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Urban-rural differences in childhood overweight

A study on the relationship between the urbanity level of the living environment and overweight among German children

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Abstract

Overweight is a growing worldwide problem. It is not only prevalent in adults but also in children. Previous research suggests the urbanity level of the living environment as a factor that influences overweight levels. This research aims to exam the urban-rural differences in childhood overweight levels in order to better understand the causes of childhood overweight. The research question that is conducted is:

To what extent does the urbanity level of the living environment influence the chances of children (aged 2-17) being overweight in Germany?

To identify trends in German childhood overweight, this study made use of available literature on the childhood overweight and a statistical analysis of the KIGGS dataset. From this study can be concluded that there are no urban-rural differences in childhood overweight levels despite results from other studies that do suggest urban-rural differences. An explanation for this result might be differences between urban-rural distinctions. SES showed a negative effect on childhood overweight which is in line with other studies. Urban-rural differences were found in physical activity, this might be due to the environment that encourage or discourage children to be physically activununitee.

Keywords: urban-rural differences, urbanity level, living environment, childhood overweight, physical activity, socioeconomic status, Germany

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1. Introduction

1.1 Background

Obesity and overweight are growing worldwide problems (Zou et al, 2016). The amount of children and adults coping with obesity has increased during the last decades; in 1990 4.2% of the world population was diagnosed with obesity, while in 2010 this percentage had risen to 6,7% and it is expected to reach 9.1% in 2020 (Saeidlou et al., 2014). The growing amount of people having obesity has led to increasing health costs and more health risks (Zou et al., 2016). According to the World Health Organization (2018) are overweight and obesity linked to more deaths worldwide than underweight. Furthermore, overweight is associated with a reduced life-quality, a shorter life expectancy and several chronic diseases (Rosin, 2008).

Also, childhood overweight and obesity are growing in the last decades (WHO, 2018). Children who are overweight have a high chance of being overweight or obese during adulthood (Lifshitz, 2008). Also, obese children have a higher chance of developing type 2 diabetes and cardiovascular diseases at a young age (Lifshitz, 2008; WHO, n.d.). Further, food and health patterns developed during childhood might influence someone's later health patterns. Moreover obesity is a preventable disease and might be restraint if good health patterns are promoted during childhood (Lifshitz, 2008). Further, if intervention needs to be taken childhood is the best period to do so (Lifshitz, 2008).

Different causes are given for the growing amount of people being overweight and/or obese. Urbanization is one of the causes that is associated with more people being overweight (Neuman et al., 2013). This is mainly due to the more sedentary lifestyle that urban dwellers have (WHO, 2018). Also, the built environment and the amount of green space can influence the physical activity of people and therefore also overweight levels (Ewing et al, 2003). According to the United Nations (2018), 55% of the world's population is living in urban areas. This percentage will only rise in the future; in 2050 68% of the world's population is expected to live in urban areas (UN, 2018). With an increasing amount of people living in cities, the problem of people being overweight and obesity might rise even more.

In Germany, as in many other European countries, obesity and overweight in children is a well-known problem (WHO, n.d.). The WHO found that of the children aged 5-19 years, 6.9% of the girls and 11.2% of boys were obese in 2016 (The local, 2017).

There is done some research on urban-rural differences in childhood overweight (McMurray et al., 1999; Sjöberg et al., 2011; Zhang et al., 2014). However, none of these is done among German children. Also, most of the studies are done in non-European countries so it is hard to compare these results with the situation in Germany. Moreover, there is not done any research on urban-rural differences in childhood overweight where the KIGGS dataset is used.

Further might this research help to better understand the problem of childhood overweight and give implications for policy making. Policymakers could with the results of this research know whether they should focus on urban or rural children in their policies for preventing overweight in children. Also, they could take measures in the environment if necessary.

1.2 Research problem

This research aims to exam, through the use of secondary data, if there is a relationship between living in an urban or rural area and children being overweight. Therefore the following research-question is proposed: *To what extent does the urbanity level of the living environment influence the chances of children (aged 2-17) being overweight in Germany?*

This question will be answered through the use of the following sub-questions:

1. What is the relation between the urbanity level of the living environment and childhood overweight?
2. How does SES intermediate the effect of different urbanity levels of the living environment on childhood overweight levels?
3. To what extent is there an urban-rural difference in physical activity?

1.3 Thesis outline

After this introduction chapter, the research will continue with the theoretical framework in chapter 2. In this chapter, there is described what previous studies have published on childhood overweight and urban-rural differences in this. Also, the concepts used in this research are defined. In chapter 3, the method and data of the study are explained. This is done by describing the dataset that is used and the analysis of the data. In chapter 4, the results are elaborated for each sub-question. In Chapter 5, the results are discussed and connected to the theory that is discussed in the theoretical framework. Moreover, there is reflected on the research. Chapter 6 draws conclusions and tries to answer the research question. Also, there are made recommendations.

2. Theoretical framework

2.1 Life course approach

The life course approach is of increasing importance in how health and well-being are understood (Yu, 2006). This approach regards health as something that is influenced by someone's way of life (Yu, 2006: Kuh, 2014). This is done by risk behaviour, environmental influences but also protective factors play a role in someone health (Yu, 2006). The approach also provides an explanation for how early life experiences can influence someone's later life health outcomes (Yu, 2006; Kuh, 2014; WHO, n.d.). This also means that the environment to which a child is exposed has an impact on someone's later health life (Kuh, 2014). Further, the duration and timing of environmental exposures matter in how someone's health is affected (Kuh et al., 2004).

The life course approach can also be helpful in understanding overweight and obesity. Early life intervention for overweight and obesity is important, as overweight children have a high chance of becoming overweight adults (Kuh et al., 2004). Once present in adulthood, overweight and obesity are hard to treat diseases (Kuh et al, 2004). Consequently, childhood is an important period to intervene when necessary (Lifshitz, 2008).

2.2 Prevalence of overweight

Overweight and obesity occur when the balance between energy intake and energy consumption is disturbed in favour of energy intake (Rosin, 2008; WHO, 2018; Zou et al., 2016). Overweight and obesity levels have risen globally in the past decades across all age and socioeconomic groups also it affects both genders (Ewing et al., 2003; WHO, 2018).

According to the World Health Organization (2018) overweight and obesity have globally increased due to more consumption of energy-dense and high-fat foods and less physical activity. This might be the result of a change in lifestyles; we tend to participate more in inactive forms of work but also changes in transportation and urbanization have contributed to the rise in people that are overweight (WHO, 2018). While obesity and overweight were first considered as problems of high-income countries, it has now reached the middle- and low-income countries as well, particularly in urban areas (WHO, 2018).

