The accessibility of sports facilities and obesity in the municipalities of the Netherlands

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Abstract

This research aims to find whether obesity rates are linked to the accessibility of sports facilities in urban and rural municipalities of the Netherlands. Furthermore, it aims to find whether the accessibility of sports facilities influences weekly sports participation rates within municipalities. This thesis offers a novel research focus, as during literature review, only research was found on sports participation rates between urban and rural areas and how living environment impacts physical activity patterns. There is no earlier research investigating a connection between obesity rates and the accessibility of sports facilities in the Netherlands. This research features a cross-sectional study for the year 2018, using data from the Mulier Institute and the Central Bureau of Statistics on all municipalities of the Netherlands existing in 2018. It applies two multiple regressions to test for a relationship between the accessibility of sports facilities and obesity rates and the accessibility of sports facilities and weekly sports participation rates.

This study revealed that the accessibility of sports facilities has a significant positive impact on weekly sports participation. Additionally, a 90 percent significant negative relationship was found between the number of sports facilities per 1000 people in a municipality. No significant differences in obesity rates and sports participation rates have been found between urban and rural municipalities. This would conclude that, according to this research, the accessibility of sports facilities does not significantly affect obesity rates, and therefore no future policy implications aiming to decrease obesity rates should be installed based solely on the accessibility of sports facilities. If a municipality wishes to increase weekly sports rates within a municipality, increasing accessibility within municipalities could be advised. However, the absence of significant relationships in this research does not directly imply that these relationships do not exist. Samples on an individual level or increasing the sample size could lead to different conclusions.

Contents

1. Introduction

Obesity and heart failure are ever-growing problems in current-day society (Lavie et al., 2003). The prevalence of obesity is increasing worldwide. In the Netherlands, 15.5 percent of the population over twenty years old was severely overweight in 2022, while this was 9.6 percent in 2001 (CBS, 2023). In a worldwide perspective, obesity nearly tripled between 1975 and 2016 (WHO, 2021). Interestingly, the percentage of the population that is mildly overweight only changed from 35.3 percent to 35.7 percent (CBS, 2023). Research by Nyberg et al. (2018) concludes that men and women between the ages of 40 and 70 with a BMI between 30 and 35, suffer a loss of 3.9 and 2.7 disease-free years on average, compared to an average of 29.4 disease-free years. For a BMI over 35, the loss is 8.7 and 7.3 years, respectively. The growth in prevalence of obesity will put an increasing strain on national health systems. An example would be that U.S. women with a BMI above 29, the risk of developing coronary artery disease if 3.3 times as large compared to women with a BMI lower than 21 (Manson et al., 1995). In the Netherlands, lifetime drug expenditures of obese individuals for diseases related to smoking or obesity are on average €9200, whereas a "Healthy-living", non-smoking individual would spend €5200 (Rappange et al., 2009). Hecker et al. (2022) found that the average annual healthcare costs per obese individual are €2907.24. In the same research, however, it was mentioned that these costs account for the lowest share of the annual societal costs of overweight and obese individuals, which are €11,462,66. In this research, a decrease in productivity accounts for the highest share of these costs. An example of decreased productivity would be that in the Netherlands, obese employees are absent 14 workdays more per year than employees with a healthy weight (Jans et al., 2007).

The accessibility of sports facilities may depend on population size and density. Hoekman et al. (2016) found that in the Netherlands, travel distances to sports facilities are shorter in urban areas. The number of sports facilities per 1000 inhabitants is higher in less urbanized areas. Therefore, urbanity is of influence on the number of sports facilities available in a certain area (Bale, 2002). In the Netherlands, the wealth of an area does not appear to have a significant impact on the accessibility of sports facilities (Hoekman et al., 2016). Earlier research suggests that the availability and accessibility of sports facilities have a considerable influence on sports participation in Belgium and the Netherlands (Vande Casteele et al., 2009; Kuppens and Ebbers, 2010). Furthermore, a review study by Sallahuddin et al. (2019) looking into obesity, the urban environment, and the accessibility of sports facilities, found that there are no papers that show a relationship between obesity in adults living in an urban environment and the accessibility of sports facilities. Additionally, similar research has been conducted in Sweden by Raza et al. (2022). This paper showed that increased distance to a sports facility is associated with lower exercise frequencies. Differences in distance to sports facilities, however, did not appear to have a statistically significant effect on obesity levels. No research on either the relationship between the accessibility of sports facilities and obesity rates, or the relationship between obesity rates and accessibility of sports facilities measured in sports facilities per 1000 inhabitants was found for the Netherlands. Additionally, no research on a relationship between sports facilities and weekly sports participation on a municipal level in the Netherlands was found. It would be interesting to see if the accessibility of sports facilities does have a significant effect on obesity rates in the Netherlands, whereas no significant result was found in Sweden.

Therefore, this research aims to find whether there is a difference in the accessibility of sports facilities in urban and rural municipalities in the Netherlands and whether this accessibility can be linked to obesity rates in these municipalities. The research problem is "Are the obesity rates in urban and rural municipalities of the Netherlands linked to the accessibility of sports facilities in these municipalities?"

A secondary question that arises from the research problem is "Does the accessibility of sports facilities influence weekly sports participation?"

1.1 Structure of the Thesis.

The thesis is structured as follows: The theoretical framework will begin to explain the key concepts in this study. Next, the methodology section explains the research methods, how and why the data was selected and this research's ethical considerations. Lastly in this section, the operationalization of the variables will be explained. Following the methodology section will be an analysis section that displays the results of the multiple linear regressions done in this research and its discussion. Afterwards, a discussion section will discuss the limitations of this research. In the conclusion section, the results will be discussed, including future research suggestions and policy implications.

