or obese than their native Dutch counterparts,* can be confirmed for Moroccan, Turkish, and Antillean migrant groups, but not for Surinamese. Thus, people with a Moroccan, Turkish, and Antillean migration background are more likely to be overweight, after adjusting for sex and age.

In the second model, the education level variable was added to test H2: *Differences in the likelihood of being overweight or obese between Moroccan, Turkish, Surinamese, and Antillean migrants and their native Dutch counterparts can be partially explained by the education level.* This model was statistically significant, $X^2$ (10, N = 1,110) = 54.19, $p < 0.001$, indicating that the model was able to distinguish between individuals who were overweight and those who were not. Compared to Model 1, the model's predictive ability increased by 0.8% to 3.8%. Adding the education level variable to the model decreased the coefficients of all migrant groups and eliminated the significant contribution of the Moroccan and Antillean migration variables on the model. However, the statistically significant influence of Turkish migrants remained. In contrast, not all education variables were statistically significant predictors of overweight. Middle and high education levels appeared to be significant ($p < 0.05$). The higher the educational level, the more negative the coefficient, suggesting that individuals with higher education levels were less likely to become overweight than those with no education. In addition, to examine the effect of education, the indirect and direct effect of migration background on overweight was examined after adding the mediator education level. The mediator was added to test whether this variable partially explains the direct effect of the independent variable on the outcome variable. The first assumption that should be met to perform a mediation analysis is that there must be a significant effect of the independent variable on the dependent variable. In Model 1, this was the case for Turkish, Moroccan, and Antillean migrants. The second and third assumptions are that the mediator education should have a significant effect. This was the case for two of the three categories, namely middle and high education level. The last assumption is that the significant effect of the independent variable on the dependent variable declines after the mediating variable is added. The Moroccan and Antillean migrants meet all four conditions.

*Table 4.* Mediation analysis overweight, KHB method.

| A. MODEL 1 VS. MODEL 2 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Moroccan* | | | Turkish* | | | Surinamese* | | | Antillean* | | |
| | Coeff. | (SE) | *p* | Coeff. | (SE) | *p* | Coeff. | (SE) | *p* | Coeff. | (SE) | *p* |
| Reduced-form model | 0.678 | (0.231) | <0.01 | 1.115 | (0.259) | <0.001 | 0.105 | (0.171) | 0.536 | 0.383 | (0.189) | <0.05 |
| Full model | 0.281 | (0.265) | 0.290 | 0.812 | (0.272) | <0.01 | 0.082 | (0.171) | 0.633 | 0.352 | (0.190) | 0.06 |
| Δ Reduced-form model – Full model | 0.397 | (0.156) | <0.05 | 0.303 | (0.111) | <0.01 | 0.024 | (0.046) | 0.603 | 0.030 | (0.048) | 0.528 |

| B. MODEL 2 VS. MODEL 3 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Moroccan* | | | Turkish* | | | Surinamese* | | | Antillean* | | |
| | Coeff. | (SE) | *p* | Coeff. | (SE) | *p* | Coeff. | (SE) | *p* | Coeff. | (SE) | *p* |
| Reduced-form model | 0.284 | (0.266) | 0.286 | 0.815 | (0.273) | <0.01 | 0.081 | (0.171) | 0.635 | 0.354 | (0.190) | 0.063 |
| Full model | 0.207 | (0.269) | 0.442 | 0.759 | (0.274) | <0.01 | 0.054 | (0.172) | 0.752 | 0.339 | (0.191) | 0.075 |
| Δ Reduced-form model – Full model | 0.077 | (0.049) | 0.114 | 0.056 | (0.039) | 0.152 | 0.027 | (0.028) | 0.341 | 0.015 | (0.025) | 0.554 |

| C. MODEL 3 VS. MODEL 4 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Moroccan* | | | Turkish* | | | Surinamese* | | | Antillean* | | |
| | Coeff. | (SE) | *p* | Coeff. | (SE) | *p* | Coeff. | (SE) | *p* | Coeff. | (SE) | *p* |
| Reduced-form model | 0.206 | (0.269) | 0.444 | 0.758 | (0.275) | <0.01 | 0.053 | (0.172) | 0.757 | 0.341 | (0.191) | 0.074 |
| Full model | 0.172 | (0.271) | 0.525 | 0.729 | (0.276) | <0.01 | 0.025 | (0.175) | 0.886 | 0.334 | (0.194) | 0.086 |
| Δ Reduced-form model – Full model | 0.034 | (0.036) | 0.335 | 0.029 | (0.039) | 0.459 | 0.028 | (0.040) | 0.485 | 0.007 | (0.045) | 0.879 |

*Note:* *reference category native Dutch.
Data are from the Survey on the Integration of Minorities 2015; N= 1,110.