Overweight and obesity is not something that only affects adults but also children. According to the World Health Organization (2014) 33% of the 11-year-olds in Europe are overweight or obese. Childhood overweight and obesity have several complications for children's health. In the short term, children might suffer from some chronic diseases like asthma (Lifshitz, 2008; CDC, 2018). Later, childhood overweight results in a higher chance of becoming overweight adults which is not only hard to treat but also increases the risk of heart diseases and diabetes (Kuh et al., 2004; CDC, 2018; Papoutsi, 2012). Moreover, childhood overweight and obesity can cause physiological harm, like a negative body image or social isolation (Lifshitz, 2008; Papoutsi, 2012). Because overweight has thus a substantial influence on the health of children in their current stage of life but also later in life, overweight should be seen in light of the life course approach.

There are different ways to define overweight and obesity. The World Health Organization (2018) defines overweight as a BMI equal or greater than 25 and obesity is defined as a BMI that is equal or greater than 30. However, this is used for adults and does not always apply in the same way for

children. Children are still growing and therefore the link between weight and height is different (Anderson & Butcher, 2006). Overweight and obesity of children are therefore measured differently. As with adults, there are several approaches to determine childhood overweight and obesity. The World Health Organization (2018) defines overweight for children between 5-19 years as BMI-for-age more than 1 standard deviation above the WHO growth reference. Obesity in children is defined as BMI-for-age greater than 2 standard deviations above the WHO growth reference median (WHO, 2018). Another way to measure childhood overweight and obesity is the Kromeyer-Hauschild reference system. This system defines overweight as exceeding the 90th percentile of childhood weight (Moreno et al., 2011). The advantage of using this reference system is that it is specially designed for children in Central Europe (Moreno et al., 2011).

2.3 Environmental influences

2.3.1 Urban-rural differences

Childhood overweight is influenced by many different aspects that range from genetics to the social-cultural environment (Wood et al., 2015; Papoutsi et al., 2012). However, considering the enormous growth of overweight and obesity in the last decades, the environment might play a role in this effect. An factor that is linked to overweight and obesity are urban-rural differences (Wood et al., 2015). There is an ongoing debate about whether inhabitants of urban areas are more likely to be overweight or obese or inhabitants of rural areas (Wood et al., 2015). According to different literature; urbanization is associated with higher obesity and overweight levels (Rosin, 2008; WHO, 2018). In the study of Zhang et al. (2014), there was found a link between overweight and obesity in children and adolescents in China. The level of children and adolescents with overweight or obesity increased for different levels of urbanization (Zhang et al., 2014). Besides, Zhang et al. (2014) found that this effect was stronger for boys than for girls. Further, Hyska et al. (2014) found the effect of urbanization on overweight and obesity levels for children in Albania. Zou et al. (2016) also report this link between urban areas and the prevalence of overweight and obesity in children and adolescents in their study in China. Yet, they also acknowledge the double burden of malnutrition. Neuman et al. (2013) found that BMI in less-developed countries was usually higher in urban areas. However, after there was corrected for SES, this effect turned out to be weaker.

On the other hand, there are also studies indicating that children and adolescents in rural areas are more likely to be overweight. McMurray et al. (1999) found that rural children had a 54.7% greater risk of becoming obese compared to their urban counterparts. Also, Joens-Matre et al. (2008) concluded that rural children have a higher chance of becoming overweight, during their study in the US. Further, childhood overweight and obesity are more prevalent in small towns and rural areas in Sweden (Sjöberg et al., 2011). This effect was smaller when there was corrected for SES. The negative effect of urbanity on childhood overweight is also found in Japan in the study of Itoi et al. (2012).

Urban-rural differences are thus found in several studies. However, with contradicting results. This might be due to the development level of a country (Itoi et al., 2012). This can also be seen in Table 1. More developed countries, where the development is very high based on the HDI, like the US, Sweden and Japan show a negative effect between urbanity and childhood overweight while the less developed countries, with only a high development, show a positive relationship between urban living and overweight (United Nations, w.d.).

Study	Effect of urbanity on overweight levels	Country	Development of the country based on the Human development index
McMurray et al. (1999)	Negative	United States	Very high
Sjöberg et al. (2011)	Negative	Sweden	Very high
Neuman et al. (2013)	Positive	38 low and middle-income countries	
Joens- Matre et al. (2008)	Negative	United States	Very high
Hyska et al. (2014)	Positive	Albania	High
Zhang et al. (2014)	Positive	China	High
Zou et al. (2016)	Positive	China	High
Itoi et al. (2012)	Negative	Japan	Very high
Saeidlou et al. (2014)	No difference	Iran	High

Table 1: Urban-rural overweight differences in various countries

In this research the distinction between urban and rural is important and thus there should be a clear distinction between different levels of urbanity. Germany is a densely populated country with around 230 inhabitants per km^2 (Spangenberg, 2010). Also, there are large differences between areas concerning the population size (Spangenberg, 2010). Further, there is no clear distinction between urban and rural (Spangenberg, 2010). However, to distinguish between different levels of urbanity; municipality size class is used. These are divided into four categories which are displayed in table 2 (Bangel et al., 2017).

Municipality size class	Inhabitants	Percentage of Germans living there
Rural	less than 5.000	15%
Small city	between 5.000-20.000	27%
Medium city	between 20.000-100.000	27%
Big city	more than 100.000	31%

Table 2: municipality size categories

2.3.2 Socio-economic status

An important factor predicting childhood overweight is socio-economic status (Wood et al., 2015). SES could influence someone's lifestyle and therefore their access to food and their physical activity which are related to overweight levels (Wang & Lim, 2012). SES for adults is based on their personal and economic resources (Johnson et al., 2019). However, the SES of children is mostly determined by the SES that is attained by their parents (Johnson et al., 2019). This results in parents influencing their children through a package of both genes and environment, which are also related to each other (Johnson et al., 2019).

Johnson et al. (2019) found that childhood SES is negatively associated with BMI in Germany and Minnesota (USA). Also, Sjöberg et al. (2011) found that obesity prevalence was more likely in areas with low SES compared to areas with high SES. This effect was also found in England where the rate of overweight children was almost twice as high in more deprived areas (National Obesity Observatory, 2010). This might be due to the finding that low SES is associated with less control over life in general and more stress which contributes to making poorer health choices (Johnson et al., 2019).

2.4 Factors that influence childhood overweight

2.4.1 Physical activity

Explanations for urban-rural differences in overweight levels are mostly given by differences in physical activity. According to Zhang et al. (2014) people in urban areas are more likely to have a lower physical activity than people in rural areas. Joens-Matre et al. (2008) found that urban children were the least active and children from small cities were the most active. The lower physical activity in urban areas can be explained through the limited urban green spaces and better access to public transportation (Gurwitz, 2014). According to Papoutsi et al. (2012) the limited green spaces and the street networks that are found in urban areas withhold people from walking and cycling. Also, Kuh et al. (2004) state that the activity of children and adolescents is influenced by the different characteristics of the environment. These characteristics include walkability, residential density and proximity of destinations (Kuh et al., 2004). This effect is also looked into by Ewing et al. (2003) who did research on the relation of urban sprawl and physical activity, obesity and morbidity in the United States and found that the urban environment influences physical activity and also health outcomes. In more sprawled areas, people were likely to exercise less and weigh more compared to more dense areas (Ewing et al., 2003). This suggests that the built environment has an effect on people's health behaviours which corresponds with the life-course approach that views the environment as one of the factors that influence health (Yu, 2006).