2. Theoretical Framework

This research investigates whether there is a link between the accessibility of sports facilities and sports obesity in the Netherlands. To better understand the theory behind these concepts, a deeper understanding of obesity and the factors that play a role in either becoming obese or battling obesity should be gained. Therefore, the following paragraphs will lay the theoretical foundation of this research.

According to WHO, a person is considered obese once they reach a BMI of above 30 (WHO, 2020). BMI is an index that classifies whether an adult is overweight or obese (WHO, 2021). In this research, BMI will be used to categorize the population and to define whether one is overweight or not.

As mentioned before in this paper, the main cause of obesity is a disbalance in energy expenditure and energy consumption, specifically a higher energy consumption compared to expenditure. (Aronne et al., 2009). Both sides should be considered when observing obesity rates. As this research focuses on the accessibility of sports facilities, the focus is on the expenditure side of the energy intake and expenditure disbalance.

A method to increase energy expenditure, and therefore aid in battling obesity, could be increasing exercise levels (Niemiro et al., 2021). This could be beneficial, as weekly participation in exercise is associated with lower obesity rates in adults (Mielke et al., 2020). Thus, physical activity is necessary to prevent obesity (Ilacqua et al., 2018). In most European countries, men are more likely to participate in exercise than women (Hartman-Tews, 2006**).**

As mentioned earlier, increasing the sports participation rates of inhabitants can be done by increasing the accessibility of sports facilities. When it comes to the planning of traffic, accessibility is often defined by how much time or distance a population needs to reach a destination (Iwarsson and Stahl, 2009). Other measures to determine accessibility can be how many facilities are available per 1000 inhabitants or square kilometer, opening hours or admission fees. This research focuses on the average distance travelled to a facility and the density of sports facilities. The accessibility of sports facilities can differ for every individual and every municipality, depending Urban and rural areas often show distinct differences in the accessibility of sports facilities. First, the urbanity of an area is often categorized based on population density (CBS, 2020). Travel distances to, and the number of sports facilities are lower in urban areas compared to rural ones. Important to mention is that the differences in distances traveled to the nearest sports facilities are not as large as they could be in other countries, as the Netherlands is more densely populated than most countries. In larger cities, higher-order sports facilities can be found, as these facilities require a higher population

(Hoekman et al., 2016). Apart from higher order sports facilities, a higher variety of sports facilities can be found in larger cities, which is related to higher chances of monthly sports participation (Hoekman et al., 2016).

However, Hoekman et al., (2017) found that weekly sports participation (In this research often shortened to WSP) rates in rural areas in The Netherlands are higher than those in urban areas. On a monthly basis, no significant difference was found. Opposed to these findings, Steenbekkers et al. (2006), have found no significant difference between weekly sports participation in urban and rural areas. This research found that inhabitants spend an equal amount of time on sports, regardless of urban or rural areas. Rural dwellers practice more outside and non-trendy team sports, whereas urban dwellers practice more trendy and mostly inside duo sports. Inhabitants of rural dwellers find it important to be able to practice sports in their area (Hoekman et al., 2014), but if a certain sports facility is not present in their area, they are willing to travel to another. This is why it would be important to perform research on a municipal level, as this would account for the willingness of rural inhabitants to travel.

Urban and rural municipalities also often experience differences in demographic composition which can have an impact on obesity rates. A measure that could be influential to obesity rates is income. Lower income could cause someone not to be able to go to a fitness center. Healthy food options may also become unobtainable as these often are more expensive than unhealthy food options (Hendriks et al., 2021). A trend that has become visible is that when looking at income level, for males with a low income, the odds of being obese are nearly doubled (Devaux, Sassi, 2013). However, research by Borders et al. (2006) found no differences in obesity rates in males in the US when it came to income height. The same research did find that females with a higher income had lower obesity rates than females with a lower income.

A factor that influences energy expenditure and therefore obesity is age. Westerterp and Plasqui (2004) mention that age may influence obesity rates through a decrease in energy expenditure caused by physical activity decreases with age. For females, the level of physical activity decreases after age 65, while this level decreases after a peak between the ages of 18 to 29 for men. There is another side to the medal, though, as the same research found that increased exercise will often be compensated for by a decrease in non-exercise-related physical activity. Important to note is that the effect on energy expenditure is not the only way age influences obesity. Body composition changes with age. Hormone production declines, which may decrease lean tissue and increase fat mass (Pataky, 2021).

Lastly, the ethnic composition of municipalities can be a factor in the prevalence of obesity. Ethnic minorities have higher obesity rates than ethnic majorities. For example, in the Netherlands between 2013/2017, the obesity rate of people with a Dutch heritage was 10.5 percent. In contrast, the obesity rate of individuals with Turkish, Moroccan, Suriname and Antillian heritage is 18.1, 15,9, 14.5, and 22.5 percent respectively (CBS, 2018). An explanation for these disparities can be the lower social and economic resources, lower education levels, cultural backgrounds, health education and lower access to healthy food (Calzada, Anderson-Worts, 2009).

2.1 Conceptual Model

Figure 1 will be used to explain how accessibility to sports facilities may lead to a higher prevalence of obesity.