In the first model, migration background was the only independent variable. The estimated total effect from Table 4 (line c from Figure 4A) of Moroccan origin on overweight is 0.678. In the second model, adjusted for education level, the effect of Moroccan origin declined to 0.281; this was the direct effect of the variable Moroccan on overweight (line c’ from Figure 4B). The indirect effect was 0.397 and significant $p < 0.05$. This means that the level of overweight for Moroccans is partially explained by education level.
A mediation analysis of all the remaining models was performed to check if there was any significant effect. As seen in Table 3 and Table 4, there were slight differences between the coefficients from the logistic regression and mediation analysis. The estimated total effect of Turkish origin is 1.115. In the second model, adjusted for education level, the effect of Turkish declined to 0.812; this was the direct effect of the variable Turkish on overweight. The indirect effect was 0.303 and significant $p < 0.01$. The direct effect, however, also remained significant. The assumption for mediation that the direct effect should no longer be significant was therefore not met.
The estimated total effect of Antillean origin was 0.383. In the second model, adjusted for education level, the effect of Antillean declined to 0.352; this was the direct effect of the variable Antillean on overweight. The indirect effect was 0.030 and not significant, indicating that the effect of Antillean on overweight could not be explained by education level. For the last ethnicity, Surinamese, none of the coefficients was a significant predictor of overweight. Therefore, differences in the likelihood of being overweight between Moroccan, Turkish, Surinamese, and Antillean migrants and the native Dutch explained by education level only existed for Moroccan individuals, after adjusting for sex and age. Hence, H2 holds for Moroccan migrants only.

The variable employment was added to Model 3 to test the following hypothesis: *Differences in the likelihood of being overweight or obese between Moroccan, Turkish, Surinamese, and Antillean migrants and their native Dutch counterparts can be partially explained by employment status.* As observed in Table 3, Model 3 is statistically significant, $X^2$ (11, N = 1,110) = 57.51, $p < 0.001$, indicating that the model was able to distinguish between individuals who were overweight and those who were not.
The model’s predictive ability increased to 4.1%. Regarding the migrant variables, the coefficients decreased, with only Turkish remaining significant. Conversely, the education coefficients increased and became less negative. In this model, the 65–74 years (control) variable also became significant ($p < 0.05$). The non-employment coefficient (0.317) was not a significant contributor to the predictive ability of Model 3. To be sure, a mediation analysis was also performed, which also found no significant effect on the dependent variable overweight, Table 4B. Thereby, differences in the likelihood of being overweight between Moroccan, Turkish, Surinamese, and Antillean migrants and

the native Dutch cannot be explained by employment, when adjusting for age, sex, and education level. Hence, H3 is rejected for all migrant groups.

In the fourth model, the sports participation variable was added to test the following hypothesis: *Differences in the likelihood of being overweight or obese between Moroccan, Turkish, Surinamese, and Antillean migrants and their native Dutch counterparts can be partially explained by sports participation.* Model 4 was statistically significant, $X^2$ (14, N = 1,110) = 61.16, $p < 0.001$, indicating that the model was able to distinguish between individuals who were overweight and those who were not. The model's predictive ability increased to 4.3%. Sports participation had no significant effect on being overweight; however, the coefficients were positive. When this variable, was included, the significance of the variables remained the same as in Model 3. To be sure, a mediation analysis was also performed, which also found no significant effect on the dependent variable overweight, Table 4C. Therefore, the differences in the likelihood of being overweight between the migrant groups and the native Dutch cannot be explained by sports participation, when adjusting for age, sex, education level, and employment. Thereby, H4 is rejected for all four migrant groups.

