Master Thesis

MSc Social Policy and Public Health

"To what extent do the perceived barriers of availability, affordability and quality of fruit and vegetables explain socioeconomic inequalities in fruit and vegetable consumption among adults in The Netherlands"

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Abstract

Consumption of fruit and vegetables has been shown to be below recommended intake levels among adults in the Netherlands, acting as a risk factor for health. Countries such as the UK and USA show there is an association between Socioeconomic Position (SEP) and fruit and vegetable consumption, whereby lower fruit and vegetable intake is often associated with socioeconomically disadvantaged groups. However, there has been little empirical research to whether there are differential views surrounding affordability, availability, and quality of produce between groups differing in socioeconomic characteristics in The Netherlands. The present study investigates to what extent perceived barriers of availability, affordability, and quality (AAQ) of fruit and vegetables explain socioeconomic inequalities in fruit and vegetable consumption using the 2004 Dutch GLOBE study. Linear regression analysis was carried out to test whether household income was a predictor of fruit and vegetable consumption as suggested by previous research. This was followed by a mediation analysis examining whether the relationship between SEP (household income) and fruit and vegetable consumption were mediated by the perceptions of AAQ of fruit and vegetables. There was no significant relationship between household income in fruit and vegetable consumption. Results indicated that the relationship between household income and perceived barriers of AAQ of vegetables was significant. Fruit and vegetable consumption was not mediated by the perceptions of AAQ of fruit and vegetables. Therefore, it is likely individuals do not differ in their perceived views in relation to affording, accessing and obtaining high quality fruit and vegetables regardless of SEP. This study did not find that individuals with high, middle, or low incomes differed in their fruit and vegetable consumption among adults in The Netherlands.

Keywords: Socioeconomic position, diet inequity, perception, fruit, vegetables, the Netherlands, consumption, affordability, availability, quality

Chapter 1: Introduction

Diet is a key contributor to disparities in many chronic diseases and conditions, accounting for one tenth of the total global disease burden (Satia, 2009). Certain groups that experience disparities in society are at higher risk of adverse health conditions due to diet inequality. This means being at higher risk for illness including cardiovascular disease, hypertension, cancer, type II diabetes, and obesity (Satia, 2009). Individuals with lower Socioeconomic Position (SEP), such as those with a lower level of education or income, have poorer diets as compared with those with a higher SEP. This potentially leads to having higher incidence of illness, morbidity, and mortality rates accompanied with poorer survival for many diet-related chronic diseases and conditions (Satia, 2009). Consuming a sufficient amount of fruit and vegetables can decrease the risk of multiple diseases, meaning a healthy diet can play an important role in the promotion and maintenance of good health, which acts as a determinant of chronic non communicable disease (NCD) (WHO, 2002). In most Western countries, like The Netherlands, vegetable consumption is far below recommended intake levels (Springvloet et al., 2014).

According to the Dutch National Food Consumption Survey, the median daily intake of vegetables was 102-140g for adults, much below the recommendation of 200g per day. Fruit consumption was also below the recommended daily amount, with only 3-26% of individuals across age groups reaching the daily requirements (RIVM, 2010). With a lack of fruit and vegetable consumption acting as a risk factor for illness, it is evident that promotion in the area of fruit and vegetable consumption is important. Consumption can be influenced from an individual, community and societal level (Pem & Jeewon, 2015). Diet inequalities pose a societal issue. Groups with higher SEP are more likely to have healthier food habits, whereas people with lower SEP have dietary profiles less consistent with nutritional recommendations or dietary guidelines (Alkerwi et al, 2015) and therefore, a lower status of health (Pechey & Monsivias, 2016).

Evidence indicates that the relationship between SEP and fruit and vegetable consumption in the Netherlands warrants further research. Availability, affordability and quality have been shown to play a role in diet (Miller et al., 2016) with research suggesting that contrasting perceptions exist between socioeconomic groups due to social and economic characteristics (Bosma et al., 2014). Other studies indicate that affordability and accessibility do not play a barrier role in explaining socioeconomic inequalities in diet (Helbeich et al., 2017). By questioning groups about their perceptions of AAQ policy makers gain a greater insight into the barriers and enabling factors associated with fruit and vegetable consumption. Differential perceptions of AAQ of fruit and vegetable consumption in relation to SEP has had little exploration from a Dutch context (Giskes et al., 2005).

This conflicting evidence warrants further research. This study aims to make an important contribution to social inequalities, often poorly understood and unevenly measured in this case the issue of diet inequality (Binelli, at al., 2015). Whilst taking a scientific view of these inequalities, the aim is to create an understanding surrounding the links between SEP, opportunities in diet and adverse health implications. Diet inequality can potentially cause chronic diseases, such as type II diabetes, obesity, coronary heart disease and cancer (CDC, 2021). These illnesses are preventable and so, the research aims to contribute to scientific knowledge in order to implement societal change and sustain population health. By questioning whether different SEP groups have differential perceptions in relation to fruit and vegetables, with low SEP groups often having poorer diets, this study aims to gain insight into causes of low fruit and vegetable consumption in order to prevent illness and enable access to healthy foods.

First, the relationship between SEP and fruit and vegetable consumption will be examined. Then to explore how this relationship is influenced by AAQ barriers to fruit and vegetables. The aim of this current study is to investigate what socioeconomic differences occur in the perceptions of AAQ of fruit and vegetables and how this impacts fruit and vegetable consumption among adults in The Netherlands.