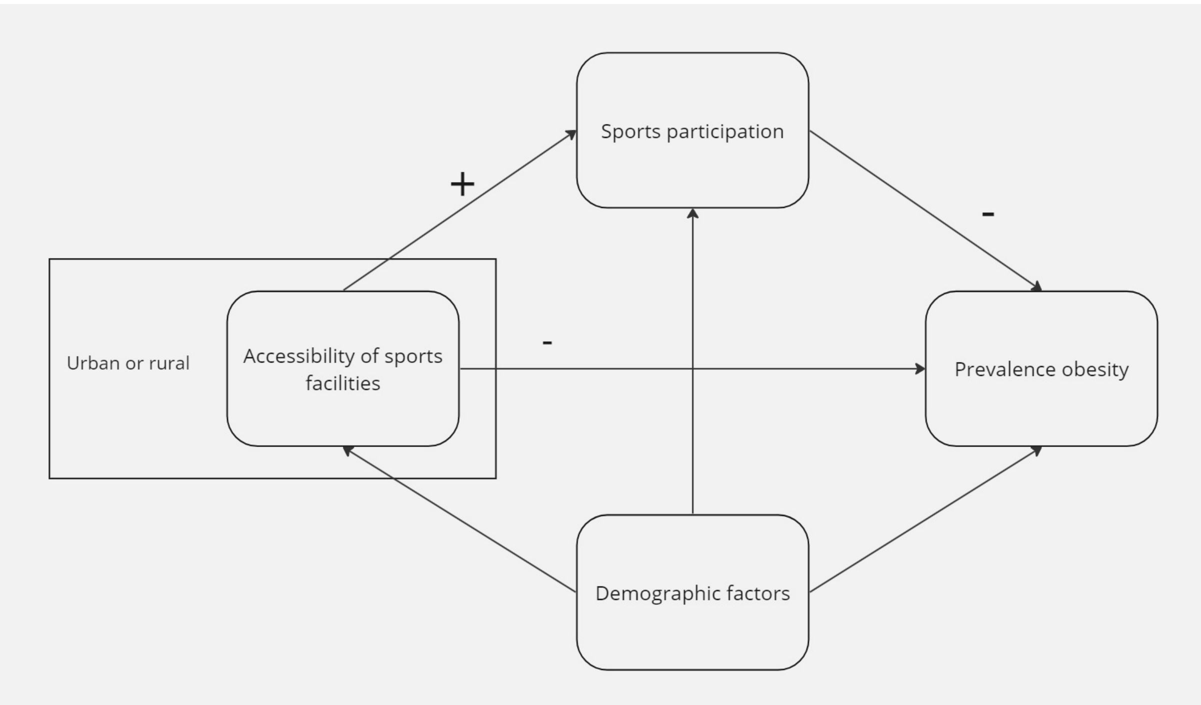

Figure 1: Conceptual Model

Following the theoretical framework, expectations of influence on the concepts mentioned in Figure 1 are raised. It is expected that the accessibility of sports facilities positively influences sports participation and that sports participation negatively influences obesity rates.

Furthermore, a direct effect of the accessibility of the accessibility of sports facilities is expected on the prevalence of obesity. However, earlier research in Sweden has found no significant relationship.

Demographic factors are expected to influence all other concepts mentioned in this model.

2.2 Hypotheses/Expectations

Following the theoretical framework, the expectation for the outcome of the main research question is that better accessibility will decrease obesity rates, as it will lead to higher sports participation in both urban and rural populations.

The expectations for the outcome of the secondary research question are that accessibility positively influences sports participation, in both urban and rural areas.

Hypothesis 1 follows from the main research and is stated as follows: H0: There is no relationship between the accessibility of sports facilities and obesity rates in the municipalities of the Netherlands while controlling for the effects of age, gender. Urbanity and socioeconomic status.

Hypothesis 2 follows from the secondary question and is: H0: There is no relationship between the weekly sports participation rates and sport facilities accessibility in the municipalities of the Netherlands while controlling for accessibility, age, gender, socioeconomic status, and urbanity.

3. Methodology

3.1 Research Methods

This research aims to find whether there is a relationship between obesity rates and the accessibility of sports facilities and WSP rates and the accessibility of sports facilities on a municipal level. To test for a relationship, numerical data would be required for all municipalities. The need for numerical data calls for a quantitative approach to this research. In terms of research design, this research features a cross-sectional study. This offers an opportunity to determine the occurrence of diseases in certain areas (Fortney et al., 2000). This is a useful type of research design to answer this research question, as it offers an opportunity to investigate multiple municipalities at one point in time. Furthermore, examining the differences in a relationship in different years is not a point of interest in this research. Since the purpose of this research is to search for the existence of a relationship between the accessibility of sports facilities and obesity, a cross-sectional study would suffice. For this cross-section data from the year 2018 is used, as most datasets used in this research are released either every two or every four years and the years 2020 and 2022 may not be as representative of the population's WSP levels and obesity rates as they could have been due to COVID-19. Unfortunately, not all variables had data available on a municipal level for 2018. This issue was resolved by using datasets ranging from 2016 to 2020. The datasets included that are not from 2018 show little differences in values over the years or do not appear to be affected by COVID-19. Therefore, these are still included, despite their divergent year of measurement.

This research is not only interested in testing whether there is a relationship between the different variables, but also what the nature and strength of this relationship is. The dependent variables used to test for relationships are continuous ratio variables. These variables will be compared to multiple independent variables that are either continuous ratio variables or binary variables. The nature of these variables and the fact that the research aims to check for a relationship between one dependent variable and multiple independent variables would suit a multiple linear regression.