2.4.2 Access to food

Another factor that could explain the urban-rural differences in overweight prevalence, is the difference in access to food. Zhang et al. (2014) found that in rural areas in China the access to high-fat, energy-dense foods are more limited than in urban areas. Moreover, according to Gurtwitz (2014) children living in rural areas are more likely to eat whole foods rather than processed foods. Wang & Lim (2012) concluded in their study that SES-groups that have the highest chance to be obese are those who have greater access to energy-dense diets. This differs in developed and developing countries. In developed countries, low SES-groups have more access to energy-dense

foods while in developing countries, this relationship is the other way around (Wang & Lim, 2012). However, in the study of Arambepola et al. (2008) there was not found a link between the consumption of energy-dense food and BMI. Anyhow, dietary patterns are quite hard to measure because of the risk of misreporting; it might be hard for respondents to recall what and which amount of food they consumed (Favé et al., 2009). Therefore the access to food is not addressed in this research.

2.5 Conceptual model

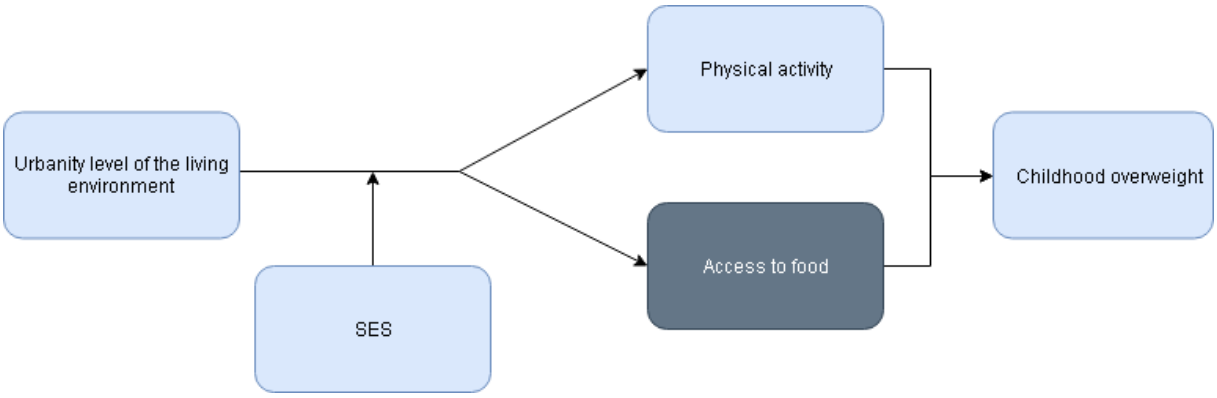

Figure 1: Conceptual model

The conceptual model visualizes how urban-rural differences in childhood overweight levels can be explained. The urbanity level of the living environment might influence childhood overweight through the effect it has on physical activity and/or access to food. SES might intermediate the effect of the living environment. In this research there will be looked into the effect of physical activity on childhood overweight. Access to food will not be addressed in this study because it is hard to measure and the data is not included in the KIGGS dataset.

2.6 Hypotheses

The hypothesis for this research is that the living environment influences the chances of children being overweight. Considering that Germany is a developed country and that in developed countries there is found a negative effect of living in urban areas and childhood overweight in several studies (Mcmurray et al., 1999; Sjöberg et al., 2011; Itoi et al., 2012; Joens-Matre et al., 2008), it is expected that in rural areas childhood overweight is more prevalent. The expectation is that this is due to the difference in offered food and/or the difference in physical activity for urban and rural children and adolescents. Further, it is expected that a higher SES will reduce the likelihood of childhood overweight.

3. Data & method

3.1 Method & population

In this research there will be done a quantitative analysis using secondary data. For this research, the KIGGS dataset is used. With this dataset a statistical analysis will be executed. With a statistical analysis it is possible to make statements over a larger population (Rahman, 2016). Moreover, a quantitative analysis gives accurate and precise results (Clifford et al., 2016). The population of this research is children aged 2-17 years living in Germany.

3.2 Data & data quality

The secondary data that will be used during this research is the German Health Interview and Examination Survey for Children and Adolescents (KIGGS) dataset. This dataset is conducted in the period May 2003 till May 2006 and the data of 17641 children is collected in the dataset (Kurth, 2007). The data was collected because there were no other recent studies that gave insight into the health of children in Germany (Kurth et al., 2008). The study was done at 167 different locations in Germany and to obtain the most accurate data, the parents also took part in the survey (Kurth, 2007). For the study, participants were selected by first selecting 167 locations where the study would be executed and from these locations the participants were chosen through a random selection of the residents' register (Kurth et al., 2008). The fact that the sample is randomly selected, improves the reliability of the study (Rahman, 2016). The study made use of questionnaires, which were filled in by the parents or the child itself, physical tests and a computer-assisted interview (Kurth et al., 2008). During the study the quality of the data was guaranteed through the use of a manual of operation and a detailed checklist (Filipiak-Pittroff & Wölke, 2007). However, the reliability of the data is hard to measure. Children are maybe not always aware of the exact situation and also for parents this might be a problem (Manz et al., 2019). However, the Robert Koch Institute was performing quality control measures to fulfil the quality requirements (Kurth et al, 2008).

Variable	**Scale**	**Values**	
Municipality size class	Ordinal	Rural	3913 (22,2%)
		Small city	4654 (26,4%)
		Medium city	5059 (28,7%)
		Big city	4014 (22,8%)

Age	Ordinal		Non-overweight	Overweight
		2-3	823 (90,4%)	87 (9,6%)
		4-5	1757 (91,4%)	166 (8,6%)
		6-7	1772 (87,4%)	255 (12,6%)
		8-9	1762 (84,1%)	334 (15,9%)
		10-11	1704 (82,5%)	362 (17,5%)
		12-13	1620 (80,6%)	389 (19,4%)
		14-15	1630 (83,0%)	333 (17,0%)
		16-17	1453 (82,9%)	299 (17,1%)
Gender	Nominal (binary)		Non-overweight	Overweight
		Boy	6390 (51.0%)	1140 (51,2%)
		Girl	6131 (49,0%)	1085 (48,8%)
Overweight (P>90 Kromeyer-	Nominal (binary)	Yes	2225 (15,1%)	

Hauschild)		No	12521 (84,9%)			
SES (Winkler index)	Ratio		Mean	S.E.	Min	Max
		Winkler index score	11,44	4,34	3	21
Physical activity (amount)	Ordinal	(Almost) every day	● 1596 (23,9%)			
		3-5 times a week	● 2072 (31,1%)			
		About 1-2 times a week	● 1982 (29,7%)			
		About 1-2 times a month	● 361 (5,4%)			
		Not	● 655 (9,8%)			
Physical activity (hours/week)	Ratio		Mean	S.E.	Min	Max
	5766 cases included	Hours per week	7,04	7,55	0	96

Table 3: variables that are used in the analysis

In the dataset that is used, there are 17641 cases included. For the variable overweight, there are 2894 missing cases. The percentage of children that are overweight using the Kromeyer-Hauschild reference is 15,1%. In Table 3 the frequency of different living environments is represented. This does not exactly correspond with the data from Table 2 however, the differences are small and the number of respondents is large enough to regard the sample as representative.

