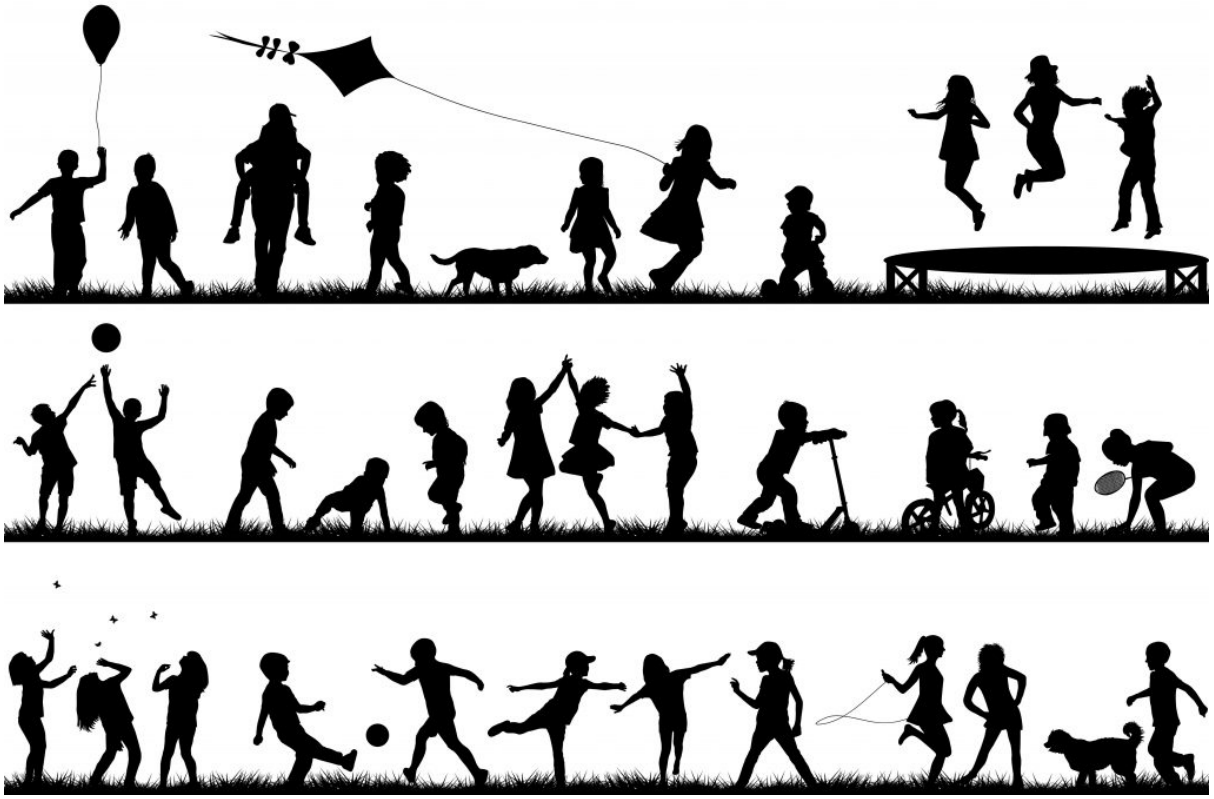

Physical Activity of Children and Adolescents

The relationship between socioeconomic status and physical activity levels of children and adolescents

Bachelor's thesis Human Geography & Urban and Regional Planning
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Abstract

Physical activity has many important health benefits for children and adolescents, both for during their childhood and for health outcomes at older ages. Understanding the factors that influence physical activity levels of children and adolescents might contribute to designing effective interventions to prevent physical inactivity. One factor that has often been found to affect physical activity of children and adolescents, is the socioeconomic status of the family. However, little research has been done on the differences between the individual effects of separate socioeconomic status indicators. Therefore, it is relevant to do follow-up research on the influence of household income, parents' occupational status, and parents' educational level on physical activity levels of children.