As can be seen in Figure 1, this research wishes to find relationships between the prevalence of obesity, the accessibility of sports facilities, sports participation, and demographic factors. The variables used to test the relationships between these concepts are derived from CBS and the Mulier Institute. These instances have done demographical and statistical analysis on the population and facilities of the Netherlands. CBS gathers their data through questionnaires and administrative sources of other government bodies, like the tax authorities, municipalities and the Rijkswaterstaat (Department of Waterways and Public Works) (CBS, 2023). The Mulier Insitute gathers its data through its own data retrieval and makes use of the databases of external parties. Examples of databases used by the Mulier Institute are CBS's health surveys, NOC*NSF member information, Municipalities' sports expenses and a database displaying sports facilities in the Netherlands of the Chamber of Commerce (Mulier Instituut, 2018).

The first dataset selected for this research is a file with all sports facilities situated in the Netherlands, retrieved from the data portal of the Mulier Institute, displaying addresses, place names, the type of facility and the sports it facilitates (Mulier Instituut, 2023b). The data found in this dataset can be used to calculate the number of sports facilities within a municipality.

The variable displaying the share of obese inhabitants per municipality is derived from the "Gezondheidsmonitor; bevolking 19 jaar of ouder, regio, 2016" (Health monitor; population 19 years or older, region, 2016) dataset (CBS, 2021a). This dataset provides information on people above age 19 on a national, regional, and local level, about health (determinants), social situation and the lifestyle of the Dutch population. These are results from a sample test of the CBS Health survey and the data of the VGZ Adult Monitor for all the 25 GGD regions. This survey is held every 4 years (CBS, 2016). The variable depicting the share of inhabitants that participate in sports weekly can be derived from this dataset as well.

To determine the accessibility of sports facilities, a variable on the average distance to a sports facility for every municipality is derived from the "Op de kaart: Afstand tot sportaccomodaties, 2020" (On the map: distance to sports facilities, 2020) dataset (Sporten en Bewegen in Cijfers, 2020).

To create variables for the demographic factors, the dataset "Inkomen per gemeente en wijk, 2018" (Income per municipality and neighborhood, 2018) is used (CBS, 2021b). This dataset depicts the average income in thousands of euros for all persons in private households per municipality. This dataset was created for the Kamer van Koophandel (Chamber of Commerce). Variables on migration background, age, and gender are derived from the "Bevolking; Migratieachtergrond, generatie, lft, regio, 1jan; 2010-2022" (Population; Migration background, generation, age and region, Jan 1; 2010-2022) dataset (CBS, 2023). This is a dataset showing information on inhabitants on a national, provincial, and municipal level. It gives information on the migration backgrounds, generations, and ages of the inhabitants. The variable for the share of inhabitants with a migration background and the variable share of people aged 65 and above is derived from this dataset.

Lastly, to determine the urbanity rates for the municipalities, the dataset "Gebieden in Nederland, 2018" (Areas in the Netherlands, 2018) is used (CBS, 2020). This dataset shows the codes and names of all municipalities in the Netherlands in 2018. It shows the population, size, and urbanity of the municipalities.

3.2 Sample Selection

This research features data from 341 out of the 380 municipalities in the Netherlands in 2018. Some datasets displaying 2018 data use 2020 municipality borders. 35 Out of 380 municipalities no longer existed in 2020. Furthermore, some municipalities miss data for one or more variables that are irreplaceable by data from another year. These municipalities have been deleted from the sample. Data on obesity and weekly sports from 2020 has been used to complete missing values for five municipalities to complete missing values.

Furthermore, the variables used in this research contain information about the facilities within the municipalities themselves, and about the population aged 19 years and older living within the municipality, as very little information on the entirety of the population could be found.

3.3 Variables

3.3.1 Dependent variable

The dependent variable of the main research question is obesity. This variable is measured by calculating the percentage of people with a BMI above 30 in the total population within a municipality. This variable measures a percentage from 0 to 100 which makes this a continuous ratio variable and therefore suitable for multiple linear regression.

3.3.2 Independent Variables

Firstly, because this research aims to find whether there is a relationship between the accessibility of sports facilities and obesity in urban and rural municipalities, a variable displaying the average distance from the population to the nearest sports facility in kilometers is used. This variable is a continuous ratio variable that is derived from the "Sporten en bewegen in cijfers, 2020" map. The distances given for this variable have been measured using road networks, living addresses and addresses of sports facilities. Other variables used to describe the accessibility of sports facilities describe how many sports facilities a municipality averages per square km and how many sports facilities a municipality averages per 1000 inhabitants. These are continuous ratio variables and are created by using the Mulier Insitute's database. To calculate this variable, all information on sports facilities was downloaded from the Mulier Insitute and entered into ArcGIS, along with a shapefile displaying all municipalities (NGR, 2018). After entering these files, the number of sports facilities per municipality can be calculated. The process of retrieving these variables is described in Appendix A.

Secondly, as the urban and rural municipalities play a role in the main question of this research, the urbanity rate of these municipalities is also used as an independent variable.

Originally this variable, derived from the “Gebieden in Nederland, 2018” dataset displayed the urbanity rate of municipalities on a scale of 1-5 as shown in Table 1.

URBANITY RATE	DESCRIPTION	SURROUNDING ADDRESS DENSITY
1	Very highly urbanized	>2500
2	Strongly urban	1500 - 2500
3	Moderately urban	1000 - 1500
4	Little urban	500 – 1000
5	Non-urban	<500

Table 1: Division of urbanity levels

The surrounding address density is determined by dividing the number of addresses by the area of the municipality in square kilometers. (CBS, 2020). The variable, in the way it is mentioned above, is an ordinal variable and therefore not suitable for multiple linear regression. This problem has been solved by transforming this variable into five separate dummy variables, using “1” as “Yes”, and “0” as “No” to indicate whether a municipality fits within the category described by the new dummy variable. This is now a discrete binary variable and is suitable for multiple linear regression.