The variables that will be used are presented in table 3. As variable for overweight there is chosen for 'overweight (P>90 using Kromeyer-Hauschild)'. This is a binary variable, where the options were 'yes' or 'no'. This variable is chosen as the dependent variable because the Kromeyer-Hauschild reference system is especially focused on children in Central-European countries (Moreno et al., 2011).

As a SES-variable, the Winkler-index score is used. This variable bases the socio-economic status of a child on different SES-factors of its parents. There are three SES-factors of the parents that are taken into account; the education level, household income and the occupation (Winkler & Stolzenberg, 2009). These factors will together provide a score between 3 and 21, the classification of these scores are described in table 4 (Winkler & Stolzenberg, 2009).

	Score
Low SES	3 till 8
Moderate SES	9 till 14
High SES	15 till 21

Table 4: classification of the Winkler index score.

3.3 Data analysis

The data will be analysed with the use of SPSS. In the statistical analyses of the data, the variable that indicates overweight 'overweight (P>90 using Kromeyer-Hauschild)' will be used as the dependent variable. This dependent variable is a dummy which makes it possible to carry out a logistic regression (Venhorst, 2017). As independent variables, the municipality size class, sex, age group, physical activity & physical activity (hours/week) will be used. Also, the variable 'Winkler index-score' will be used as an independent variable to correct for socio-economic status. There will be carried out a hierarchical logistic regression to measure the effect of the urbanity level of the living environment on childhood overweight and to control for SES and demographic characteristics.

Further, there will be looked at possible urban-rural differences in physical activity. This will be done by comparing the means of the different urban-rural groups using a one-way ANOVA.

In this research, there will not be looked at the eating behaviour of children, which also influences the chances to be overweight. This is due to the fact that it is hard to measure the eating behaviour of children. Also, defining healthy and unhealthy food is difficult.

4. Results

4.1 The living environment and childhood overweight

It is expected that children in rural areas in Germany are more likely to be overweight and that overweight levels will rise with decreasing levels of urbanity. To answer the question 'What is the relation between the urbanity level of the living environment and childhood overweight?' the percentage of children being overweight for different levels of urbanity are visualized in Figure 2. From this figure there cannot be drawn scientific conclusions. However, there can be seen that there are only small differences in childhood overweight for different levels of urbanity. To measure if there are any rural-urban differences in the chances of children to be overweight, a hierarchical logistic regression was carried out. This test showed that there was no relation between the urbanity level of the living environment and childhood overweight. In the first model where only level of urbanity was taken into account (Table 5), all the different levels of urbanity showed a non-significant effect. This would mean that the urbanity level of the living environment does not influence the chances for children to be overweight.

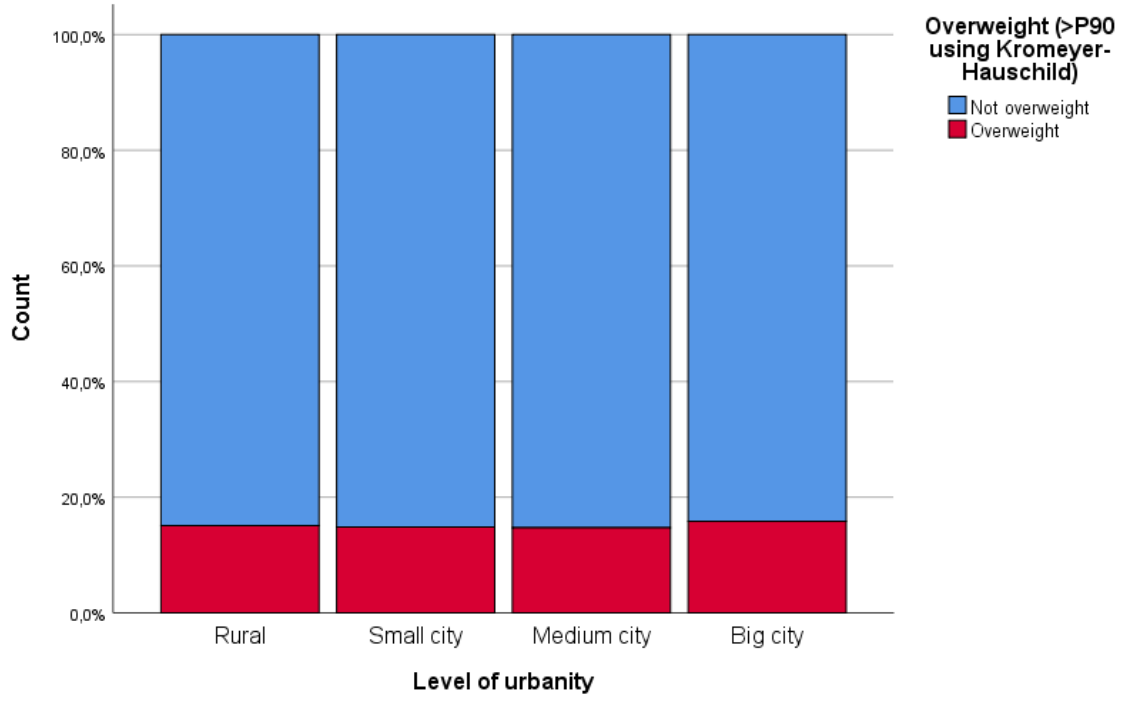

Figure 2: Percentages of respondents being overweight in different living environments

Model and predictors	B	S.E.	Wald	Nagelkerke R square	Sig	Exp (B)
Model 1				0,000		
Level of urbanity (rural =reference)			2,912		0,405	
Small city	-0,012	0,067	0,030		0,862	0,988
Medium city	-0,033	0,066	0,245		0,620	0,968
Big city	0,074	0,069	1,142		0,285	1,076
Model 2				0,023		
Level of urbanity (rural =reference)			3,256		0,354	
Small city	0,031	0,068	0,215		0,643	1,032
Medium city	-0,004	0,067	0,003		0,956	0,996
Big city	0,104	0,069	2,241		0,134	1,110
SES (using winkler-index)	-0,076	0,006	180,268		0,000	0,926
Model 3				0,023		
Level of urbanity (rural =reference)			3,241		0,356	
Small city	0,031	0,068	0,213		0,645	1,032
Medium city	-0,004	0,067	0,003		0,955	0,996
Big city	0,104	0,069	2,230		0,135	1,109
SES (using winkler-index)	-0,076	0,006	180,239		0,000	0,926