The following central question was formulated for this study: "How do different socioeconomic status indicators influence physical activity levels of children and adolescents?". An answer to this question was found by performing a six-step hierarchical linear regression on the KiGGS dataset from the German research institute on population health.

From the results, it appears that at least 63,5% of the respondents do not meet the physical activity guidelines. Also, a higher socioeconomic status is associated with lower physical activity levels. The results show that boys tend to have higher physical activity levels than girls. Besides, age is nog significantly linked to physical activity. The only socioeconomic status indicator that seems to significantly influence physical activity negatively, is household income. The educational level and occupational status of the parents are not significantly related to physical activity levels of their children.

Based on the above-mentioned results, It can be concluded that policymakers in Germany should find ways for creating effective strategies to increase physical activity of children and adolescents. Policies should focus mainly on increasing physical activity levels of girls, in order to reduce disparities between the sexes. This research has also shown that physical activity policies should not necessarily focus on children from lower social layers, because for this research sample, children with a higher SES tend to have lower physical activity levels.

Key concepts: *physical activity, socioeconomic status, life course approach.*

Index

1. Introduction

1.1 Background

Physical activity offers various health benefits for children and adolescents, like the prevention of chronic disease in adult life and the improvement of overall health (Sothern et al., 1999). Moreover, physical activity during childhood and adolescence also has long-term health benefits. For example, physical activity during childhood and adolescence is linked to a physically active lifestyle in adulthood (Telama et al., 2005). Also, physical activity during childhood influences bone density and cognitive functioning at older age positively (Cox, 2017). Therefore, it is advised that children and adolescents participate in physical activity for at least 60 minutes a day at moderate to vigorous intensity (WHO, 2011). However, data from large observational studies in Europe and North America show that many children and adolescents in Western countries do not reach these recommendations (Riddoch et al., 2004). One example of a country where many children and adolescents do not meet the recommended physical activity norms is Germany. Only 27,5% of German children aged 3 to 17 years meet the WHO recommendations of at least 60 minutes of physical activity a day at moderate to vigorous intensity (Manz et al., 2014). Therefore, in Germany, it is of general political concern to prevent inactivity of children and adolescents (Lampert et al., 2007). A lack of physical activity during childhood and adolescence might lead to health problems during adult life, which comes with high societal costs. The total estimated economic costs for Germany in 2020 that can be associated with low physical activity are 177.8 million euros (Candari et al., 2017). Understanding the factors that influence physical activity levels of children and adolescents can contribute to designing more effective interventions for preventing physical inactivity. Also, investigating the determinants of childhood physical activity can help policymakers with finding out on which specific population groups intervention programs should focus. Therefore, it is of large societal importance to find out which factors correlate with physical activity of children and adolescents.

Although there are many different aspects that might influence physical activity levels, one main factor that has often been found to influence physical activity of children and adolescents positively is socioeconomic status (SES) (Cohen et al., 2010). There are different reasons why a higher SES is associated with higher physical activity levels of children and adolescents. For example, with increasing SES, families are more likely to live in an environment that promotes physical activity, because of a higher availability of public parks, garden space, or recreational facilities (Estabrooks et al., 2003). Also, parents with a higher SES tend to have higher physical activity levels themselves and they often have more financial abilities to provide their children with sports memberships (Johnston et al., 2007). If a positive relationship between SES and physical activity is found, policymakers could focus on increasing physical activity levels of children and adolescents from low SES families.

The relationship between SES and physical activity has been measured in various ways in existing scientific literature, for example by using an indicator of SES like household income, home ownership or occupational position of parents. For example, In Germany, multiple studies already showed a correlation between SES and physical activity of children and adolescents (Lampert et al., 2007; Jekauc et al., 2012; Lämmle et al., 2012). However, little research has been done on the differences in influence on physical activity between these

SES indicators and on the differences between the influence of the SES of the mother and the SES of the father. Therefore, it is relevant to do follow-up research on the individual effects of different socioeconomic indicators (like the household income, occupational status and educational level of the mother and father) on physical activity levels.