3.3.3 Control Variables

To enhance the internal validity of this research, control variables about the demographic characteristics of the municipalities have been added. These control variables are indicators of the gender, age, migration background and income of the municipalities’ inhabitants.

Firstly, to control for the prevalence of obesity, age is used in this research. This variable measures the share of people aged 65 and older in the population in percents. This variable is calculated by taking the sum of people aged 65 and above within a municipality and dividing this by the total number of the population in the same municipality and then multiplying the outcome by 100. This variable is a continuous ratio variable.

Another continuous ratio control variable used in this research is the share of male inhabitants within the population. To create this variable, the total amount of male inhabitants per municipality was derived from the “Bevolking; Migratieachtergrond, generatie, lft, regio, 1jan; 2010-2022” and divided by the total population per municipality also found in the same dataset and multiplying by 100.

Furthermore, a variable displaying the average income in thousands of euros for all persons in private households per municipality is derived from the "Inkomen per gemeente en wijk, 2018" dataset. This is a continuous ratio variable and therefore suitable for multiple linear regression. No changes have been applied to the original data to operationalize this variable.

The last demographic characteristic used in this research will be the share of inhabitants with a migration background within a municipality. The original data describes the number of inhabitants within a municipality that have a migration background. To operationalize this variable, this number is taken and divided by the total number of inhabitants within the municipality and multiplied by 100. The variable now shows the percentage of inhabitants with a migration background within the municipality. This is again a continuous ratio variable.

3.4 Ethical Considerations

As this research uses secondary, quantitative data, the data that is being used in this research has already followed the ethical considerations necessary to ethically source and publish the used data. CBS has a clear code of conduct (CBS, 2003), stating the principles on which it publishes and gathers data. The Mulier Insitute also takes privacy very seriously (Mulier Instituut, 2020) as it also uses personal information.

3.5 Data Analysis

To analyze this data, a descriptive statistics table is derived from the variables in SPSS to compare the sample sizes of the variables and the standard deviation. After inspecting the descriptive statistics table, multiple linear regression is used to investigate the relationship between obesity as the dependent variable and all independent and control variables mentioned in the "independent variables" and "control variables" section above.

4 Results

4.1 Descriptive Statistics

Appendix B shows the descriptive statistics of the variables used in this research. This table includes the size of the samples, a brief description, the unit of measurement, the mean, the standard deviation, and the minimum and maximum values of the variables. From the table can be derived that across all 341 municipalities, on average 13.8 percent of the population is obese. The obesity levels of municipalities vary between 6.2 percent and 25.1 percent.

4.2 Multiple Linear Regression for Weekly Sports Participation

The first linear regression in this research is used to test the relationship between obesity rates in the municipalities of the Netherlands, and the accessibility of sports facilities, controlling for the effects of age, gender, and socioeconomic status. Appendix C shows that the share of people that participate in sports weekly has a relationship with the share of obese inhabitants, the number of sports facilities per 1000 inhabitants, the average distance to a sports facility, the share of people aged 65 and older, the share of male inhabitants, the average income in 1000 euros and a municipality not being urbanized on a 99 percent level. On a 90 percent level, a significant relationship was found with the number of sports facilities per square kilometer. Insignificant in this model are the relationships between WSP rates and the share of people with a migration background, living in a very highly urbanized area, living in a strongly urbanized area, and living in a moderately urbanized area.

The ANOVA for this model shows that this model is statistically significant, which indicates that the odds of the results of this model appearing by chance are smaller than 0.00 percent (Burt et al., 2009). Furthermore, the model summary shows that the R square of this model is 0.548, this would indicate that 54.8 percent of the variance in WSP rates can be explained by the variables used in this model.

Following the regression results, it can be stated that increasing WSP rates within a municipality by 1 percent would lead to a 0.9 percent decrease in obesity rates.

When looking at the influence the accessibility on WSP rates, increasing the number of sports facilities per 1000 inhabitants by one would lead to an overall increase of 1.4 percent in the WSP rates. Increasing the number of sports facilities per square kilometer would cause an increase of 0.5 percent. Decreasing the distance to sports facilities would also have a positive effect on the WSP rates, as decreasing the distance by one kilometer would lead to a 1 percent increase in WSP rates. From these results can be concluded that increasing the accessibility of sports facilities would significantly increase WSP rates. This significant relationship, combined with the significant ANOVA, provides the ability to reject the second null hypothesis of this research.

Upon inspecting the relationships of WSP rates with the sociodemographic factors, it can be concluded that a higher share of inhabitants aged 65 or above within a municipality negatively impacts WSP rates. A one percent increase in population aged 65 and above would result in a 0.3 percent decrease in WSP rates. Gender differences between municipalities are shown to have the biggest impact on WSP rates, as a 1 percent increase in the share of the male population within a municipality would increase WSP levels by 1.2 percent. Income also plays a role in WSP rates, as an increase of 1000 euros would result in a 0.6 percent increase in WSP rates. Having a migration background has no significant effect on WSP rates, and even if these results had been significant, the impact would have been minor.

The level of urbanity of a municipality does not appear to have a significant influence on WSP rates unless the municipality is not urbanized. Living in a non-urbanized municipality decreases the WSP rates of its inhabitants.