Gender	-0,012	0,047	0,070		0,791	0,988
Model 4				0,040		
Level of urbanity (rural =reference)			2,697		0,441	
Small city	0,030	0,068	0,190		0,663	1,030
Medium city	-0,008	0,067	0,014		0,906	0,992
Big city	0,092	0,070	1,749		0,186	1,097
SES (using winkler-index)	-0,076	0,006	177,638		0,000	0,926
Gender	-0,011	0,047	0,052		0,820	0,989
Agegroup (2-3Y = reference)			128,57		0,000	
4-5Y	-0,095	0,141	0,456		0,500	0,909
6-7Y	0,332	0,133	6,261		0,012	1,394
8-9Y	0,597	0,129	21,385		0,000	1,816
10-11Y	0,679	0,128	27,974		0,000	1,972
12-13Y	0,808	0,128	39,983		0,000	2,244
14-15Y	0,672	0,130	26,920		0,000	1,959
16-17Y	0,689	0,131	27,451		0,000	1,99

Table 5: Hierarchical logistic regression including level of urbanity, SES, gender & age.

4.2 SES and childhood overweight

Because research suggests that SES might play a role in childhood overweight differences, SES, measured in the combined Winkler-index score, was included in the second model. From the results of the regression shown in Table 5 can be concluded that SES changes the effect of the level of urbanity of the living environment on childhood overweight however these differences are still non-significant. Contrarily, SES gives a significant result (P<0,0005) with B = -0,076. This means that socioeconomic status influences childhood overweight negatively. A higher SES thus reduces the chance that children become overweight. However, the effect is relatively small (Exp(B)=0,926). The effect of SES for different levels of urbanity is visualized in Figure 3. From this figure, there can be derived that for every level of urbanity, the Winkler-score of non-overweight children is higher than those of their overweight counterparts. Further can be derived that there are no major differences in SES between the different levels of urbanity.

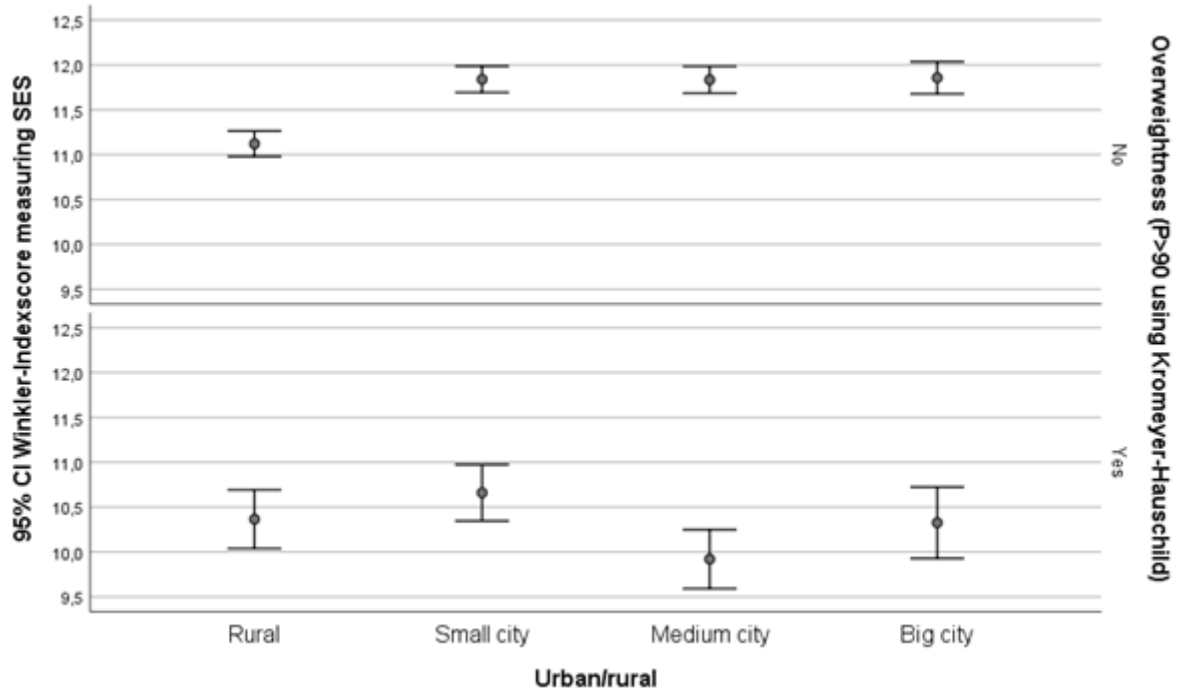

Figure 3: Winkler index score for different levels of urbanity for overweight and non-overweight children.

4.3 Demographic characteristics

The influence of gender on overweight levels has also been tested in the logistic regression. In Table 4 can be seen that there is no significant difference (P=0,820) in overweight when comparing genders.

Age, on the other hand, turned out to have an effect on overweight. There was a significant difference between age groups. In the study, the 2-year-age-groups are used. With the age group 2-3-year-olds serving as a reference category, significant differences were found for all the other age groups except 4-5-year-olds, which is shown in Table 5. The effect differs for the different age groups but 12-13-year-olds are most likely to be overweight compared to 2-3-year-olds. Children in this age group are more than 2 times (Exp(B)=2,244) as likely to be overweight than 2-3-year-olds .

4.4 Physical activity and childhood overweight

The relationship between physical activity and childhood overweight was measured in a logistic regression. The results of the logistic regression are visualized in Table 6. From this table can be derived that there is a significant difference (P<0,0025) in overweight between children who are 'almost every day' physically active and those who are 'not' physically active. It turns out that children who participate in physical activity almost every day are 69,6% (Exp(B)=0,696) less likely to be overweight compared to children who are not physically active.

	B	S.E.	Wald	Nagelkerke R Square	Sig.	Exp(B)
				0,004		
Physical activity (not = reference)			16,18		0,003	
Almost every day	-0,363	0,12	9,18		0,002	0,696
3-5 times a week	-0,25	0,114	4,843		0,028	0,779
1-2 times a week	-0,082	0,113	0,527		0,468	0,921
1-2 times a month	-0,019	0,163	0,014		0,907	0,981

Table 6: logistic regression with physical activity

Also, there is done a logistic regression with another variable indicating physical activity. This variable measures the hours of physical activity per week. However, this logistic regression does not show a significant effect of physical activity on childhood overweight levels which is made visible in Table 7. A reason for this difference might be that physical activity in hours per week might be hard to recall or might be interpret differently by the respondents.