1.2 Research problem

The goal of this research is to gain insights into the relationship between socioeconomic status exposures and physical activity of children and adolescents, using a quantitative data analysis of the KiGGS database. This research will specifically look into the independent influences of multiple separate socioeconomic status indicators. In this way, the influence of SES indicators of the mother and the father can also be compared. Therefore, the following research question is formulated: *"How do different socioeconomic status indicators influence physical activity levels of children and adolescents?"*

An attempt is made to answer the main research question using a number of sub-questions:

1. How does the SES index score influence physical activity of children and adolescents?
2. How does household income influence physical activity of children and adolescents?
3. How does the occupational status of both the mother and father influence physical activity of children and adolescents?
4. How does the educational level of both the mother and father influence physical activity of children and adolescents?

1.3 Structure of the thesis

Chapter two forms the theoretical framework of this thesis. This theoretical framework briefly discusses the scientific publications on childhood physical activity and socioeconomic status up to now. Subsequently, the theoretical background is used to compose a conceptual model about the relationships between socioeconomic status and physical activity. Chapter three discusses the methodology of this research, including the research sample and the data analysis. Next, the results of the research are represented in chapter four. In chapter five, the results are discussed in relation to the theoretical framework. Finally, in chapter six, an attempt is made to answer the main research question by drawing conclusions from the results. Besides, recommendations are made for follow-up research.

2. Theoretical framework

2.1 The life course approach

The life course approach is a perspective developed in the 1960s, about long term effects on later health based on physical or social exposures during gestation, childhood, adolescence, young adulthood and later adult life. The life course approach hypothesizes that exposures during early life, for example during childhood, are already influencing health outcomes at older age (Kuh et al., 2013). The application of the life course approach to epidemiology has helped epidemiologists with understanding how social gradients influence population health (Cable, 2014). Therefore, the life course approach has advanced the conceptualization of social inequalities in population health. An essential theory that the life course approach endorses is the accumulation of risk. This is the notion that through life, risks for health problems at older age gradually accumulate because of episodes of illnesses and injuries, poor environmental conditions and health-damaging behaviors (Kuh et al., 2003). An example of a health-damaging behavior, that might influence adult health outcomes negatively, is not getting enough physical activity (WHO, 2018).

2.2 Physical activity of children and adolescents

Physical activity is defined as movements of the skeletal muscles that increase the use of energy (Caspersen et al., 1985). Many studies have found evidence for the health benefits for adults that come with physical activity. Regular physical activity contributes to the prevention of several chronic diseases, like cardiovascular disease, diabetes, cancer, obesity, osteoporosis, depression, and hypertension (Warburton et al., 2006). The World Health Organization (2018) even concludes that insufficient physical activity is one of the leading risk factors for death worldwide. Next to health benefits for adults, physical activity during childhood and adolescence also has three main benefits. Figure 1 represents the relations between childhood physical activity and health outcomes, as Boreham & Riddoch (2001) describe them. First of all, physical activity during childhood and adolescence influences health status and quality of life directly, as displayed in relationship A. Secondly, childhood physical activity also influences health during adulthood, by delaying the onset of chronic disease in adulthood (relationship B). Lastly, as represented in relationship C, physical activity during childhood and adolescence indirectly influences adult health by increasing the likelihood that physical activity levels will be maintained through adulthood (Boreham & Riddoch, 2001). Relationship B and C are both in line with the life course approach, as described in section 2.1.