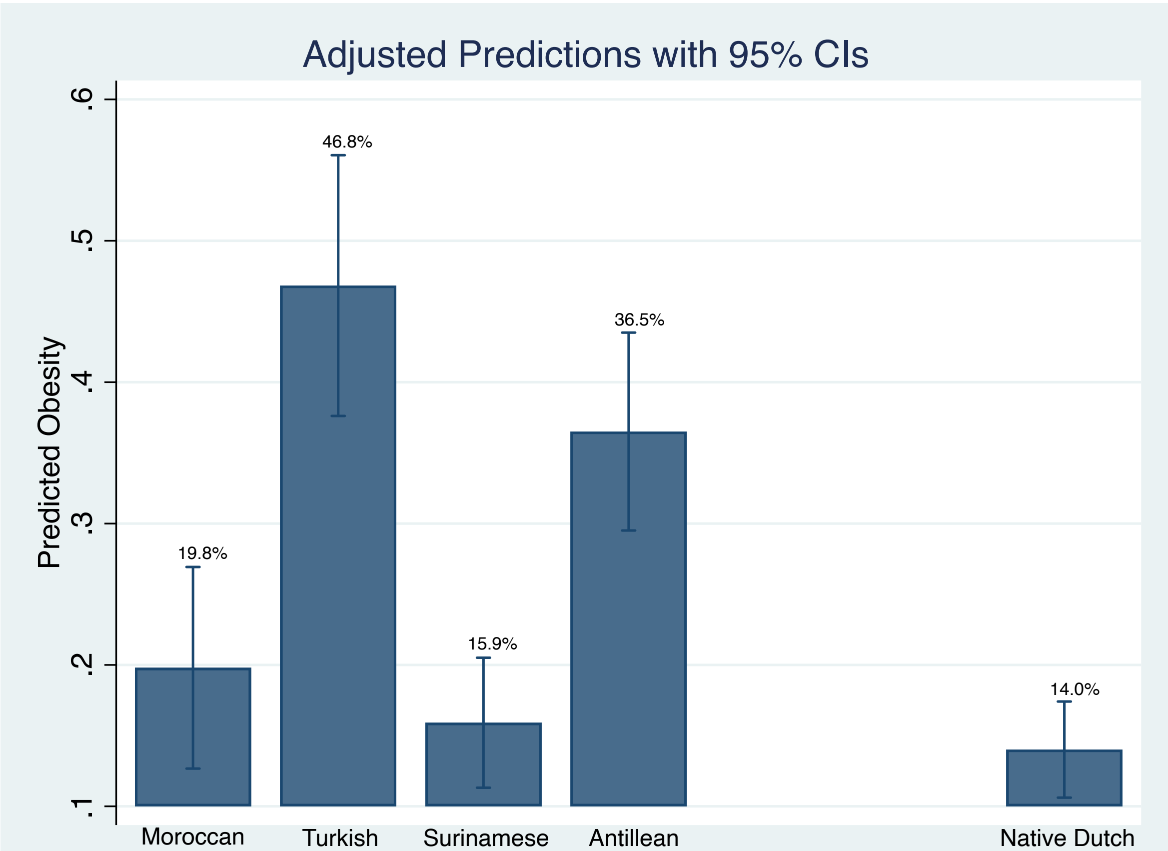
*Table 5.* Coefficient estimates from logistic regression analyses of obesity.

| | Model 5 | | Model 6 | | Model 7 | | Model 8 | |
|---|---|---|---|---|---|---|---|---|
| | Coeff. | [95% CI] | Coeff. | [95% CI] | Coeff. | [95% CI] | Coeff. | [95% CI] |
| Ethnicity: | | | | | | | | |
| Native Dutch | Ref. | | Ref. | | Ref. | | Ref. | |
| Moroccan | 0.415 | [-0.113,0.944] | 0.388 | [-0.228,1.004] | 0.260 | [-0.367,0.886] | 0.235 | [-0.394,0.865] |
| Turkish | 1.687*** | [1.224,2.151] | 1.669*** | [1.156,2.182] | 1.586*** | [1.066,2.105] | 1.557*** | [1.034,2.080] |
| Surinamese | 0.149 | [-0.288,0.587] | 0.183 | [-0.257,0.623] | 0.146 | [-0.296,0.588] | 0.100 | [-0.349,0.549] |
| Antillean | 1.261*** | [0.852,1.670] | 1.314*** | [0.899,1.730] | 1.298*** | [0.880,1.716] | 1.261*** | [0.834,1.688] |
| Female | 1.222*** | [0.906,1.538] | 1.213*** | [0.890,1.537] | 1.146*** | [0.818,1.473] | 1.141*** | [0.812,1.470] |
| Age: | | | | | | | | |
| 55-64 | Ref. | | Ref. | | Ref. | | Ref. | |
| 65-74 | -0.039 | [-0.365,0.286] | -0.082 | [-0.412,0.248] | -0.261 | [-0.620,0.097] | -0.264 | [-0.623,0.094] |
| >=75 | -0.687** | [-1.189,-0.185] | -0.733** | -1.240,-0.225] | -0.938** | [-1.468,-0.408] | -0.981*** | [-1.515,-0.447] |
| Education level: | | | | | | | | |
| None | | | Ref. | | Ref. | | Ref. | |
| Low | | | 0.084 | [-0.427,0.595] | 0.089 | [-0.423,0.600] | 0.124 | [-0.392,0.640] |
| Middle | | | -0.383 | [-0.981,0.214] | -0.351 | [-0.949,0.248] | -0.289 | [-0.895,0.318] |
| High | | | 0.019 | [-0.610,0.648] | 0.111 | [-0.521,0.744] | 0.192 | [-0.454,0.838] |
| Employed: | | | | | | | | |
| Yes | | | | | Ref. | | Ref. | |
| No | | | | | 0.505* | [0.105,0.904] | 0.504* | [0.104,0.905] |
| Sports participation: | | | | | | | | |
| Two or more times per week | | | | | | | Ref. | |
| Once per week | | | | | | | 0.049 | [-0.439,0.537] |
| Once per month | | | | | | | -0.015 | [-0.562,0.532] |
| Less than once per year/never | | | | | | | 0.223 | [-0.168,0.614] |
| (Constant) | -2.346*** | [-2.734,-1.958] | -2.298*** | [-2.981,-1.615] | -2.528*** | [-3.240,-1.816] | -2.651*** | [-3.417,-1.885] |
| Pseudo $R^2$ (McFadden) | 0.126 | | 0.130 | | 0.136 | | 0.137 | |
| $X^2$ | 156.21 (7) | | 161.64 (10) | | 167.90 (11) | | 169,68 (14) | |