	B	S.E.	Wald	Nagelkerke R Square	Sig.	Exp(B)
Physical activity (hours/week)	0,005	0,004	1,412	0,000	0,235	1,005

Table 7: logistic regression with physical activity (hours/week)

To measure if there were any urban-rural differences in the hours of physical activity per week there was done a one-way ANOVA test which is visualized in Table 8. There was found a significant difference (P<0,0015) between physical activity in rural areas and small cities. Children in rural areas tend to get more physical activity than children living in small cities. This can also be seen in Figure 4. Further, there can be seen that rural children in Germany have the highest amount of hours of physical activity per week and children from small cities have the lowest amount. For medium and big cities there were not found differences.

(I) Urban/rural	**(J) Urban/rural**	**Mean Difference (I-J)**	**Std. Error**	**Sig.**	**95% Confidence Interval**	
					Lower Bound	**Upper Bound**
Rural	Small city	1,116*	0,286	0,001	0,36	1,87
	Medium city	0,416	0,28	0,825	-0,32	1,16
	Big city	0,749	0,295	0,066	-0,03	1,53
Small city	Rural	-1,116*	0,286	0,001	-1,87	-0,36
	Medium city	-0,7	0,269	0,056	-1,41	0,01
	Big city	-0,367	0,284	1	-1,12	0,38
Medium city	Rural	-0,416	0,28	0,825	-1,16	0,32
	Small city	0,7	0,269	0,056	-0,01	1,41
	Big city	0,333	0,279	1	-0,4	1,07
Big city	Rural	-0,749	0,295	0,066	-1,53	0,03

	Small city	0,367	0,284	1	-0,38	1,12
	Medium city	-0,333	0,279	1	-1,07	0,4

* The mean difference is significant at the 0.05 level.

Table 8: One way ANOVA comparing means of hours of physical activity per week for different levels of urbanity.

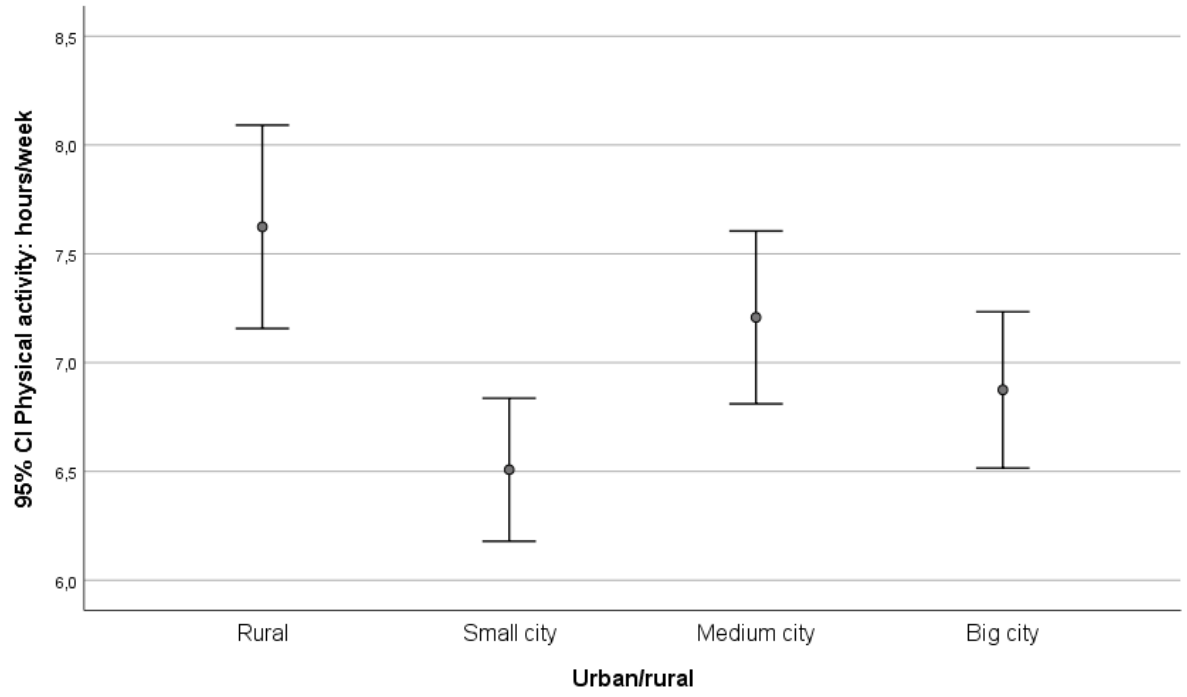

Figure 4: Physical activity levels for children divided by different levels of urbanity

5. Discussion

5.1 The living environment and childhood overweight

This study indicates that there are no urban-rural differences in Germany considering childhood overweight. Based on the literature this outcome is surprising because other studies found a link between childhood overweight and the urbanity level of the living environment. However, the direction of this link was not clear. In studies that were carried out in countries with a HDI below 'very high', there was found that children in urban areas were more likely to be overweight (Neuman et al et al., 2013; Hyska et al., 2014; Zhang et al., 2014; Zou et al., 2016). While on the other hand, studies in countries with a very high HDI reported that children in rural areas were more likely to be overweight (McMurray et al., 1999; Sjöberg et al., 2011; Joens- Matre et al., 2008; Itoi et al, 2012). As Germany is classified as a developed country with a very high HDI (UN, 2016), there could be expected that childhood overweight would be more prevalent in rural areas. Yet, the same outcome (no urban-rural difference) was only reported in the study of Saeidlou et al. (2014) who studied the effect of urbanity on childhood overweight in Iran.

The fact that there is found no urban- rural difference in childhood overweight in Germany can be explained by its demographic characteristics. There might be country-level differences in how 'urban' and 'rural' is defined, this is for example the case when comparing Germany and United States (Ingram & Franco, 2012). Furthermore, unlike the United States and Sweden, developed countries were urban-rural differences were found, Germany is a densely populated country (World population review, 2019). Therefore, the differences between urban-rural might be smaller than in sparsely populated countries. The relatively small difference between urban and rural might result in minor or ineffective urban-rural differences in physical activity and/or access to food. Further, cultural differences between countries might play a role in childhood overweight, for example the access to food or food preferences could differ between cultures (Kumanyika, 2008).

5.2 SES and childhood overweight

The negative effect of SES on childhood overweight that was found, confirms the study of Sjöberg et al. (2011) that studied the effect of SES on overweight and found that low SES is an indicator for childhood overweight. The result is also in line with the findings of Johnson et al. (2019) who found a negative relationship between childhood SES and BMI in Germany. This relationship might be due to the fact that persons with lower SES experience less control in life which sometimes leads to choices that undermine their health (Johnson et al., 2019).