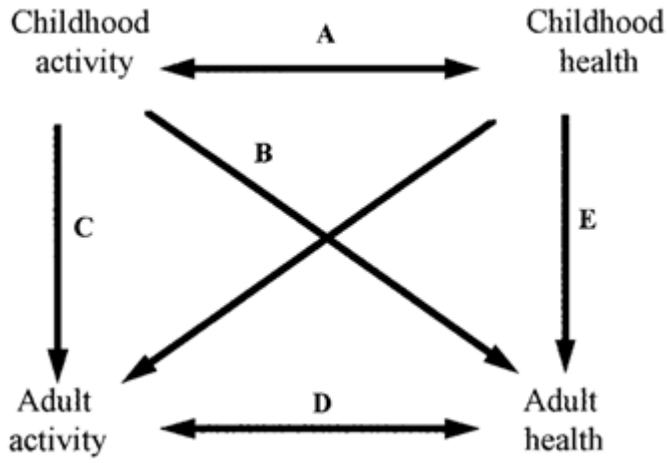

Figure 1: Relations between physical activity and health in children and adults (Boreham & Riddoch, 2001)

Next to physical health benefits, physical activity is also positively associated with children's cognitive performance (Sibley & Etnier, 2003). Therefore, higher physical activity levels might also create better school results and intellectual development of children and adolescents. On top of that, physically active children and adolescents tend to have better mental health than their less active counterparts (Biddle et al., 2004).

As a result of the above-mentioned benefits, it can be concluded that physical activity is of great importance to children and adolescents. Despite all the benefits of physical activity, Boreham & Riddoch (2001) argue that children have become less physically active in recent decades, with children today expending approximately 600 kcal a day less than children did 70 years ago. There is still a lot of scientific disagreement about the possible reasons for the reduction of children's physical activity levels over the years.

Primary and secondary schools in Germany teach PE (physical education) between 90 and 180 minutes a week (Naul et al., 2014). This means that in order to meet the WHO guidelines of 60 minutes of physical activity a day at moderate to vigorous intensity, children in Germany should incorporate other forms of physical activity as well. Since only 27,5% of German children and adolescents meet the WHO physical activity recommendations, it can be concluded that low physical activity levels are also a problem for German children and adolescents (Manz et al., 2014).

2.3 Determinants of physical activity of children and adolescents

Many studies have looked into the factors that influence physical activity levels of children and adolescents. Often, an ecological model of physical activity behavior is used to identify the correlates (Spence & Lee, 2003). This model explains that physical activity is influenced by three domains, namely: (a) environmental (facilities, communities, accessibility), (b) intrapersonal (biological, psychological, and behavioral influences), and (c) social (family or peer support, modeling) (Sallis & Owen, 1999). The ecological model suggests that in order

to understand the factors that influence physical activity, one should address the correlates of physical activity at multiple levels and consider the interaction of these factors within the three domains.

One of the factors that influences physical activity in the intrapersonal domain is the sex of the child since boys tend to have higher physical activity levels than girls (Telford et al., 2016). According to Telford et al. (2016), the reason for this difference between the sexes is that girls participate less in extracurricular sports. Also, physical activity levels seem to decline as children progress from childhood to adolescence (Craggs et al., 2011). This means that age is negatively related to physical activity levels. Another main factor that influences physical activity of children and adolescents, is socioeconomic status (Cohen et al., 2010). Socioeconomic status is a factor that influences physical activity levels on all three domains of the ecological model.

An increase in socioeconomic status (SES) during adult life has been associated with a wide range of adult health benefits (Adler et al., 1994). However, research has shown that SES exposures during childhood are also influencing adult health outcomes (Galobardes et al., 2004). This finding is in line with the life course approach, which hypothesizes that exposures during early life are influencing health outcomes at older age (Kuh et al., 2013). SES exposures during childhood and adolescence might therefore already influence adult health. One of the ways in which SES exposures during youth influence adult health indirectly, is through health behaviors, like physical activity (Cohen et al., 2010). However, SES itself does not seem to influence physical activity levels independently, but indirectly, through factors on the three domains of the ecological model of physical activity.