*Notes:* Data are from Survey on the Integration of Minorities 2015; N=1,110; data are weighted; coefficient estimates with 95% confidence intervals in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Model 5 contained the variables to test the influence of ethnicity on obesity, controlling for the variables sex and age to test H1: *Individuals aged 55 and above with a Moroccan, Turkish, Surinamese, or Antillean migration background are more likely to be overweight or obese than their native Dutch counterparts.* Comprising all predictors, Model 5 was statistically significant, $X^2$ (7, N = 1,110) = 156.21, $p < 0.001$, indicating that the model was able to distinguish between individuals who were obese and those who were not. Model 5, as a whole, explained 12.6% of the variance in obesity (McFadden R-squared) and correctly classified 77.84% of the cases. As indicated in Model 5, four of the independent variables made a statistically significant contribution to the model (Turkish, Antillean, female, and age >=75). The coefficients of Turkish and Antillean were positive and significant, which indicates that they were more likely to be obese than the reference group native Dutch. No significant effect was found for being Moroccan or Surinamese on obesity. The effect of being Turkish was greater than that of being Antillean. So, Model 5 shows that old people with a Turkish and Antillean migration background are more likely to be obese than native Dutch, when adjusting for sex and age.

***Figure 6.*** Predicted probabilities of being obese by ethnicities.




*Notes:* Data are from the Survey on the Integration of Minorities 2015; N= 1,110.

These relative differences between migrant groups and native Dutch are visualized in Figure 6, which shows that the probability of being obese is 14.0% for native Dutch, compared to 19.8% for Moroccan, 46.8% for Turkish, 15.9% for Surinamese, and 36.5% for Antillean people aged 55 and above. In conclusion, in this model, Turkish and Antillean individuals with a migration background were significant contributors to the predictive ability of Model 5 on later life obesity. Therefore, H1, *individuals aged 55 and above with a Moroccan, Turkish, Surinamese, or Antillean migration background are more likely to be overweight or obese than their native Dutch counterparts,* can be partially confirmed. Thus, people with a Turkish and Antillean migration background are more likely to be obese, after adjusting for sex and age.

In the second model, the education level variable was added to test H2: *Differences in the likelihood of being overweight or obese between Moroccan, Turkish, Surinamese, and Antillean migrants and their native Dutch counterparts can be partially explained by education level.* This model was statistically significant, $X^2$ (10, N = 1,110) = 161.64, $p < 0.001$, indicating that the model was able to distinguish between individuals who are obese and those who are not. The predictive ability of this model increased to 13.0%. The significant effect of being Turkish or Antillean remained when adding the education level. It is notable that none of the levels of education were significant predictors for obesity. Therefore, the differences in likelihood of being obese between Moroccan, Turkish, Surinamese, and Antillean migrants and the native Dutch cannot be explained through educational level, when taking control variables into account. Therefore, H2 can be rejected for obesity.

The employment variable was added to Model 7 to test H3: *Differences in the likelihood of being overweight or obese between Moroccan, Turkish, Surinamese, and Antillean migrants and their native Dutch counterparts can be partially explained by employment status.* As can be seen in Table 5, Model 7 was statistically significant, $X^2$ (11, N = 1,110) = 167.90, $p < 0.001$, which demonstrates that the model was able to distinguish between individuals who are obese and those who are not. The predictive ability of this model has increased to 13.6%. Regarding the migration variables, the coefficients decreased for all migration backgrounds, with only Turkish and Antillean background remaining significant. The coefficient of not being employed was 0.505 and a statistically significant contributor to the predictive ability of Model 7 ($p < 0.05$). This indicates that individuals who are not employed are significantly more likely to be obese than individuals who are employed. In addition, to examine the effect of employment, the indirect and direct effect of migration background on obesity was examined after adding the mediator employment, to test whether this variable partially explains the direct effect of the independent variable on the outcome variable. The first assumption of a mediation analysis is that there must be a significant effect of the independent variable on the dependent variable. In Model 6, this was the case for the ethnicities Turkish and Antillean. The second and third assumptions are that the mediator education should have a significant effect, and the last assumption is that the significant effect of the independent variable on the dependent variable is dropped after the mediating variable is added. The Turkish and Antillean migrant groups did not meet the last condition. To be sure, a mediation analysis was also performed.