5.3 Physical activity and childhood overweight

The lowest level of physical activity was found in small cities. This finding contradicts the findings of Joens-Matre et al. (2008) who found during a study in the United States that children from small cities had the highest levels of physical activity. This difference might be due to how 'urban' and 'rural' is measured. In the United States there are different classifications for urban and rural (Ingram & Franco, 2012). Moreover, Germany and the United States differ in the share of children that are overweight (Lissau et al., 2004). Also, difference in the built environment might cause these difference (Ewing et al., 2003). Further might cultural differences play a role in physical activity levels (Haase et al., 2004). This might also be the reason why this study does not correspond with the study

of Itoi et al. (2012) who found that rural children in Japan were less physically active compared to urban children while the results of this study show that rural children are the most active. Itoi et al. (2012) suggest this is due to urban-rural differences in walking to school. The difference between Japan and German might be the effect of German children having other transportation habits when going to school. Further, the research only takes into account 11 and 12-year-olds while this research focuses on children aged 2-17 years.

On the other hand, correspond the differences in physical activity in different environments with Kuh et al. (2004) and Ewing et al. (2003) who state that the characteristics of the environment influence the physical activity of children.

5.4 Reflection

During the data analysis, there were several difficulties. The dataset that was used was in German so this had to be translated to English. Further, the first intention was to use BMI as the dependent variable that indicates overweight. However, this was not possible because there could not be determined if children were overweight or not since the exact age of the children was necessary to do so and in the dataset the age of children was sorted in categories.

Another difficulty which was encountered during the research, was the amount of missing cases for the variables physical activity & physical activity (hours/week). Because it is not possible to exclude the variables pairwise, these variables are not included in the hierarchical logistic regression but are tested in a separate logistic regression.

Additionally, it was not always clear how some of the questions were classified. For example, it was hard to find how the different levels of urbanity were defined. Further, it was intended to also measure the access to food however this turned out to be hard to measure. Moreover, as Germany is a densely populated country, differences in access to food might be non-existent or ineffectual.

6. Conclusion

6.1 Conclusion

In this research the link between childhood overweight and the urbanity level of the living environment in Germany is studied. The results suggest that there are no urban-rural differences in childhood overweight despite other studies that did find a difference. This could be explained by country-level differences in the distinction between urban and rural. When there was controlled for SES, still no significant urban-rural differences were found. However, SES does have a negative effect on childhood overweight, which was the effect that was expected. It can thus be concluded that a higher SES decreases the chances for a child to be overweight.

Additionality, urban-rural differences in physical activity were examined because physical activity is related to overweight. There is found a significant difference between physical activity in rural areas and small cities. Rural children tend to get the most physical activity while children from small cities are getting the lowest amounts of physical activity. While it could be expected that this would then create urban-rural differences in overweight levels this is not the case.

Moreover, the influence of some demographic characteristic on childhood overweight was tested. Gender does not seem to influence overweight while age does have an effect on childhood overweight. It turns out that 12-13-year-olds are most likely to be overweight compared to other age groups.

Altogether, it can be concluded that the urbanity level of the living environment does not influence the chances of children to be overweight in Germany. Contradictingly, the urbanity level does influence the amount of physical activity that children are getting. Further, there can be assumed that SES is negatively related to childhood overweight.

6.2 Recommendations

From this research can be concluded that there is no relationship between the living environment and childhood overweight in Germany while differences were found in other countries. For future research it could be interesting to look into the differences between countries. Also, in this research access to food is not taken into account while it could be interesting to examine urban-rural differences in this in future studies.

Another conclusion that can be drawn from this research is that rural children are the most active while children from small cities are the least active. It could be interesting to find the underlying causes of this phenomenon so that policies can be adjusted to prevent childhood overweight in the future.

7. References

Anderson, P. & Butcher, K. (2006). Childhood Obesity: Trends and Potential Causes. *Future of Children* Volume 16 (1), 19-45.

Arambepola, C., Allender, S., Ekanayake, R., & Fernando, D. (2008). Urban living and obesity: is it independent of its population and lifestyle characteristics? *Tropical medicine & international health*. Volume 13 (4), 448-457.

Bangel, C., Faigle, P., Gortana, F., Loos, A., Mohr, F., Speckeier, J., Stahnke, J., Venohr, S. & Blickle, P. (2017). Diving into Urban-rural prejudice. *Zeit Online,* 20-09-2017.

Center for disease control and prevention (2018). *Childhood obesity facts*. Retrieved on 29-4-2019 from https://www.cdc.gov/healthyschools/obesity/facts.htm

Clifford, N. J., Cope, M., Gillespie, T. W. and French, S. (2016). *Key methods in geography*. 3rd edition. London: SAGE.

Ewing, R., Schmid, T., Killingsworth, R., Zlot, A. & Raudenbush, S. (2003). Relationship between urban sprawl and physical activity, obesity and morbidity. *American Journal of Health Promotion.* Volume 18 (1), 47-57.

Favé, G., Beckmann, M. E., Draper, J. H., & Mathers, J. C. (2009). Measurement of dietary exposure: a challenging problem which may be overcome thanks to metabolomics?. *Genes & nutrition*. Volume 4 (2), 135–141.

Filipiak-Pittroff, B. & Wölke, G. (2007). External quality assurance in the German Health Interview and Examination Survey for Children and Adolescents (KiGGS): Procedure and results. *Gesundheitsschutz.* Volume 50, 573-577.

Gurwitz, A.(2014). The spreading worldwide obesity epidemic. *Journal of Community Health*. Volume 39 (5), 827.

Haase, A., Steptoe, A., Sallis, J. F., & Wardle, J. (2004). Leisure-time physical activity in university students from 23 countries: associations with health beliefs, risk awareness, and national economic development. *Preventive medicine*. Volume 39 (1), 182-190.

Hyska, J.; Mersini, E.; Mone, I. & Burazeri, G. (2014). Prevalence and demographic correlates of overweight and obesity among children in a transitional southeastern European population. *Journal of Community Health.* Volume 39 (5), 828-834.

Ingram, D. D., & Franco, S. J. (2012). NCHS urban-rural classification scheme for counties. *Vital and health statistics. Series 2, Data evaluation and methods research*. Volume 154, 1-65.

Itoi, A., Yamada, Y., Watanabe, Y., & Kimura, M. (2012). Physical activity, energy intake, and obesity prevalence among urban and rural schoolchildren aged 11–12 years in Japan. *Applied Physiology, Nutrition, and Metabolism*. Volume 37 (6), 1189-1199.

Joens-Matre, R.; Welk, G.; Calabro, M.; Russel, D.; Nickaly, E.; Hensley, L. (2008). Rural-urban differences in physical activity, physical fitness and overweight prevalence of children. *The journal of rural health.* Volume 24 (1).

Johnson, W., Hahn, E., Gottschling, J., Lenau, F., Spinath, F. M. and McGue, M. (2019). Ses-Of-Origin and BMI in Youth: Comparing Germany and Minnesota. *Behavior Genetics : An International Journal Devoted to Research in the Inheritance of Behavior*. Volume 49(1), 24–48.