Chapter 2: Existing Research

2.1 Health Benefits of Fruit and Vegetables

Diets consisting of high fruit and vegetable intake are widely recommended for their health promoting properties. Relatively low in calories, fruits and vegetables have a high concentration of vitamins, especially vitamins C and A, minerals, and antioxidants. Additionally, fruits and vegetables are recommended as a source of dietary fibre (Rekhy & McConchie, 2014). These health promoting properties of consuming fruit and vegetables include reduced risk of NCD's, such as cardiovascular disease, cancers, type II diabetes and obesity (Slavin & Lloyd, 2012). Research suggests there is a positive association between lower SEP and decreased consumption of both fruit and vegetables, which indicate an increased risk of chronic disease (Vlismas, et al., 2009). Therefore, low-income groups face the greatest risk of developing several diet-related conditions (Daniel, 2020). For this reason, this study specifically focuses on fruit and vegetable consumption in the Netherlands compared to other areas of nutrition.

2.2 Inequities in The Netherlands

In the Netherlands, fruit and vegetable consumption falls far below recommended intake levels (Springvloet et al., 2014) and like in many western countries, inequalities in health exist between those of high and low SEP (van Bon-Martens et al., 2012). In 2012, 9.4% of households were living below the income threshold which is 8.4% of the Dutch population (Neter et al., 2014), with those of a lower SEP often experiencing a lower status of health. Reasons behind this can be attributed to barriers in relation to consumption of healthy foods which in turn, may differ between socioeconomic groups and can play a role in the explanation of socioeconomic inequalities in diet (Mackenbach, et al., 2019). Diet inequalities are caused by a highly complex mix of factors at a societal, community and individual level. These levels of influence impact the food system directly, and the political, economic, social and cultural pathways indirectly, often leading to social stratification and prompt the quality of conditions in which people live (Friel et al., 2015).

2.3 Barriers Perceived in Fruit and Vegetable Consumption

Social stratification can be attributable to health differences between demographic groups. SEP is associated with differences in diet and is linked to barriers in relation to perceived views of AAQ of fruit and vegetables (Thurber et al., 2017). Research suggests

that contrasting perceptions exist between socioeconomic groups due to social and economic characteristics (Bosma et al.,2014), all influenced by a complex set of factors, based on environmental, cultural and socioeconomic conditions (Eurostat, 2020). Considering perceptions in relation to fruit and vegetable consumption is important in understanding differential views of health opportunities, as they may act as indicators in the willingness to maintain a healthy diet (Racine et al., 2020).

Perceived barriers for healthy eating behaviour can be attributed to poor mental health, financial stress, and high food prices (van der Velde et al., 2019). The perception of having less access to foods can be caused by various factors, such as income status, education and neighbourhood characteristics all acting as likely contributors to the socioeconomic pattern of inability to maintain a healthy diet due to the cost and accessibility of food (Mackenbach et al., 2019). Low SEP groups often have a lower income leading way to purchasing less nutritious, energy-dense foods. These foods are often cheaper sources of calories as higher diet quality has been associated with higher diet cost (Pechey & Monsivais, 2016). Consequently, opting for cheaper alternatives through the introduction of energy-dense junk food can be considered a direct cause of non-communicable disease. Therefore, it is clear health inequities are related to environmental influences such as AAQ barriers (Hemmingson, 2017).

2.4 Perceptions of AAQ and Fruit and Vegetable Consumption

The ability to achieve a healthy diet can be linked with health behaviours (Armitage et al., 2007). Health behaviours are actions individuals take that affect their health, in this case consuming a healthy diet (Short & Mollborn, 2015). When considering the perceptions of AAQ and the ability to consume fruit and vegetables, the Dahlgren and Whitehead model of the Social Determinants of Health suggests there are three levels of influence of health behaviours; environmental, social networks and individual lifestyle choices, as shpwn in Figure 1. According to this model, individual's lifestyle behaviours, including dietary behaviours, are not only based on individual choices but influenced by broader daily living conditions in which individuals are born, live, learn, work and age (WHO, 2011). All of these factors are relevant to the food environment and therefore the consumption of fruit and vegetables (Bambra et al., 2013).

With research suggesting low income groups have disproportionally poorer access to healthy foods (Black et al., 2017), income is a key force in one's nutrition environment whereby residents who acquire a low income may have higher perceptive barriers in relation

to AAQ of fruit and vegetables to maintain a healthy diet (NRC, 2013). This shows the need to understand the environmental influences and emphasises the need to adapt the environment to make fruit and vegetable consumption easier, particularly for individuals from disadvantaged backgrounds (Black et al., 2017).

Figure 1

The Social Determinants of Health (Dahlgren & Whitehead, 1991).



2.5 Food Environment

There is growing evidence that the neighbourhood food environment is an important determinant of dietary behaviour (Black et al.,2013). Food environments can be defined as "all objective and perceived aspects of the physical and economic food environment outside the home" (Mackenbach et al., 2019). In order make healthy choices easier environmental determinants need to be adapted in order to have an impact on an individual's diet, whereby healthy food environments are imperative for public health (Helbich et al., 2017). Research suggests that neighbourhood environments surrounding food availability have an influence on the quality of life and health individuals encounter (van der Velde, 2020).