***Table 6.*** Mediation analysis obesity, KHB method.

| A. MODEL 5 VS. MODEL 6 | Moroccan* | | | Turkish* | | | Surinamese* | | | Antillean* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coeff. | (SE) | *p* | Coeff. | (SE) | *p* | Coeff. | (SE) | *p* | Coeff. | (SE) | *p* |
| Reduced-form model | 0.421 | (0.271) | 0.120 | 1.697 | (0.238) | <0.001 | 0.154 | (0.224) | 0.490 | 1.268 | (0.210) | <0.001 |
| Full model | 0.388 | (0.315) | 0.217 | 1.669 | (0.262) | <0.001 | 0.183 | (0.225) | 0.415 | 1.314 | (0.212) | <0.001 |
| Δ Reduced-form model – Full model | 0.033 | (0.153) | 0.831 | 0.028 | (0.111) | 0.803 | -0.029 | (0.039) | 0.455 | -0.046 | (0.044) | 0.296 |

| B. MODEL 6 VS. MODEL 7 | Moroccan* | | | Turkish* | | | Surinamese* | | | Antillean* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coeff. | (SE) | *p* | Coeff. | (SE) | *p* | Coeff. | (SE) | *p* | Coeff. | (SE) | *p* |
| Reduced-form model | 0.382 | (0.316) | 0.226 | 1.675 | (0.263) | <0.001 | 0.189 | (0.225) | 0.401 | 1.322 | (0.213) | <0.001 |
| Full model | 0.260 | (0.320) | 0.416 | 1.586 | (0.265) | <0.001 | 0.146 | (0.226) | 0.517 | 1.298 | (0.213) | <0.001 |
| Δ Reduced-form model – Full model | 0.122 | (0.062) | 0.050 | 0.089 | (0.053) | 0.090 | 0.043 | (0.042) | 0.308 | 0.024 | (0.040) | 0.544 |

| C. MODEL 7 VS. MODEL 8 | Moroccan* | | | Turkish* | | | Surinamese* | | | Antillean* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coeff. | (SE) | *p* | Coeff. | (SE) | *p* | Coeff. | (SE) | *p* | Coeff. | (SE) | *p* |
| Reduced-form model | 0.258 | (0.320) | 0.420 | 1.586 | (0.265) | <0.001 | 0.140 | (0.226) | 0.535 | 1.295 | (0.213) | <0.001 |
| Full model | 0.235 | (0.321) | 0.464 | 1.557 | (0.267) | <0.001 | 0.100 | (0.229) | 0.662 | 1.261 | (0.218) | <0.001 |
| Δ Reduced-form model – Full model | 0.023 | (0.037) | 0.533 | 0.029 | (0.041) | 0.469 | 0.040 | (0.043) | 0.351 | 0.034 | (0.048) | 0.481 |

*Note:* *reference category: Native Dutch.
Data are from the Survey on the Integration of Minorities 2015; N= 1,110.

The total effect of Turkish migrants, when adjusting for age, sex, and education level, is 1.675. The direct effect of Turkish migration background on obesity is 1.586, while the indirect effect is 0.089. This indirect effect was not significant, while the direct effect stayed significant, indicating that, for Turkish, being obese cannot be explained by employment.

The total effect of Antillean individuals with a migration background, when adjusting for age, sex, and education level, is 1.322. The direct effect of Antillean migrants on obesity is 1.298, while the indirect effect is 0.024. This indirect effect was not significant, while the direct effect stayed significant, indicating that, for Antillean, being obese cannot be explained by employment. All other coefficients for Moroccan and Surinamese migration backgrounds in Table 6B were not significant. Hence, H2 is rejected.

In Model 8, the variable sports participation was added. Model 8 contained the variables to test H4: *Differences in the likelihood of being overweight or obese between Moroccan, Turkish, Surinamese, and Antillean migrants and their native Dutch counterparts can be partially explained by the physical activity level.* Model 8 was statistically significant, $X^2$ (14, N = 1,110) = 169.68, $p < 0.001$, which means that the model was able to distinguish between people with and without obesity. The predictive ability of this model has increased to 13.7%. None of the levels of sports participation were significant predictors of obesity, which means H4 can be rejected for obesity. To be sure, a mediation analysis was also performed, which also found no significant effect on the dependent variable obesity, Table 6C. It is remarkable that the variables once per week and less than once per year/never have positive coefficients and that the coefficient of once per month is negative compared to the reference group, that is, two or more times per week.

# 5. Conclusion and Discussion

The purpose of this research was to increase the knowledge of ethnic differences in later life overweight and obesity and the extent to which education level, employment, and sports participation explain such differences in the Netherlands. Overall, the main finding is that this research indicates that in the Netherlands, ethnic differences in later life overweight can be found for Moroccan, Turkish, and Antillean individuals with a migration background, as compared to native Dutch ones. Turkish and Antillean individuals are more likely to be obese than native Dutch individuals.