Kuh, D. (2014). *A life course approach to healthy ageing*. First edition. New York, NY: Oxford University Press.

Kuh, D., Ben-Shlomo, Y. and Ovid Technologies, Inc (2004). *A life course approach to chronic disease epidemiology*. 2nd edition. Oxford: Oxford University Press.

Kumanyika, S. K. (2008). Environmental influences on childhood obesity: ethnic and cultural influences in context. *Physiology & behavior*. Volume 94 (1), 61-70.

Kurth, b. (2007). The German Health Interview and Examination Survey for Children and Adolescents (KiGGS): an overview of its planning, implementation and results taking into account aspects of quality management. *Gesundheitsschutz.* Volume 50, 533-546.

Kurth, B., Kamtsiuris, P., Hölling,H., Schlaud, M., Dölle, R., Ellert, U., Kahl, H., Knopf, H., Lange, M., Mensink, G., Neuhauser, H., Schaffrath Rosario, A., Scheidt-Nave, C., Schenk, L., Schlack, R., Stolzenberg, H., Thamm, M., Thierfelder, W., & Wolf, U. (2008). The challenge of comprehensively mapping children's health in a nation-wide health survey: Design of the German KiGGS-study. *BMC Public Health.* Volume 8 (1), 1.

Manz, K., Mensink, G., Finger, J. D., Haftenberger, M., Brettschneider, A. K., Lage Barbosa, C. & Schienkiewitz, A. (2019). Associations between Physical Activity and Food Intake among Children and Adolescents: Results of KiGGS Wave 2. *Nutrients*, Volume 11 (5), 1060.

McMurray, R.; Harrell, J.; Bangdiwala, S. & Deng, S. (1999). Cardiovascular disease risk factors and obesity of rural and urban elementary school children. *The journal of rural health.* Volume 15 (4), 365-374.

Moreno, L.; Pigeot, I.; Ahrens, W. (2011). *Epidemiology of obesity in children and adolescents: prevalence and etiology*. Springer Science & Business Media.

National Obesity Observatory (2010). *Child Obesity and Socioeconomic Status.* NOO: Oxford.

Neuman, M., Kawachi, I., Gortmaker, S., Subramanian, S. (2013). Urban-rural difference in BMI in low- and middle-income countries: the role of socioeconomic status. *The American Journal of Clinical Nutrition.* Volume 97 (2), 428-436.

Lifshitz, F. (2008). Obesity in Children. *Journal of Clinical Research in Pediatric Endocrinology.* Volume 1 (2), 53-60.

Lissau, I., Overpeck, M. D., Ruan, W. J., Due, P., Holstein, B. E., & Hediger, M. L. (2004). Body mass index and overweight in adolescents in 13 European countries, Israel, and the United States. *Archives of pediatrics & adolescent medicine*. Volume 158 (1), 27-33.

Papoutsi, G., Drichoutis, A. & Nayga, R. (2012). The causes of childhood obesity: a survey. *Journal of Economic Surveys.* Volume 27 (4), 743-767.

Rahman, S. (2016). The Advantages and Disadvantages of Using Qualitative and Quantitative Approaches and Methods in Language "Testing and Assessment" Research: A Literature Review. *Journal of Education and Learning*. Volume 6, 102-106.

Rosin, O. (2008). The economic causes of obesity: a survey. *Journal of Economic Surveys.* Volume 22 (4), 617-647.

Saeidlou, N., Babaei, F. & Ayremlou, P. (2014). Malnutrition, overweight and obesity among urban and rural children in north of west Azerbijan, Iran. *Journal of obesity.* Volume 2014.

Sjöberg, A., Moraeus, L., Yngve, A., Poortvliet, E., Al-Ansari, U. & Lissner, L. (2011). Overweight and obesity in a representative sample of schoolchildren: exploring the urban–rural gradient in Sweden. *Obesity Reviews.* Volume 12 (5).

Spangenberg, M. (2010). Germany urban/rural typology: diversities of rural areas in Europe and beyond. *Federal Institute for research on building, urban affairs and spatial development*.

The local (2017). *'Too many German kids are overweight': WHO calls for tighter ad restrictions.* Retrieved on 14-03-2019 from https://www.thelocal.de/20171229/too-many-german-kids-are-overweight-who-calls-for-tighter-ad-restrictions

United Nations (2018). *68% of the world population projected to live in urban areas by 2050, says UN.* Department of economic and social affairs. 16-05-2018. Retrieved on 25-02-2019 from https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html

United Nations (2016). Human Development Index Trends, 1990-2017. Retrieved on 27-5-2019 from http://hdr.undp.org/en/composite/trend

Venhorst, V. (2017). College 7: Binaire logistische regressie. *Statistiek 2.* 13-03-2017. University of Groningen.

Wang, Y. & Lim, H. (2012). The Global Childhood Obesity Epidemic and the Association between Socio-Economic Status and Childhood Obesity. *International review of psychiatry (Abingdon, England)*. Volume 24(3), 176–188.

Winkler, J. and Stolzenberg, H., 2009. *Adjustierung des Sozialen-Schicht-Index für die Anwendung im Kinder-und Jugendgesundheitssurvey (KiGGS)* (No. 07/2009). Wismarer Diskussionspapiere.

Wood, S.; Demougin, P.; Higgins, S.; Husk, K.; Wheeler, B.; White, M. (2016). Exploring the relationship between childhood obesity and proximity to the coast: a rural/urban perspective. *Health & Place.* Volume 40, 129-136.

World Health Organization (2018). *Obesity and overweight.* 16-02-2018. Retrieved on 21-02-2019 from https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

World Health Organization (n.d.). *Childhood overweight and obesity.* Retrieved on 26-02-2019 from https://www.who.int/dietphysicalactivity/childhood/en/

World Health Organization (n.d.). *Obesity: data and statistics.* Retrieved on 29-4-2019 from http://www.euro.who.int/en/health-topics/noncommunicable-diseases/obesity/data-and-statistics

World Population Review (2019). *Germany Population 2019.* Retrieved on 13-5-2019 from http://worldpopulationreview.com/countries/germany-population/

Yu, S. (2006). The Life-Course Approach to Health. *American Journal of Public Health.* Volume 96 (5), 768–768.

Zhang, Y. X., Zhao, J. S., & Chu, Z. H. (2014). Prevalence of overweight and obesity among children and adolescents is associated with urbanization in Shandong, China. *International journal of cardiology*. Volume 176 (3), 1212-1213.

Zou, Y., Zhang, R., Xia, S., Huang, L., Fang, Y., Meng, J., Chen, J., Zhang, H., Zhou, B., Ding, G. (2016). The rural-urban difference in BMI and anemia among children and adolescents. *International Journal of Environmental Research and Public Health.* Volume 13 (10), 1020.