4.3 Multiple Linear Regression for Obesity Rates

The second multiple linear regression performed in this research tests the relationship between obesity and the share of people who participate in sports weekly, the accessibility of sports facilities, social demographics, and urbanization rates of municipalities. Appendix D shows that, when it comes to obesity rates within a municipality, the share of the population that sports weekly, the share of people that are aged 65 and older the average income in 1000 euros and the share of the population with a migration background show a relationship that is significant on a 99 percent level. The number of sports facilities per 1000 inhabitants and municipalities that are very highly urbanized show a relationship with obesity rates on a 90 percent significance level. Regression 2 shows fewer significant relationships than Regression 1. An explanation for this would be that a disbalance in energy intake and expenditure does not have a unilateral cause. Obesity has a wide variety of factors influencing its prevalence. These factors are not as wide for WSP rates.

The ANOVA results show that this model too is statistically significant, indicating that the odds of the results of this model appearing by chance are smaller than 0.00 percent. The R square of this model is 0.521 which would indicate that 52.1 percent of the variance in WSP rates can be explained by the variables used in this test.

The insignificant results for the relationship between obesity rates and accessibility would imply that the second null hypothesis for this research cannot be rejected. However, for a relationship between the number of sports facilities per 1000 inhabitants and obesity rates, the null hypothesis can be rejected if a 90 percent significance level is taken.

In Regression 2 the effect of WSP on obesity rates, while controlling for the other variables included in the regression, appears to be smaller than the effect of obesity rates on sports participation as described in Regression 1. This would mean that being obese has a substantial impact on sports participation rates, whereas WSP rates have a smaller impact on the obesity rates within a municipality. This could be explained by the disbalance of energy expenditure and energy intake. Sports participation influences obesity, as this increases energy expenditure. However, energy intake should be considered as well when looking at factors that may explain the prevalence of obesity. This would lower the share of the effect sports participation can have on the prevalence of obesity. The other way around, obesity has a larger effect on sports participation, as it may decrease physical comfort, which can have a direct impact on a person's willingness to participate in sports.

The accessibility of sports facilities also appears to have a lower impact on obesity rates than it has on WSP rates. The number of sports facilities per 1000 inhabitants negatively influences obesity rates, as when the number of sports facilities per 1000 inhabitants rises by 1, obesity rates within a municipality decrease by 0.4 percent. The number of sports facilities per square kilometer is insignificant for Regression 2, interestingly, the significance of this variable was the lowest of the accessibility variables of Regression 1 as well. A possible explanation for this could be that increasing the number of sports facilities per kilometer by 1 would have more of an impact on a municipality with a lower population density than it would have on a municipality with a high population density, as it would increase the number of sports facilities per 1000 inhabitants more than it would on a municipality with more inhabitants.

When it comes to the obesity rates of a municipality, it appears that social demographics have a larger impact than the accessibility of sports facilities. From Regression 2 can be derived that when the share of the population aged 65 or above within a municipality rises by one percent, obesity rates also rise by 0.1 percent. A one percent increase in inhabitants with a migration background would account for a 0.7 percent change in obesity rates, and a rise in average income of 1000 euros would decrease the obesity rates by 0.4 percent.

Whereas living in a non-urbanized municipality has a significant effect on WSP, only living in a very urbanized municipality appears to have a significant effect on obesity rates. An increase in very highly urbanized municipalities would account for a decrease in the national average obesity rate. This could be explained by the higher share of students living in cities.

Eight out of seventeen of the very highly urbanized cities have a university. A municipality with a higher share of students often has a lower average age. As mentioned in the theoretical framework, younger people have lower odds of obesity (Pataky et al., 2021).

5. Discussion

This research offers insight into the effects of the accessibility of sports facilities on obesity rates. Although the number of sports facilities within a squared kilometer and the average distance to a sports facility did not show a significant relationship with obesity rates, the number of sports facilities per 1000 habitants did show negative relationship on a 90 percent significance level.

Following the theoretical framework, it was expected that the influence of WSP on obesity would be prevalent, as it is a cause of a higher expenditure of energy. When it comes to socioeconomic factors, such as income, and migration background, the results are also in line with the theoretical framework.

Another finding of this research is the positive influence of accessibility of sports facilities, measured by the number of facilities per 1000 inhabitants, on WSP on a 99 percent significance level. Being over the age of 65 had a negative influence on WSP, whereas being male and having a higher income significantly increases WSP. When it comes to urbanity, only non-urban areas have a significant negative impact on WSP.

The outcomes of both multiple linear regressions have found little significant differences in the influence of urbanity level on both the prevalence of obesity and WSP. This was not the expected result and could be due to shortcomings of the model.

As can be concluded from the theoretical framework, obesity has a large variety of influential factors on its prevalence. As this research does and cannot incorporate every influential variable of obesity, the outcomes of this could be influenced by variables not incorporated in the model. Factors such as access to healthy food options, illness, socioeconomic status, education level and mobility could have made the model more complete. Most data on these influential variables is however not available or incomplete at the municipal level and can therefore not be incorporated into the model. For example, a dataset on education levels was found, including data for 30 municipalities. If this dataset had been included in the research, the sample size of this research would have decreased by over 300. Another issue that arises from the data is the possibility of untruthfulness. Part of the examined data is based on surveys, which could be influenced by participants not answering honestly.

BMI might not be the best indicator of body fat and its distribution either. Research by Romero-Corral et al. (2008) found that people with a BMI higher than thirty had a 97 percent chance of being obese. However, of all people with a body fat percentage higher than the obesity threshold, only 36% of men and 49% of women had a BMI over 30.