As mentioned in the background of this research, there are three hypothesized reasons why SES exposures during childhood influence physical activity of children and adolescents. Firstly, with increasing SES, families are more likely to live in a safe environment with public parks, a yard, garden space, or recreational facilities (Estabrooks et al., 2003). These environmental characteristics provide opportunities for physical activity through the environmental domain (a) of the ecological model. Secondly, as SES increases, so do parents' financial abilities to provide their children with opportunities to play organized sports or other athletic activities (Johnston et al, 2007). This factor can be classified in the intrapersonal domain (b) of the ecological model. Finally, socioeconomic status also influences physical activity of parents positively (Cohen et al., 2010). Parents might be a role model to their children in terms of physical activity since physical activity levels of parents influence physical activity levels of their children positively (Yang et al., 1996). Therefore, SES also influences physical activity through the social domain (c) of the ecological model.

2.4 Measuring socioeconomic status

Socioeconomic status is one of the most studied constructs in the social sciences (Bradley & Corwyn, 2002). SES is often measured through wealth indicators (for example income, house ownership, or savings), educational level, or occupational status. However, most social scientists agree that a combination of these indicators provides a better approximation to SES than either alone (Bradley & Corwyn, 2002). Therefore, an SES index consisting of multiple indicators is often used in studies on the effects of SES. However, further investigation

examining multiple SES indicators like income and educational level as separate measures is needed (Ferreira et al., 2007).

A small number of studies already examined the influence of separate SES measures on physical activity levels of children and adolescents. However, many studies show contradictory evidence for the effects of SES indicators on physical activity levels. For example, a study on 594 Portuguese adolescents showed that both the educational and occupational levels of the mother have a stronger influence on physical activity levels of adolescents than the educational and occupational levels of the father (Santos et al., 2004). However, a study on 5457 Finnish adolescents showed that the educational level of the father is a better predictor of physical activity levels of adolescents than the mother's educational level (Kantomaa et al., 2007). This research also showed that educational level is a better predictor of physical activity levels than household income. Moreover, a study on 2411 junior high school students in Italy has shown that the fathers' physical activity, which might be a result of the fathers' SES, has a larger impact on extra-curricular physical activity of their children than the mother's physical activity levels (La Torre et al., 2006).

2.5 Conceptual model

Based on the above-mentioned theoretical framework, a conceptual model (Figure 2) was composed. It is expected that physical activity of children and adolescents depends on four factors, of which three represent SES. The indicators that represent SES are household income, parental educational level, and parental occupational status. The sex and age of the child are the demographic characteristics that influence physical activity independently of SES.