Chapter 3: Theoretical Approach

This paper aims to use the "Model of Nutrition Environments" by Glanz to investigate the association between ones environment and fruit and vegetable consumption in order to investigate influential factors such as AAQ barriers. This model incorporates factors that are influential surrounding healthy eating outcomes. Considering four particular nutritional environments, it draws on the complexity of diet inequalities from a neighbourhood context. This model takes into account, policy, environment, social and individual determinants of diet which are essential in investigating the complexity of diet inequality (Glanz et al., 2005). Food environments are shown as having pathways of influence on eating patterns.

Figure 2



Model of nutrition environments (Glanz et al., 2005)

This study includes some components of the Glanz model. As seen in Figure 3 environmental variables of community nutrition environment, and consumer nutrition environment will be included as well as the perceived nutritional environment and eating patterns.

Figure 3

Adapted Glanz Model



Note: Model showing the association between the community and consumer environment and eating patterns whilst considering the link of the perceived nutrition environment (Glanz et al., 2005).

The model focuses on perceptions of two environmental settings. Firstly, the "Community Nutrition Environment" reflecting on factors that consumers encounter considering food stores and accessibility of fruit and vegetables is taken into account. Accessibility refers to "the location of the food supply and convenience of travelling to that location, which is commonly operationalised as proximity to identify food outlets" (Penney et al., 2014). This feature considers whether stores have an availability of fruit and vegetables according to a neighbourhood context and whether they are difficult to reach. These factors can be useful to identify important perceptive views that may indicate barriers of availability exist in relation to fruit and vegetable consumption (Pinho et al., 2017).

Secondly, the "Consumer Nutrition Environment" assessing the affordability and quality of produce consumers experience when shopping for fruit and vegetables within their neighbourhood is a key focus. Research indicates that a negative association exists between perceived fruit and vegetable costs and consumption. Affordability is often associated with lower diet quality or lower intake of fruit and vegetables (Mackenbach, 2019). This has a knock on effect for consumers, whereby the perception of cost influences the perceived view of quality of produce. The perception of quality available to individuals plays hand in hand with the perception of affordability. If low socioeconomic groups experience barriers in relation to cost, they will not be willing to spend money on low quality produce if that is all that is available, therefore choosing to spend money available on less nutritious, energy dense options (Williams et al., 2012). The organisational nutrition environment was not included in this study, referring to specific settings where defined groups of people consume food. In this case the home and whether family members influence the intake of fruit and vegetables which is rarely relevant for the age group considered (25-83 years). For this reason this variable was not considered as the age group of those included are not influenced as highly by their home setting (Rasmussen et al, 2006).

Rather than looking at all food environment variables included in the Glanz model, the following conceptual model adapted these nutritional environmental variables to SEP. The perception of having less access to foods can be attributed to various factors, due to neighbourhood characteristics but also income status and education, all acting as likely contributors to the socioeconomic pattern of inability to maintain a healthy diet due to the cost and accessibility of food (Mackenbach et al., 2019). Considering the food environment variables influence over eating patterns, income is also considered a major indicator in influencing eating patterns, in this case fruit and vegetable consumption. In order to show the influence of SEP on perceived nutrition environment, the consumer and community nutrition environment is looked at in terms of SEP, as seen in Figure 4. SEP acts as an influential factor of the perception of AAQ of fruit and vegetables, and these factors impact the eating behaviour of fruit and vegetable consumption. This study focuses on perceptions of fruit and vegetable AAQ to ultimately observe whether these perceptions create barriers to fruit and vegetable consumption and therefore diet inequities based on SEP.

Figure 4



Conceptual Model of SEP, AAQ Perceptions & Fruit and Veg Consumption

Note: Conceptual Model showing the association between the food environment and fruit and vegetable consumption whilst controlling for age and gender, and considering the link of SEP and perceptions of fruit and vegetable availability, affordability and quality

Chapter 4: Research Question:

This paper aims to investigate diet inequities by examining to what extent perceived barriers of AAQ of fruit and vegetables explain socioeconomic inequalities in fruit and vegetable consumption among adults in The Netherlands. This research aims to establish whether barriers exist in accessing, affording and obtaining high quality healthy foods between socioeconomic groups within society in The Netherlands, and to gain a better understanding of this phenomenon. This is achieved by considering three key research questions:

- To what extent do we observe socioeconomic inequalities in fruit and vegetable consumptions?
- To what extent do we see socioeconomic inequalities in perceptions of AAQ?
- Does the perception of AAQ of fruit and vegetables mediate the relationship between SEP and, fruit and vegetable consumption?

This paper hypothesises that:

- 1. SEP is a predictor of fruit and vegetable consumption, with a positive relationship between the two variables.
- 2. SEP is a predictor of perceptions in AAQ, with a positive relationship between the two variables.
- The perceptions of AAQ mediate the relationship between SEP and fruit and vegetable consumption.

Chapter 5: Methods

5.1 Description of the Research Design and Suitability to the Research Question

To investigate these mediation relationships a quantitative research design is used. To carry out this research a mediation analysis will be conducted using adapted data from a previously collected sample of the 2004 GLOBE study. This is suitable to our design because we want to use statistical methods to further understand the relationship between the variables using the conceptual model. The independent variable is SEP, represented as "household income", and the dependent variable is fruit consumption and vegetable consumption. The mediator is the combined perception of affordability, availability and quality of both fruit and vegetables, to represent potential barriers in relation to fruit and vegetable consumption. Age and gender acted as potential confounders.