Secondly, the variable education level has a significant effect on the outcome variable, overweight. Thus, the education level of individuals aged 55 and over seems to affect the likelihood of being overweight. However, the difference in likelihood of being overweight between Turkish and Antillean individuals, on the one hand, and native Dutch ones, on the other hand, cannot be explained through education level. In contrast, the difference in likelihood of being overweight between Moroccan and native Dutch can be explained through education level, when adjusting for age and sex.

The education level was not a significant predictor of obesity, indicating that education level does not affect the likelihood of being obese. Therefore, the differences in likelihood of being obese of Turkish and Antillean migrants compared to native Dutch cannot be explained through education level.

Thirdly, employment status had no significant effect on the outcome variable overweight. Hence, this seems not to affect the likelihood of being overweight. Therefore, the differences in likelihood of being overweight between Moroccan, Turkish, Surinamese, and Antillean compared to native Dutch cannot be explained through employment status.

However, employment status has a significant effect on obesity, indicating that employment status does affect the likelihood of being obese. In contrast, the differences in likelihood of being obese of Turkish and Antillean individuals compared to native Dutch cannot be explained through employment status.

The last finding was that sports participation does not have a significant effect on overweight and obesity, indicating that sports participation does not affect the likelihood of being overweight and obese. Therefore, the differences in the likelihood of being overweight or obese between Turkish, Moroccan, and Antillean individuals compared to native Dutch cannot be explained through sports participation.

Surprisingly, the content of the mediation variables in this thesis were found to have less effect on overweight and obesity. Possible explanations are given in the following section.

## 5.1 Limitations and future research

Although the results of this study may help the understanding of ethnic differences in later life overweight and obesity, some limitations should be mentioned. First, the findings of Cornelisse-Vermaat and Maassen van den Brink (2007) about the order of the migration groups, from highest prevalence of overweight to lowest, corresponds with this study, namely Turkish, Moroccan, Antillean, Surinamese, and Dutch. In addition, the significant effect of ethnicity on overweight is supported by the results of this thesis, except in the case of Surinamese origin. Furthermore, the effect of ethnicity on obesity was not as strong, and Turkish and Antillean ethnicities were the only significant predictors of obesity. The differences between previous studies and the current one may be due to the fact there were fewer migrants than native Dutch among the respondents. The sample size of older people with a Moroccan (N = 128), Turkish (N = 124), Surinamese (N = 240), and Antillean (N = 200) background was smaller than that of such people with a native Dutch background (N = 418). As a result, the non-Dutch ethnicities were less represented, and less data was available about them than about native Dutch.

Furthermore, most respondents were in the age group of 55 to 64 years, which may indicate that the questionnaire was less accessible for the older people aged 65 years and above than for the younger group. This is due to selection bias, or data collection. It can be more difficult for older people to complete a questionnaire. This is also evident in the response rate of people of 75 and over. In comparison, the dataset including individuals aged 18 and above (which still includes erroneous data) had 5,074 respondents. After removing this group, 1,137 respondents were left, indicating a response rate of just 22% for individuals aged 55 and above. This might have influenced the external validity. For future research, these thresholds could be lowered by allowing people aged 65 and above to participate directly, via CAPI, instead of first inviting them to participate in an internet-only questionnaire. Furthermore, previous studies have shown that individuals in the 55–64 age group are more likely to be overweight than those aged 65 and above (Volksgezondheidenzorg, 2021b). However, the results from the dataset show that the percentage of overweight is highest among Turkish, although this ethnicity does not have the highest percentage of aged 55–64, indicating that Turkish migration background has a stronger effect than age, as can also be deduced from the coefficient of 1.091 for the Turkish.

Turning to the variable education level, Cornelisse-Vermaat and Maassen van den Brink (2007) found in their research that native Dutch and Surinamese/Antillean populations generally have higher education levels than Turkish and Moroccans. This was confirmed in a study by CBS (2018) and by the current thesis, which found that the Turkish population had the lowest percentage respondents with a high education level. The contention of Cornelisse-Vermaat and Maassen van den Brink (2007) that education plays a role in the prevalence of overweight, was partially borne out by the results of this study. Middle and high education play a role in the prevalence of overweight, but not of obesity, while low education has no significant effect. One reason for this discrepancy may be how the variable education is reported. For this study, a high education level indicated a completed degree; thus, a bachelor's degree had to have been received in order to be characterized as high education. In the aforementioned study, education was split into three categories (low, medium, and high) instead of four (none, low, middle, and high), which may have influenced the difference in results. Furthermore, a notable result of the coefficients of education level was the direction in obesity. While middle education level showed a negative coefficient, low and high education level were positive to the reference group no education. The coefficients of education level at overweight were all negative. However, the results on obesity were not significant predictors of obesity, future research can look at the reliability of the variable education level.