5.1 Conclusion

Circling back to the main research question: “Are the obesity rates in urban and rural municipalities of the Netherlands linked to the accessibility of sports facilities in these municipalities?” This research has found that in terms of accessibility of sports facilities, the number of sports facilities per 1000 inhabitants has a significant effect on obesity levels in municipalities and no significant differences have been found between different urbanity rates.

The second research question: “Does the accessibility of sports facilities influence weekly sports participation?” can be answered by the results of the featured multiple linear regression. It can be concluded that all accessibility factors have a significant positive influence on weekly sports participation.

Combining the two questions leads to the conclusion that accessibility has a positive influence on WSP, but the only significant accessibility factor in obesity rates is the number of facilities per 1000 inhabitants. This could mean that there likely is a set of different variables that are more important in the explanation of obesity rates.

Future research in energy intake, contrary to the expenditure, could be more beneficial in finding a more impactful way to battle obesity rates. An example of this research could be the influence of the accessibility of healthy food options in supermarkets on obesity. Furthermore, including other modes of physical activity, such as cycling or walking may also aid in determining the importance of physical activity when it comes to obesity rates in the population.

For future policy implications, it would be advisable to increase the number and accessibility of sports facilities to improve weekly sports participation. However, increasing the accessibility of sports facilities to lower obesity rates would not have any significant effect, according to this research.

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Appendix

A. Creating Accessibility variables

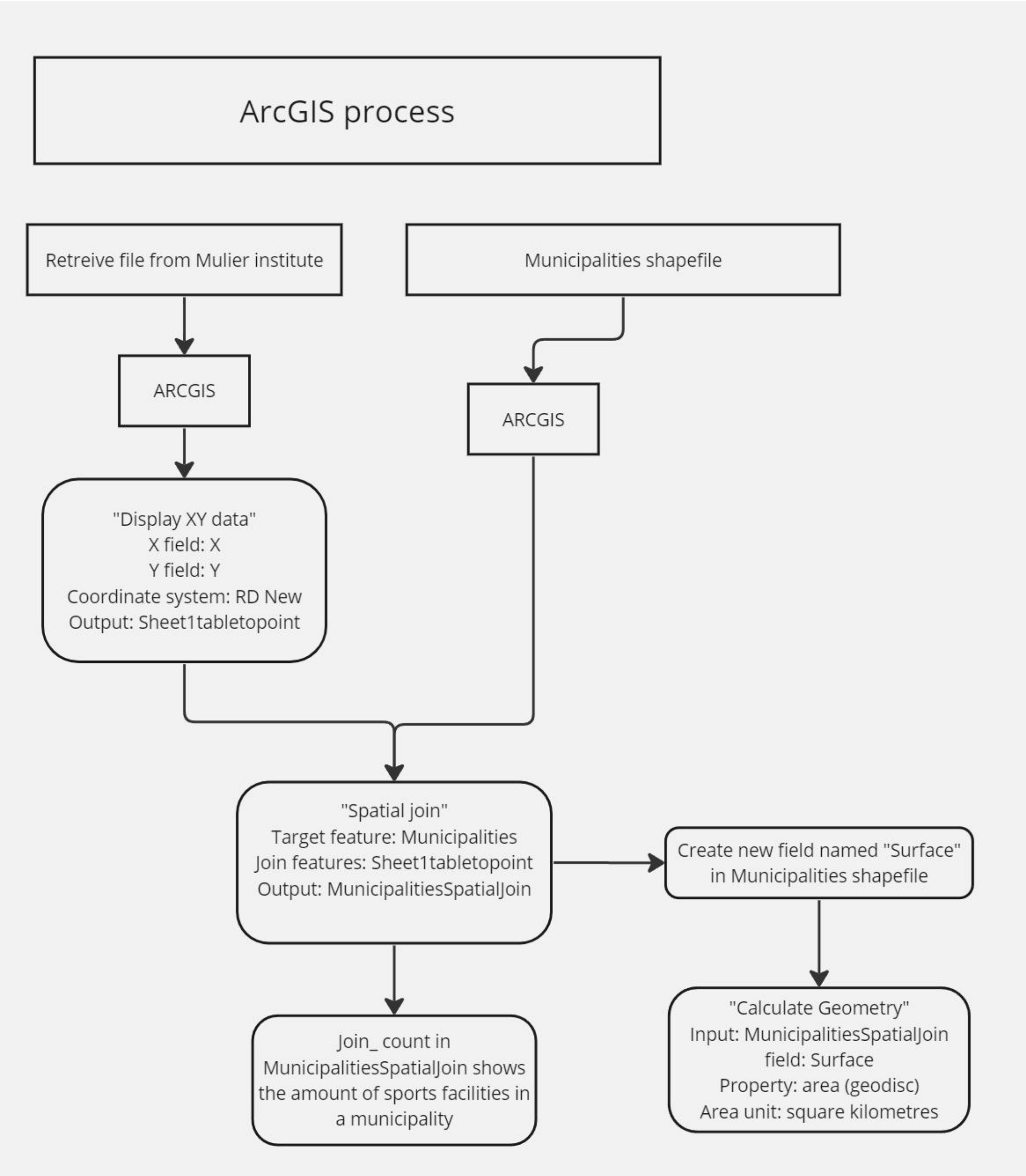

Figure 2: Flowchart of the Process in ArcGIS

After completing the steps mentioned in figure 2 in ArcGIS, the tool “Table to Excel” was used to enter the new variables into SPSS. Next, after entering the variables into SPSS the variable “SPORTS_PER_KM” can be created by using “Calculate variable” and entering

"Join_Count/surface." Another way of measuring the availability of sports facilities is by calculating the average amount of sports facilities per 1000 inhabitants, resulting in the "SPORTS_PER_1000_INH" variable. This is a continuous ratio variable. To calculate this variable, the "Join_Count" variable, created in ArcGIS, and the "Population" variable, derived from the "Bevolking; Migratieachtergrond, generatie, lft, regio, 1jan; 2010-2022" dataset are used. In SPSS, the function "Calculate variable" is used, entering the calculation "JoinCount/(population/1000)", resulting in a new variable, named "SPORTS_PER_1000_INH".