5.2 Participants and Sampling

The data from the 2004 GLOBE "Health and Living Conditions" study questionnaire investigating the AAQ of fruit and vegetables from a neighbourhood context was utilized in this study. The GLOBE study aims to investigate mechanisms and underlying factors contributing to socioeconomic differences in health (van Lenthe et al., 2014). A cross-sectional sample was used in this study, with 4851 participants included in the analysis (Boeing, et al., 2012).

The sample population consisted of adults of 25 years of age and older, residing in the Netherlands at the time of the survey. Data was obtained among a stratified sample of the adult population (age 25–85yrs) from Eindhoven and surrounding cities.

Criteria for participation:

Those over the age of 25 were considered for this study. Participants also must have resided in The Netherlands at the time of the survey in order to be included.

5.3 Information and Strategies Used in Order to Gather Data

Data Collection Instrument(s)

Cross-sectional data from the 2004 GLOBE data set was obtained by a postal questionnaire among adults living in 168 neighbourhoods in the south-eastern Netherlands. This included a consistent series of questions for the purpose of gathering information from respondents in relation to perceptions of AAQ and fruit and vegetable consumption. These questions were asked in Dutch and then translated.

Measures:

Independent Variable: SEP Indicator (Household Income)

A potential range of factors were considered to represent SEP, referring to the social and economic factors that influence what positions individuals or groups hold within the structure of a society. Household income was used as an indicator of SEP. Income is a direct measure of material resources and therefore influences one's perceptions in order to afford, access and view quality of fruit and vegetables (Galobardes et al., 2006). The survey asked participants to indicate how high their household income was. This was answered through a 1-5 scale; 1 indicated "About 0-1200 euro a month", 2 "About 1200-1800 euro per month", 3 "About 1800-2600 euro a month", 4 "About 2600 or more a month" and 5 "Unknown/refuse to say". Net income was defined as household income after the subtraction of taxes, premiums, and pension contributions, with household income representative of individual SEP in this study. Dummy variables were conducted to create three levels of income, i.e., "high", "middle" and "low" income thresholds. These dummy variables were conducted using those indicating "About 0-1200 euro a month" and "About 1200-1800 euro per month" representing low income, "About 1800-2600 euro a month", representing middle income and "About 2600 or more a month" representing high income groups.

Fruit and vegetable intake were gathered separately and investigated as two separate variables for the full analysis. The intake of fruit and vegetables were investigated separately to distinguish between the two food groups.

Vegetable Intake

Based on the questionnaire to assess vegetable consumption, respondents were asked about their intake of both warm and cold vegetables. They were asked to indicate "*How often did you eat warm vegetables in the past month? (Days per week)*" followed by "*On a day you ate warm vegetables, how much did you take? (Serving spoons* = 50g)". The same was asked in relation to cold vegetables "*How often did you eat salad or raw vegetables in the past month? (days per week)*" followed by "*On a day you ate salad or raw vegetables, how much did you take? (Serving spoons* = 50g)".

Then total number of vegetable servings per week resulted in multiplying the two variables in relation to warm vegetables, with the same process carried out for cold vegetables, which were then added together resulting in the "total number of vegetables servings per week".

Fruit Intake

Based on the validated questionnaire to assess fruit consumption, respondents were asked to indicate "*On a day when you eat fruit, how many pieces do you generally eat in total?*" followed by "*On how many days a week (average) do you eat this total number of fruit in one day?*" These variables were representative of "total individual fruit consumption" whereby they were multiplied by each other, resulting in an "the total average weekly amount of pieces of fruit consumed".

Mediator: Combined Perceived AAQ of Fruit and Vegetables

The perceptions of participants were used as mediators for this study analysis. The perception of the ability to afford fruit and vegetables was questioned, whereby respondents were asked to indicate whether "vegetables are expensive" and "fruit is expensive" These were answered by respondents indicating whether the " $1 = Agree \ and \ 2 = Disagree$." This was followed by the perception of availability. Availability of fruit and vegetables was questioned whereby

respondents were asked to indicate whether "the shops I visit have a limited supply of vegetables in my neighbourhood" and "the shops I visit have a limited supply of fruit in my neighbourhood", this was answered by scale whereby "1 = Agree" and "2 = Disagree". The perception of fruit and vegetable quality was also questioned, whereby respondents were asked "In the shops I visit the vegetables has poor quality" and "In the shops I visit the fruit has poor quality." These were answered by respondents indicating whether they again "1 = Agree and 2 = Disagree."

All three perceptions representative of affordability, accessibility and quality of fruit and vegetables were added together and computed to create one combined variable representing "perception of barriers to vegetable consumption" and "perception of barriers to fruit consumption." Considering individual questions opting for answers 1 =Agree and 2 =Disagree. This ranged from 0-3, whereby 0 represents "perceiving 0 out of 3 barriers", 1 represents "perceiving 1 out of 3 barriers", 2 represents "perceiving 2 out of 3 barriers" and 3 represents "perceiving 3 out of 3 barriers" separately in relation to fruit and vegetable consumption. One's SEP may have an impact on having a low or high overall perceived barrier score . This suggests that perceiving no barriers, with having a high overall perceived barrier score suggesting perceiving all barriers.

Potential Confounders

"Age" and "Gender" were used as potential confounders for the analysis in both the linear regression and mediation analysis.

5.4 Data Management and Data Analysis Approach

SPSS was used to clean, analyse and present the data. Before the regression analyses were carried out, a descriptive analysis was conducted to explore the data. Frequencies were ran, where the mean and standard deviation were computed. Respondents who had missing data (those who refused to answer the question indicated or "Do not know" or "Unknown") on any dependent variable were excluded from the analyses.