The next variable, employment, was found to have a significant effect on obesity only. Again, this partially deviates from previous studies. In the literature, a distinction is made between retired and unemployed within the group of non-employed. This distinction was not made for the variable used in this study, in which respondents were either employed or non-employed. Looking at the results, however, the percentage of individuals aged 65 and over is highest among native Dutch. If the non-employment category were only composed of retired people, then the percentage of non-employed should be highest among native Dutch; this is not, however, the case. It can therefore be assumed that the non-employed group also included people who were actually unemployed. In addition, there may be reverse causality, according to Moris (2006) and as presented in Hummel et al. (2012). Moris (2006) indicates that overweight/obese people are less likely to be employed. It is therefore recommended that future research should control for reverse causality.

Finally, the last variable, sports participation, did not match the findings presented in the literature in any respect. This difference may also be caused by reverse causality (Hummel et al., 2012). In their model, Hummel et al. (2012) explain that overweight/obesity can arise from a series of interacting factors, the so-called "cause-effect chain". According to the model proposed by Hummel et al. as well as the findings of other authors, the effect of sports participation also works the other way around. Obesity causes people to exercise less. In addition, recall bias could be an explanation for the differences in the results found. The question about sports participation referred to the previous year, and people had to recall how often they practiced sport (Coughlin, 1990). In addition, the answer to the question may depend on when the questionnaire was completed. As the questionnaire ran from January 29 to July 15, 2015, some in January may have reported a lower level of sports participation because of the winter weather while some in July may have reported a higher one because of the summer weather. In future research, the month of collection could therefore also be included as a control variable. Furthermore, sports participation contains the same striking result as for education level. In obesity it is notable that the variables once per week and less than once per year/never have positive coefficients and that the coefficient of once per month is negative compared to the reference group, that is, two or more times per week. Reason for a deviating coefficient could be that in sports participation two groups have been merged, namely once per month and couple of times per year have been merged into once per month. However, this difference could be examined in future research.

There are also some general limitations on the study, beginning with the measurement of weights and heights of the individuals. The BMI values in the dataset used in this thesis were calculated through length and weight as self-measured by the respondents. Self-reported length and weight can suffer from measurement error, as people may overreport their length and weight or underreport, which, in turn, affects the BMI measurement (Danubio et al., 2008; Craig & Adams, 2008; Zanin, 2014). The affected BMI values could result in incorrect classifications of overweight, not overweight, obese, and not obese. In future research, this limitation can only be solved by applying the CAPI strategy, whereby the interviewers can measure the lengths and weights of the participants. This will take more time and effort; however, the measurements will be more accurate. Second, omitted variable bias may occur, for example, the food culture of an ethnicity group. A question was asked about Ramadan, but this festival is time-limited. Questions about, for example, how often sweets are eaten, as well as views on diets can differ between ethnic groups (Lin et al., 2018; Boyington et al., 2008). Furthermore, Klokgieters et al. (2018) explain the greater unhealthiness of migrants with reference to the phenomenon of "triple jeopardy", whereby migrants are exposed to three risks or hazards. The first risk involves vulnerabilities generally associated with advanced age, when the number of both physical limitations and chronic conditions increases. The second risk is due to their migration, as their lives have changed as they have moved from one socio-cultural context to another. This can cause stress and distress and have health consequences which can last many years after migration. The third risk stems from the vulnerable position of migrants in the new society. For example, they are more likely to be in a marginalized position and experience discrimination and segregation in living and working. Hummel et al. also addresses the fact that stress and discrimination can affect overweight/obesity. The last limitation is the heterogeneity within the group. Surinamese people have a mix of ethnicities, being Hindustani-Surinamese, African-Surinamese, or of another mixed background. In the dataset there is no means to differentiate for this, while a previous study demonstrated differences in overweight prevalence between these groups (Nicolaou et al., 2011). This could be a reason why no significant effect was found for Surinamese origin.

## 5.2 Recommendations

The focus of current policies is to promote healthier lifestyle by eating healthier and to participate more in sports (*Ministerie van Volksgezondheid, Welzijn en Sport,* 2019). Other prevention programs focus on reducing the amount of sugar in foods, organizing sport programs for children under the age of 6, and changing the food assortment in school and company canteens (*Rijksinstituut voor Volksgezondheid en Milieu,* n.d.; *Rijksinstituut voor Volksgezondheid en Milieu, 2019*). Thus, these preventive programs are not focused on older people and not on people with migration backgrounds, while the results for overweight showed that there are differences between Turkish, Moroccan, and Antillean individuals compared to native Dutch. The high prevalence of overweight and obesity in these migrant groups poses a major risk for chronic diseases. More information is needed for these migrant groups, primarily focused on the prevention of overweight/obesity. Education policies, especially among the migrant groups, might be important in reducing the increasing prevalence of overweight/obesity. Cultural factors and barriers should be considered when developing overweight prevention programs for these migrant groups, for example, the language in which they are offered, when particular holidays are celebrated, and whether they are easily accessible. People who are less mobile must also have the possibility to participate in prevention programs.