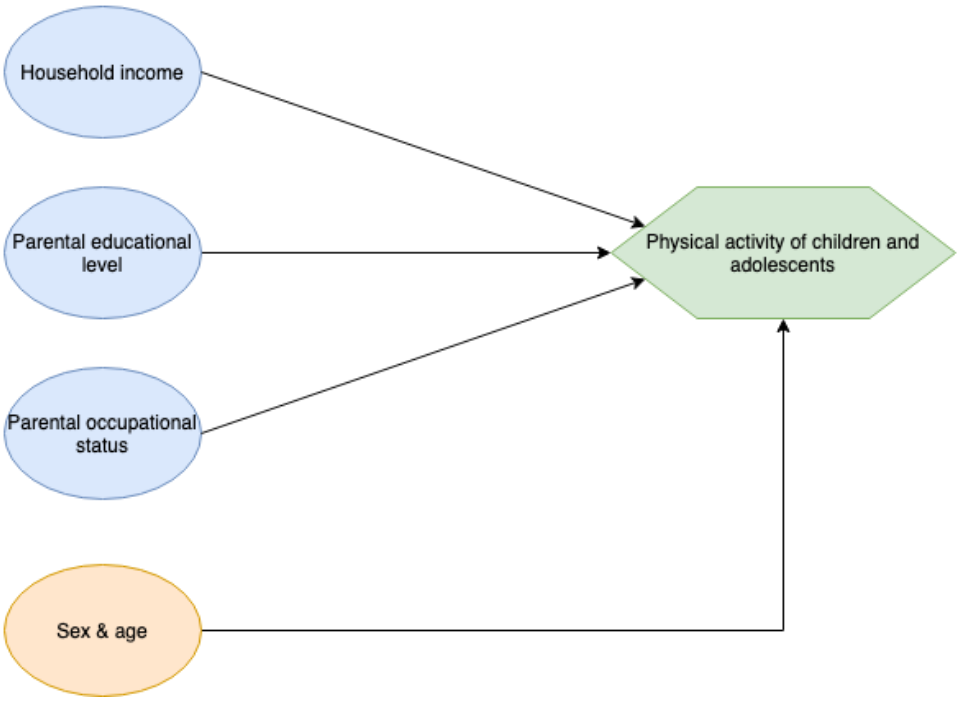

Figure 2: Conceptual model

Based on the theoretical findings, it is expected that SES influences physical activity of children and adolescents positively: if SES rises, physical activity of children and adolescents rises. Therefore, it is also expected that separate SES indicators (for example the educational level of the mother) influence physical activity levels positively. However, because of the contradictory outcomes of different influences of separate SES indicators, it is expected that there is no difference in the influence of separate SES indicators. Physical activity is a complex behavior because it can be influenced by various personal and environmental factors (Kuh et al., 2013). Therefore, it is expected that next to SES, there are various other factors that influence physical activity levels of children and adolescents. For example, age is expected to influence physical activity levels negatively. Also, boys are expected to have higher physical activity levels than girls.

3. Methodology

3.1 Method and research sample

To answer the research questions, a quantitative research approach was followed. The reason for choosing this research method is that a quantitative analysis is the most suitable method for measuring relationships between different variables, in this case SES indicators and physical activity levels. Also, a quantitative research method makes it possible to gain insights into how certain elements are related to each other and to make generalized assumptions about population-level relationships (Labaree, 2009).

In order to study the relationship between SES indicators and physical activity levels of children and adolescents, a database from the KiGGS research on the health of children and adolescents in Germany was used. The data for this research were collected by a survey from the Robert Koch Institute, the German government's central scientific institution in the field of biomedicine (RKI, 2017). From May 2003 to May 2006, the research was conducted nationwide, in order to collect comprehensive data on the health status of children and adolescents from 0 to 17 years old (Kurth et al., 2008). On the whole, 17641 children and adolescents participated in the survey, of which 8985 boys and 8656 girls (Kurth et al., 2008).

3.2 Data analysis

The KiGGS database provides a large number of variables to answer different questions related to childhood health and cognitive development. However, this research will only focus on the variables of the KiGGS database that could potentially be used to determine the relationship between SES and physical activity of children and adolescents. The dependent variable that will be used (physical activity of children and adolescents) is measured as hours of physical activity per week, which results in a ratio variable. Detailed information about the descriptives of the dependent variable can be found in section 4.1.

First of all, the relationship between socioeconomic status and physical activity levels will be analyzed by using an SES index score as the independent variable in a linear regression in SPSS. All test results will be assessed using a significance level of 5%. The SES index score has a ratio measurement level and is based on the educational level, the professional status and the monthly household income of the parents (Kurth et al., 2008). Therefore, the SES index score can be seen as a combination of separate socioeconomic status indicators. The value of the SES index score lies between "3" and "21". The SES index score can only consist of whole numbers. As a result, three groups can be identified: "low SES" (score 3-8), "medium SES" (score 9-14) and "high SES" (score 15-21). The details of how the SES index score is calculated as a result of educational level, occupational status, and household income can be found in Appendix 1.

In order to find out if separate SES indicators are linked to physical activity levels differently, the influence of the separate SES indicators will also be examined by adding them to a six-step hierarchical linear regression. The reason for choosing a hierarchical regression is that this type of linear regression is a suitable method to analyze the effect of a predictor variable after controlling for other variables (Lewis, 2007). The influences of the age and sex of the

child will be taken into account, by adding them to the first model as independent variables. There are five variables that are separate indicators of SES. The first variable that will be used as an indicator of SES is the monthly household income, which will be added to the second model of the hierarchical linear regression. Monthly household income is categorized in different scales, resulting in an ordinal variable. Following, the occupation of the mother and the father will be added to the third and fourth model. The occupation of both the mother and father is represented as a nominal variable. Finally, the educational level of the father and mother, which are also represented as nominal variables, will be analyzed in relation to physical activity of children and adolescents by adding them to the fifth and sixth model.