Linear regression analyses were carried out to test whether household income was a predictor of fruit and vegetable consumption. Firstly, the analyses aimed to determine whether SEP affected vegetable consumption, followed by the same process for fruit consumption. This was then followed by mediation analysis, to investigate the relationship between household income and vegetable consumption mediated by the combined perception of AAQ of vegetables, the same mediation analysis was then conducted for fruit consumption.

Figure 5 shows the mediation analysis for vegetable consumption including associations between SEP and combined perception of AAQ (path a), associations of perceived barriers (AAQ) and vegetable consumption (path b) and associations of SEP and vegetable consumption (path c).

Figure 5

Mediation Model for Vegetable Consumption



Note: Mediation model showing the relationship between SEP (household income) and Vegetable consumption mediated by the combined perception of AAQ of Vegetables

Figure 6 shows the mediation analysis of fruit consumption including associations between SEP and potential mediators (path a). Associations of perceived barriers (AAQ) and fruit consumption (path b), associations of SEP and fruit consumption (path c).

Figure 6

Mediation Model for Fruit Consumption



Note: Mediation model showing the relationship between SEP (household income) and Fruit consumption mediated by the combined perception of AAQ of Fruit

Ethical aspects:

Ethical dilemmas may arise "regarding confidentiality, establishing informed consent, briefing and debriefing research participants, dealing with invasive techniques, deception, and safe storage of your data" (Bos, 2020). In order to minimise the risk of harm, data collected as part of the GLOBE study is collected anonymously, in order to protect the identities of participants. It is not only important to consider direct identifiers but also indirect identifiers, such as, information on workplace, occupation or exceptional values of characteristics like salary or age. A remote access system that is password protected allows for this and the GLOBE data is only given to those authorised to carry out research. Access must be granted on the basis of a pre-approved research plan and therefore data is not published to the general public. The use of personal data in the GLOBE study is in compliance with the Dutch Personal Data Protection Act and the Municipal Database Act and has been registered with the Dutch Data Protection Authority (registration number 1248943).

Chapter 6: Results

6.1. Participants Characteristics

Table 1 illustrates the socio-demographic characteristics of the sample population (N=4851). It shows that participants of the study were of an average age of 51.7 years (M=51.7) of which, were predominantly female (53.3%) and 45.4% were male. Considering all participants 41.9% were categorised as having a low household income (N=1717), 28.1% categorised as having a middle household income (N=1153) and 29.9% of the sample population was categorised as having a high household income (N=1126). Roughly half of the participants do not experience any of the AAQ barriers to vegetables or fruit (51,1% for vegetables, 48,7% for fruit). Around 40% of the participants experience one out of three AAQ barriers (39,4% for vegetables, 42,4% for fruit). This is then followed by 3.9% experiencing 2 AAQ barriers and 1% experiencing all three AAQ barriers in consuming vegetables, with 3.2% of participants experiencing 2 AAQ barriers and 0.8% experiencing all three AAQ barriers in consuming fruit. The mean intake of vegetables was 24.2 servings (SD 12.5) servings per week, with a mean intake of 10.25 (SD 7.6) servings of fruit per week.

Table 1

Socio-Demographic Characteristics of the Sample

Variable	Ν	%	Mean	SD
Gender	4851	100%	1.54	.498
Male	2171	45.4%	-	-
Female	2559	53.5%	-	-
*missing	55	1.1%		
Age (years)	4785	100%	51.7	37
*missing	2	0%	-	-
SEP (Household Income Level)	4096	100%	2.1	.839
High	1126	25.6%	.2993	.458
Middle	1153	28.1%	.2815	.449
Low	1717	41.9%	.4192	.493
*missing	-	-	-	-
Perceived Barriers to VEG	4567	95.4%	0.53	.632
0 barriers	2443	51.1%	-	-
1 barrier	1884	39.4%	-	-
2 barriers	188	3.9%	-	-
3 barriers	52	1%	-	-
*missing	218	4.6%	-	-
Perceived Barriers to FRUIT	4550	95.1%	0.54	.607
0 barriers	2329	48.7%	-	-
1 barrier	2028	42.4%	-	-
2 barriers	153	3.2%	-	-
3 barriers	40	0.8%	-	-
*missing	235	4.9%	-	-
Total Vegetable Consumption	3467	100%	24.2	12.5
(servings/week)				
*missing	1318	27.5%	-	-
Total Fruit Consumption	4540	100%	10.25	7.61
(servings/week)				
*missing	245	5.1%	-	-

6.2. Linear Regression Analysis

Table 2 shows the prediction of household income on vegetable consumption, controlled for age and gender. The table results show that there is no significant effect between household income and vegetable consumption. The middle income group and high income groups do not differ in their vegetable consumption from the low income group. The results suggest that individuals with high, middle, or low incomes did not differ in their vegetable consumption. Age is a significant predictor of vegetable consumption which suggests that the higher the age of the individual the higher their vegetable consumption.

Gender is not statistically significant which suggests it has no effect on vegetable consumption.