Furthermore, to decrease the economic burden of overweight and obesity, cost-effective interventions should be implemented. Preventive interventions seem to affect these health care expenditures in a positive way and in which these interventions improve health (Lehnert et al., 2013). All in all, these findings suggest that education level, employment, and sports participation are not the only factors in the increased likelihood of overweight and obesity among Turkish, Moroccan, and Antillean individuals with a migration background.

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# Appendix I: Do-file STATA

***Figure 7.*** Do-file dataset SIM 2015.

```
* Rename variables
    rename (geslacht) (Gender)
    rename (lengte) (length_cm)
    rename (gewicht) (weight_kg)
    rename (leeftijd) (Age)
    rename (etngba) (ethnicity)
    rename (gengba) (generation)
    rename (maxdipnu) (education)
    rename (nuwerk) (employment)
    rename (fqsport) (sports)


* Calculate the body mass index (BMI) using the variables weight and height
    generate BMI = weight_kg / (length_cm /100)^2

* Recode BMI
    recode BMI(10/24.999=0 "not overweight") (25/99.999=1 "overweight")
    (else=.), gen(overweight)
    recode BMI(10/29.999=0 "not obese") (30/99=1 "obese") (else=.), gen(obesity)

* Missingissing data
. browse if missing(BMI)

* Inclusion criteria
    drop if ethnicity==5
    drop if ethnicity==6
    drop if Age<=4
    drop if length_cm <100
    drop if length_cm >230
    drop if weight_kg <30
    drop if BMI>99
    drop if generation==2
    drop if education==-4

* Sports participation
    recode sports 1=1 2=2 3=4 4=4 5=5

* Frequency tables
    fre ethnicity
    tabulate ethnicity Gender
    tabulate ethnicity Age
    tabulate ethnicity education
    tabulate ethnicity Employment
    tabulate ethnicity sports
    tabulate ethnicity overweight
    tabulate ethnicity obesity


* Logistic regression
    * Model 1
    logit overweight ib7.ethnicity i.Age i.Gender
    estat classification
    margins, at (Age ethnicity=(1 2 3 4 7)) atmeans
    * Model 2
    logit overweight ib7.ethnicity i.Age i.Gender i.education
    margins, at (Age ethnicity=(1 2 3 4 7)) atmeans
    * Model 3
    logit overweight ib7.ethnicity i.Age i.Gender i.education i.Employment
    margins, at (Age ethnicity=(1 2 3 4 7)) atmeans
    * Model 4
    logit overweight ib7.ethnicity i.Age i.Gender i.education
    i.Employment i.sports
    margins, at (Age ethnicity=(1 2 3 4 7)) atmeans

    * Model 1 vs. Model 2
    khb logit overweight ib7.ethnicity ||  i.education    ///
, c(i.Gender i.Age) disentangle
    * Model 2 vs. Model 3
    khb logit overweight ib7.ethnicity ||  i.Employment   ///
, c(i.Gender i.Age i.education) disentangle
    * Model 3 vs. Model 4
    khb logit overweight ib7.ethnicity ||  i.sports   ///
, c(i.Gender i.Age i.education i.Employment) disentangle
```

```
    * Model 5
    logit obesity ib7.ethnicity i.Age i.Gender
    estat classification
    margins, at (Age ethnicity=(1 2 3 4 7)) atmeans
    * Model 6
    logit obesity ib7.ethnicity i.Age i.Gender i.education
    margins, at (Age ethnicity=(1 2 3 4 7)) atmeans
    * Model 7
    logit obesity ib7.ethnicity i.Age i.Gender i.education i.Employment
    margins, at (Age ethnicity=(1 2 3 4 7)) atmeans
    * Model 8
    logit obesity ib7.ethnicity i.Age i.Gender i.education i.Employment
    i.sports
    margins, at (Age ethnicity=(1 2 3 4 7)) atmeans

    * Model 5 vs. Model 6
    khb logit obesity ib7.ethnicity ||  i.education    ///
, c(i.Gender i.Age) disentangle
    * Model 6 vs. Model 7
    khb logit obesity ib7.ethnicity ||  i.Employment   ///
, c(i.Gender i.Age i.education) disentangle
    * Model 7 vs. Model 8
    khb logit obesity ib7.ethnicity ||  i.sports   ///
, c(i.Gender i.Age i.education i.Employment) disentangle

* Barchart
    marginsplot , recast(bar) plotopts(barw(.8))

* Correctly classified cases
    estat classification
```