Since all the independent variables have an ordinal or nominal measurement level, these variables have to be transformed into dummy variables (Skrivanek, 2009). The dummy variables were constructed by creating new variables for the categories from the variables “sex”, “age”, “household income”, “educational level mother”, “educational level father”, “occupational status mother” and “occupational status father”. The created categories, including their reference categories, are represented in the left column in Table 3. After adding the newly created dummy variables to the hierarchical linear regression, except for one reference dummy variable, it will be possible to see differences between the categories. Since it can be expected that some of the SES indicators are interdependent, this research will also check if there is multicollinearity between the independent variables, by running a test on the VIF values.

3.3 Reflection

During the execution of the regression analysis, a small number of issues were encountered. First of all, a limitation of using the KiGGS dataset is that a large proportion of the data on physical activity levels (61,4%) is not available, because the physical activity levels of the respondents are left out due to privacy reasons. Therefore, N = 6812, instead of 17640. The missing cases are all the respondents from the age groups “0-2 years”, “3-6 years” and “7-10 years”. The 38,6% of the respondents of which the data is accessible therefore all belong to the age groups “11-13 years” (2719 respondents) and “14-17 years” (3047 respondents). Due to this fact research sample consists mainly of older children and could, therefore, produce different results than a sample that also includes children of younger ages. Another problem that was encountered was the emergence of multicollinearity of the independent variables. However, this issue was resolved by reducing the number of dummy variables for the household income from 13 to 3 and by reducing the number of dummy variables for both the occupational status of the mother and the father from 20 to 4. A final, obvious limitation of using the KiGGS data is that the KiGGS research used self-administered questionnaires, which might influence the reliability or validity of the research because of the possibility that respondents fill in the wrong answer (Kurth et al., 2008).

4. Results

4.1 Descriptive analysis of physical activity levels

Table 1 shows the frequency distributions for the predictors of physical activity levels of children and adolescents. Also, the average, standard deviation, minimum value and parand females is almost equal and an accurate reflection of the German population in this age group (IndexMundi, 2018).

Variable	**N (%)**	**Mean (hours of physical activity/ week)**	**Median**	**SD**	**Min**	**Max**
Age						
0 - 3 years	.	.	.	.	.	.
3 - 6 years	.	.	.	.	.	.
7 - 10 years	.	.	.	.	.	.
11-13 years	2719 (47,2%)	7,02	5	7,71	0	90
14-17 years	3047 (52,8%)	7,06	5	7,4	0	96
Sex						
Boys	3094 (53,7%)	8,49	6	8,53	0	90
Girls	2672 (46,3%)	5,37	5	5,79	0	96
Socioeconomic status						
Low SES	1423 (25,5%)	7,98	5	9,29	0	90
Medium SES	2733 (48,9%)	6,85	5	7,13	0	86
High SES	1334 (25,7%)	6,27	5	5,98	0	96
Total	5766 (100%)	7,04	5	7,55	0	96

Table 1: Descriptive statistics physical activity of children and adolescents

Figure 3 shows the physical activity levels of the respondents in hours per week. Physical activity levels amongst the respondents varied between 0 and 96 hours per week, but most of the respondents are physically active between 0 and 20 hours per week. However, there are also some outliers with very high physical activity levels.