Table 2

Regression Analysis Summary for SEP (Household Income) Predicting Vegetable Consumption

Model	Unstandardis coefficients	ed S	Standardised coefficients				
	В	SE	β	t	р	95% CI (lower)	95% CI (higher)
(Constant)	20.990	.943		22.26	.000	19.142	22.838
High Income	.954	.542	.036	1.76	.078	109	2.017
Middle Incom	e143	.549	005	260	.795	-1.220	.934
Age	.058	.016	.065	3.53	.000	.026	.039
Gender	.012	.014	.015	.842	.400	016	.090

Note: this table shows age as significant value p < 0.05

Table 3 shows the prediction of household income on fruit consumption, controlled for age and gender. The regression results show that there is no significant relationship between SEP (household income) and fruit consumption. Individuals with high, middle, or low incomes did not differ in their fruit consumption. Age and gender are significant predictors of fruit consumption which suggests that the higher the age of the individual the higher their fruit consumption. Gender is statistically significant which suggests that fruit consumption may depend on the gender of the consumer.

Table 3

Model	Unstandard coefficie	ised nts	Standardised coefficients				
	В	SE	β	t	р	95% CI (lower)	95% CI (higher)
(Constant)	1.652	.631		2.617	.009	.414	2.889
High Income	.233	.286	.014	.817	.414	327	.794
Middle Incor	me .110	.289	.007	.378	.705	458	.677
Age	.098	.009	.181	11.476	.000	1.731	2.66
Gender	2.196	.237	.145	9.260	.000	.081	.115

Regression Analysis Summary for SEP (Household Income) Predicting Fruit Consumption

Note: This table shows age and gender as significant values p < 0.05

6.3 Mediation Analysis using PROCESS v3.5 by Andrew Hayes

Vegetable Consumption

Associations between SEP (household income) and Perceived Barriers (AAQ) (Path a)

Table 4 shows that there is a significant association between household income and the perception of AAQ of vegetables (B=.0912, p=.000). Therefore, household income is associated with perceived barriers of AAQ of vegetables. The effect is positive so the higher the household income, the less barriers people experience in the AAQ of vegetables.

Associations of Perceived Barriers (AAQ) and vegetable consumption (Path b)

Table 4 shows no significant association between the combined perceptions of AAQ of vegetables and, vegetable consumption (path b) (B=-.0558, p=.879) Therefore, perceived barriers of AAQ of vegetables are not associated with vegetable consumption.

Associations of SEP (household income) and vegetable consumption (Path c)

Table 4 shows the association between household income and vegetable consumption (path c) (B=-.4019, p=.1406). Therefore, household income is not associated with vegetable consumption.

Fruit Consumption

Associations between SEP (household income) and Perceived Barriers (AAQ) (Path a)

Table 4 shows no significant association between household income and the combined perception of AAQ of fruit (B=.0866, p=.4047). Therefore, household income is not associated with fruit consumption.

Associations of Perceived Barriers (AAQ) and fruit consumption (Path b)

Table 4 shows no significant association between the combined perception of AAQ of fruit and fruit consumption (B=.1819, p=.3625). Therefore, perceived barriers of AAQ of fruit is not associated with fruit consumption.

Associations of SEP (household income) and fruit consumption (Path c)

Table 4 shows no relationship between household income and fruit consumption (path c) (B=-.1052, p=.4654). Therefore, SEP is not associated with fruit consumption.

Table 4

Breakdown of Path Effects; including path a, b and c for Fruit and Vegetable Consumption

Mediation Results for Vegetable Consumption				
Path	Estimate	p	95% CI (lower)	95% CI (upper)
Effect of SEP (household income) on perception AAQ (path a)	B=.0912	.000	.0645	.1179
Effect of Perception of AAQ Vegetables on vegetable consumption (path b)	B=0558	.8790	7741	.6626
Effect of SEP (household income) on Vegetable Consumption	B=4019	.1460	9366	.1328
(path c)				
Mediation Results for Fruit Consumption				
Path	Estimate	р	95% CI (lower)	95% CI (upper)
Effect of SEP (household income) on perception AAQ (path a)	B=.0636	.4047	.0636	.1096
Effect of Perception of AAQ Fruit on Fruit Consumption (path b)	B=2097	.3625	2097	.5734
Effect of SEP (household income) on Fruit Consumption (path c)	B=3876	.4654	3876	.1773

After investigating for path a, b and c, mediation Table 5 shows the indirect effect of SEP on vegetable consumption through perceptive AAQ barriers of vegetable consumption. Table 5 also displays the indirect mediation of SEP on fruit consumption through perceptive AAQ barriers of fruit consumption (B= .0157) which is not statistically insignificant and thus the mediation effect between the combined perception of AAQ between SEP and fruit consumption does not exist.

Table 5

Indirect Effects of Household Income on both Fruit and Vegetable consumption mediated by the combined perception of AAQ of Fruit and Vegetables

Indirect Effect of SEP on Vegetable Consumption	Effect	Boot LLCI	Boot ULCI
Perception AAQ	005	077	.057
Indirect Effect of SEP on Fruit Consumption			
Perception AAQ	.015	019	.053

Table 6 shows the direct effects of household income on both fruit and vegetable consumption mediated by the combined perception of AAQ of fruit and vegetables. These results show that household income is not associated with vegetable or fruit consumption.

Table 6

Direct Effects of Household Income on both Fruit and Vegetable consumption mediated by the combined perception of AAQ of Fruit and Vegetables

Direct Effect of SEP on Vegetable Consumption	Effect	p value
Perception AAQ	3968	.1488
Direct Effect of SEP on Fruit Consumption		
Perception AAQ	1209	.4047

Chapter 7: Discussion

7.1 Main Findings

Findings show no significant relationship between SEP and fruit intake which was surprising therefore we find no evidence to support the first hypothesis. There was a significant relationship between household income and perceptions of AAQ of vegetables therefore we do find evidence to support the second hypothesis in relation to vegetables. There was no significant relationship between perceptions of AAQ and fruit and vegetable intake. Results from the mediation analysis suggest that the perception of AAQ may not be a mediator for the relationship between SEP and vegetable consumption. Based on this we find no evidence to support the third hypothesis.