B. Descriptive Statistics of the Variables

VARIABLE	*N*	*MEAN*	*ST DEV*	*MIN*	*MAX*
Share of obese inhabitants	341	13.75	2.785	6.2	25.1
Share of people that sports weekly	341	51.1	5.982	35.4	68.2
Accessibility of sports facilities					
Sports facilities per 1000 inhabitants	341	2.01	.684	.75	5.06
Sports facilities per square km	341	1.36	1.275	.7	7.79
Average distance to a sports facility	341	1.8	.925	.5	7.5
Social demographics					
Share of population aged 65 and o1der	341	20.81	3.258	9.287	31.312
Share of male inhabitants	341	49.36	.785	47.11	53.25
Average income in 1000 euros	341	26.2	3.33	18.2	44.1
Share of population with a migration background	341	15.91	8.577	8.78	53.69
Urbanization rates of municipalities					
Very highly urbanised	341	.06	.230	0	1
Strongly urbanised	341	.21	.411	0	1
Moderately urbanised	341	.22	.415	0	1
Little urbanised	341	.36	.481	0	1
Not urbanised	341	.15	.357	0	1

Table 2: Descriptive Statistics of the variables used in this research.

C. Outcomes Multiple Linear Regression 1

Coefficients [a]

VAR NAME	Unstandardized Coefficients B	Unstandardized Coefficients ST. ERROR	standardized coefficients BETA	T	SIG.	VIF
Constant	-10.913	22.679		-.453	.651	
Share of obese inhabitants	-.850	.105	-.395	-8.069	.000	1.744
Accessibility of sports facilities						
Sports facilities per 1000 inhabitants	1.377	.482	.157	2.856	.005	2.205
Sports facilities per square km	.528	.301	.113	1.755	.080	2.983
Average distance to sports facility	-.972	.315	-.150	-3.083	.002	1.724
Social demographics						
Share people aged 65 and older	-.271	.095	-.147	-2.863	.004	1.923
Share of male inhabitants	1.215	.419	.160	2.902	.004	2.193
Average income in 1000 euros	.692	.102	.385	6.798	.000	2.983
Share of population with a migration background	-.064	.042	-.091	-1.513	.131	2.649
Urbanization rates of municipalities						
Very highly urbanised	-.556	1.742	-.021	-.319	.750	3.250
Strongly urbanised	.641	.957	.044	.670	.503	3.134
Moderately urbanised	.907	.693	.063	1.309	.192	1.677
Not urbanised	-.2.235	.811	-.133	-2.756	.006	1.702
ANOVA [a]	Sum of squares	DF	Mean square	F	Sig	
Regression	6668.664	12	555.722	33.156	.000 [b]	
Residual	5497.604	328	16.761			
Total	12166.268	340				
Model summary [a]	R	R square	Adjusted R square	St. error of the estimate		
	.740 [b]	.548	.532	4.0940		

a. *The dependent variable in this model is the share of the population that participates in sports weekly.*

b. *The predictors used in this research are all variables mentioned in this table.*

Table 3: Coefficients of Multiple Linear Regression 1

D. Outcomes Multiple Linear Regression 2

Coefficients [a]

VAR NAME	B	ST. ERROR	BETA	T	SIG.	VIF
	Unstandardized Coefficients		*standardized coefficients*			
Constant	41.754	10.760		3.880	.000	
Share of population that sports weekly	-.195	.024	-.419	-8.069	.000	1.847
Accessibility of sports facilities						
Sports facilities per 1000 inhabitants	-.415	.233	-.102	-1.782	.076	2.238
Sports facilities per square km	.037	.145	.017	.258	.797	3.010
Average distance to sports facility	-.068	.153	-.022	-.442	.659	1.772
Social demographics						
Share people aged 65 and older	.120	.045	.141	2.651	.008	1.930
Share of male inhabitants	-.219	.203	-.062	-1.080	.281	2.241
Average income in 1000 euros	-.366	.048	-.437	-7.623	.000	2.257
Share of population with a migration background	.065	.020	.199	3.236	.001	2.585
Urbanization rates of municipalities						
Very highly urbanized	-1.514	.831	-.125	-1.822	.069	3.218
Strongly urbanized	-.576	.458	-.085	-1.258	.209	3.124
Moderately urbanized	.108	.333	.016	.324	.746	1.685
Not urbanized	.060	.203	.008	-1.080	.879	1.742
ANOVA [a]	Sum of squares	DF	Mean square	F	Sig	
Regression	1374.809	12	114.567	29.787	0.000 [b]	
Residual	1261.559	327	3.846			
Total	2636.369	340				
Model summary [a]	R	R square	Adjusted R square	St. error of the estimate		
	.722 [b]	.521	.504	1.9612		

a. *The dependent variable in this model is the share of the population that is obese.*

b. *The predictors used in this research are all variables mentioned in this table.*

Table 4: Coefficients of Multiple Linear Regression 2