7.2 Interpretation of Findings

Findings show that we do not observe a relationship between considering SEP as a predictor of fruit or vegetable consumption. To answer the research question "To what extent do we observe socioeconomic inequalities in fruit and vegetable consumption?" We do not observe SEP as a predictor of fruit and or vegetable consumption, that individuals with high, middle, or low incomes did not differ in their vegetable or fruit consumption. Results show that there were no significant socioeconomic inequalities in fruit and vegetable consumption. Significant results show that the older the age group, the higher the vegetable consumption. This could be attributable to older adults receiving a higher income when compared to younger adults, allowing a greater ability to afford fruit and vegetables.

Considering "To what extent do we see socioeconomic inequalities in perceptions (barriers) of AAQ?" the results show there was no evidence to suggest that there were socioeconomic inequalities in perceived barriers to consumption of fruit. However, there is evidence to suggest socioeconomic inequalities in perceived barriers to consumption of vegetables, whereby there is a relationship between SEP and perceptions of AAQ of vegetables. This suggests that household income has an effect on the perceived views of AAQ of vegetables, but no effect on the perceived views of AAQ of fruit.

Mediation analysis showed that SEP and vegetable consumption was not mediated by the combined perception of AAQ of fruit and vegetables. When investigating whether " the relationship between fruit and vegetable consumption is mediated by perceptions of AAQ barriers?" The results show that the perception of AAQ does not act as a barrier to fruit consumption between all three income groups. This suggests that differential views surrounding AAQ of produce between areas differing in their socioeconomic characteristics in The Netherlands do not play an important role in fruit and vegetable consumption.

The findings of this study suggest there is a relationship between SEP and perceived view of AAQ barriers of vegetables. This study suggests that SEP is not a predictor of fruit consumption and did not find that groups with high, middle, or low incomes differed in their fruit or vegetable consumption among adults in The Netherlands.

7.2 Discussion of the Findings in Light of other Research

In light of previous research, it is interesting that we did not find significant results apart from income and perceptions of AAQ of vegetables, which may suggest that income is not the only factor at play here. This suggests that we need to focus on other aspects and perhaps less on income when it comes to dietary equity. Considering other indicators of SEP i.e. education level or occupation status could be useful in carrying out further research. There may be broader social aspects at play that influence peoples diets. Also, you can see when looking at gender, this had an influence on fruit consumption, which suggests that future studies can investigate why gender influences whether individuals eat fruit.

Using the same 2004 GLOBE dataset as the present study, Giskes et al., 2005, found that neighbourhood environmental factors were not associated with fruit consumption within the Netherlands. Contrasting findings were found by Kamphuis et al., 2007, also using the 2004 GLOBE study, whereby findings showed that low SEP groups perceived barriers to accessibility and cost concerns in relation to fruit and vegetable consumption. The present study shows similar results to these findings when comparing vegetable consumption. However, this study shows contrasting results with no evidence of socioeconomic inequalities in perceived barriers to consumption of fruit. It is interesting that the case is not the same for fruit, which may suggest there are different barriers for fruit and vegetable consumption. The present study shows that household income has an effect on the perceived views of AAQ of vegetables.

7.2 Strengths and Limitations:

Strengths of this study:

Using a large sample (N= 4851) enabled a more precise conclusion to investigate whether diet inequalities influenced by perceptions of AAQ can be distinguished between SEP groups. Using a quantitative study design allowed for results to be broken down by socioeconomic groups for comparison in fruit and vegetable consumption. This study controlled for a couple of important demographic factors, age and gender.

Limitations of this study:

Using only income as an indicator of SEP acts as a limitation. Education could be used in future research to see if this has contrasting results in relation to predicting perceptions of AAQ. This study did not look at any cultural or demographical aspects of individuals which could have explanations for differences in SEP perceptions, which could be implemented in further research. Further mediators could also be included such as country of birth or considering ethnicity within the sample population to see whether this impacts SEP and therefore creating different results for consumption. Further limitations include using combined perceptive view of AAQ of fruit and vegetables. Constraints occur whereby the study does not show specific results for each perception of 1. Affordability, 2. Accessibility, and 3. Quality of fruit and vegetables leaving less specific causal results as barriers..

7.3 Implications and Recommendations Based on Findings

Despite consistent findings in studies from other countries such as the UK and USA, whereby living in a deprived area is often associated with lower fruit and vegetable intake. Influencing opting for less healthy foods and higher fat intakes, the present study suggests that SEP does not play a role in fruit and vegetable consumption among this sample of adults in The Netherlands. This suggests we may not need to focus on AAQ perceptions as mediators between income and fruit and vegetable consumption, and when combined they were not shown to be a significant mediator. But rather further research could aim to mediate behavioural competencies, environmental factors or socio demographic characteristics such as ethnicity.

Considering the limitations of using a combined perceptive barrier for AAQ, it may be useful for future research to investigate these three perceptions separately in order to see if as independent factors they have a higher or lower barrier effects in relation to fruit and vegetable consumption. Furthermore, there is little information provided about specific chronic health issues related to fruit and vegetable consumption, such as; high blood pressure, coronary heart disease and type II diabetes. Further research could aim to show the relationship low fruit and vegetable consumption has an on the onset on these preventable diseases (Boeing, et al., 2012).

7.4 Concluding Statements

This study suggests that SEP is not a predictor of fruit or vegetable consumption, whereby individuals do not differ in their perceived views in relation to affording, availing and obtaining high quality fruit and vegetables. Therefore, SEP does not indicate inducing barriers to fruit or vegetable consumption, with findings suggesting groups with high, middle, or low incomes did not differ in their fruit and vegetable consumption among adults in The Netherlands. Despite participants perceiving minimal AAQ barriers to fruit and vegetable consumption, intake levels of both fruit and vegetables are still below the recommended daily intake levels in the Netherlands. Further research is needed to understand this phenomenon. With SEP and barriers of AAQ shown not to have much effect on fruit and vegetable consumption, other mediators should be investigated. Implications for policy following this study may suggest that subsidies on healthy foods such as fruits and vegetables are likely to have a positive influence in healthy eating. Whilst consistently considering reasons for low intake levels which can be attributable to multiple reasons on multiple levels, i.e. individual lifestyle factors, social and community networks and environmental conditions (Dalhgren & Whitehead, 1991). It is for this reason that future research and policy should aim to focus on relevant areas of public health, sociology and behavioural sciences, in order to distinguish the intertwined reasons and complexities of this social health problem.

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Appendices

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Our Description Telephone	21-0460 030 253 46 33			
E-mail	FETC-fsw@uu.nl			
Date Subject	08 February 2021 Ethical approval			

ETHICAL APPROVAL

Study: To investigate diet inequities, considering socioeconomic differences in the perceptions of accessibility, affordability and quality of fruit and vegetable consumption among adults in The Netherlands

Principal investigator: C.C. Kelly

Supervisor: Carlijn Kamphuis

This student research project does not belong to the regimen of the Dutch Act on Medical Research Involving Human Subjects, and therefore there is no need for approval of a Medical Ethics Committee.

The study is approved by the Ethics Committee of the Faculty of Social and Behavioural Sciences of Utrecht University. The approval is based on the documents send by the researchers as requested in the form of the Ethics committee and filed under number 21-0460. The approval is valid through 28 June 2021. Given the review reference of the Ethics Committee, there are no objections to execution of the proposed research project, as described in the protocol and according to the GPDR It should be noticed that any changes in the research design oblige a renewed review by the Ethics Committee by submitting an amendement

Yours sincerely,



Peter van der Heijden, Ph.D. Chair

Syntax Used

summarizing income into low medium high

```
RECODE v277 (1 thru 2=3) (3=2) (4=1) (ELSE=SYSMIS) INTO Income_level.
VARIABLE LABELS Income_level 'Income_level categories'.
value labels Income_level 3 'Low' 2 'Middle' 1 'High'.
EXECUTE.
```

Income example making dummy variables

recode Income_level (1=1) (2 thru 3=0) into High. value labels High 0 'Other' 1 'High'. recode Income_level (1=0) (2=1) (3=0) into Middle. value labels Middle 0 'Other' 1 'Middle'. recode Income_level (1 thru 2=0) (3=1) into Low. value labels Low 0 'Other' 1 'Low'.

```
***recoding for perceptions of veg AAQ***
```

recode v211 (1=1) (2 thru 3=0) into Vegafford. value labels High 0 'Other' 1 'High'. recode v213 (1=0) (2=1) (3=0) into Vegsupply. value labels Middle 0 'Other' 1 'Middle'. recode v219 (1 thru 2=0) (3=1) into VegQual. value labels Low 0 'Other' 1 'Low'.

```
**recoding for perceptions of fruit AAQ**
```

```
recode v229 (1=1) (2 thru 3=0) into Fruitafford.
value labels High 0 'Other' 1 'High'.
recode v231 (1=0) (2=1) (3=0) into Fruitsupply.
value labels Middle 0 'Other' 1 'Middle'.
recode v237 (1 thru 2=0) (3=1) into FruitQual.
value labels Low 0 'Other' 1 'Low'.
```

** redoing recode for perception AAQ**

recode v211 (1=1) (2 thru 3=0) into Vegafford. value labels 'Agree' 0 'disagree' 1. recode v213 (1=0) (2=1) (3=0) into Vegsupply. value labels 'Agree' 0 'disagree' 1. recode v219 (1 thru 2=0) (3=1) into VegQual. value labels 'Agree' 0 'disagree' 1.

```
**regression vegetables**
GET
```

FILE='/Users/caoikel/Downloads/4th June Data.sav' PASSWORD='/w#q#X#B5j>A<~9u7N8y'. DATASET NAME DataSet1 WINDOW=FRONT. REGRESSION /MISSING LISTWISE /STATISTICS COEFF OUTS CI(95) R ANOVA /CRITERIA=PIN(.05) POUT(.10) /NOORIGIN /DEPENDENT vt /METHOD=ENTER High Middle Low v254 v255 /RESIDUALS HISTOGRAM(ZRESID).

regression fruit

REGRESSION /MISSING LISTWISE /STATISTICS COEFF OUTS CI(95) R ANOVA /CRITERIA=PIN(.05) POUT(.10) /NOORIGIN /DEPENDENT ft /METHOD=ENTER High Middle Low v254 v255 /RESIDUALS HISTOGRAM(ZRESID).

mediation vegetables

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