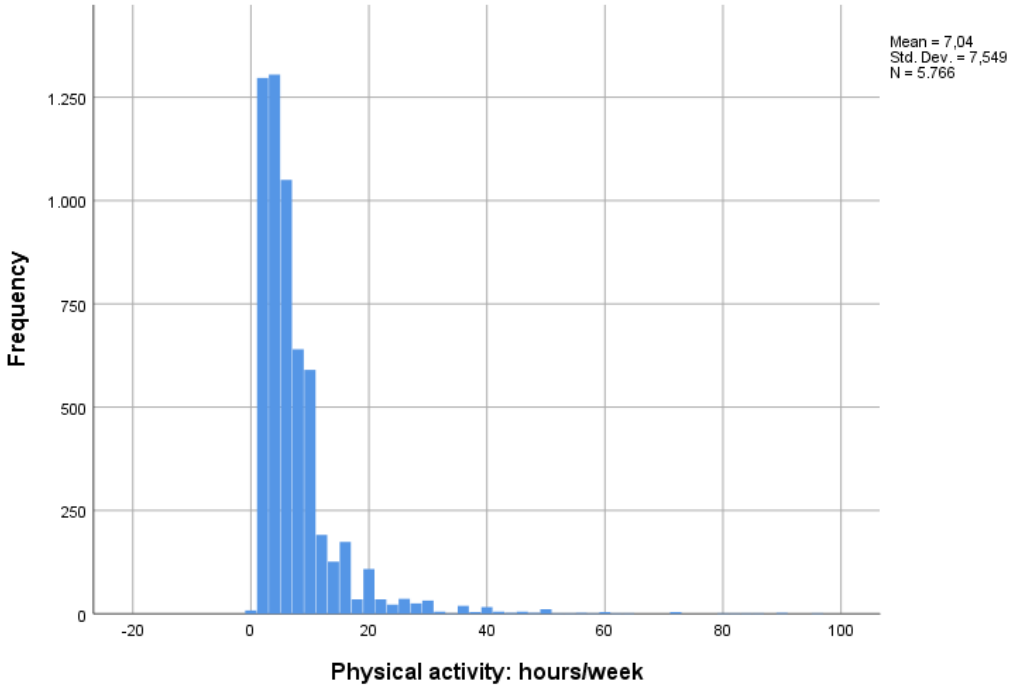

Figure 3: Physical activity levels of the respondents (hours per week)

In order to meet the WHO guidelines of 60 minutes of physical activity a day at moderate to vigorous intensity, children should be physically active at least seven hours per week (WHO, 2011). Children and adolescents might also have multiple hours of physical activity on one day and a lack of physical activity on other days. This means that some children or adolescents that have over 7 hours of physical activity per week might still not reach the WHO guidelines. However, it can be stated with certainty that children and adolescents who have less than 7 hours of physical activity per week, do not meet the WHO guidelines. The data shows that 63,5% of the respondents have less than 7 hours of physical activity per week, which means that at least 63,5% of the research sample does not reach the recommended amount of physical activity. As mentioned in the background, 72,5% of German children and adolescents do not meet the WHO recommendations. Therefore, this research sample is representative of the German population of children and adolescents.

4.2 Relationship between SES and physical activity

In order to test the relationship between SES and physical activity levels of children and adolescents, a linear regression was used with physical activity as the dependent variable and the SES index score as the independent variable. The test results are assessed using a significance level of 5%. The results of the statistical analysis of the influence of the SES index score on physical activity are represented in Table 2.

Independent variable	**B**	**t**	**p (Sig.)**
SES index score	-0,136	-5,854	0,000

Table 2: Results statistical analysis SES index score

As mentioned in the methods, the respondents can also be categorized in the following three groups based on their SES index score: “low SES” (score 3-8), “medium SES” (score 9-14) and “high SES” (score 15-21). As a result, the differences in physical activity levels between the three SES groups can be visualized in their 95% confidence intervals, as represented in Figure 4. Figure 4 indicates that there are differences in physical activity levels between each SES group. Also, as socioeconomic status rises, physical activity levels decrease evenly. This means that a medium SES is linked to higher physical activity levels than a high SES, while a low SES is also linked to higher physical activity levels than a medium SES.

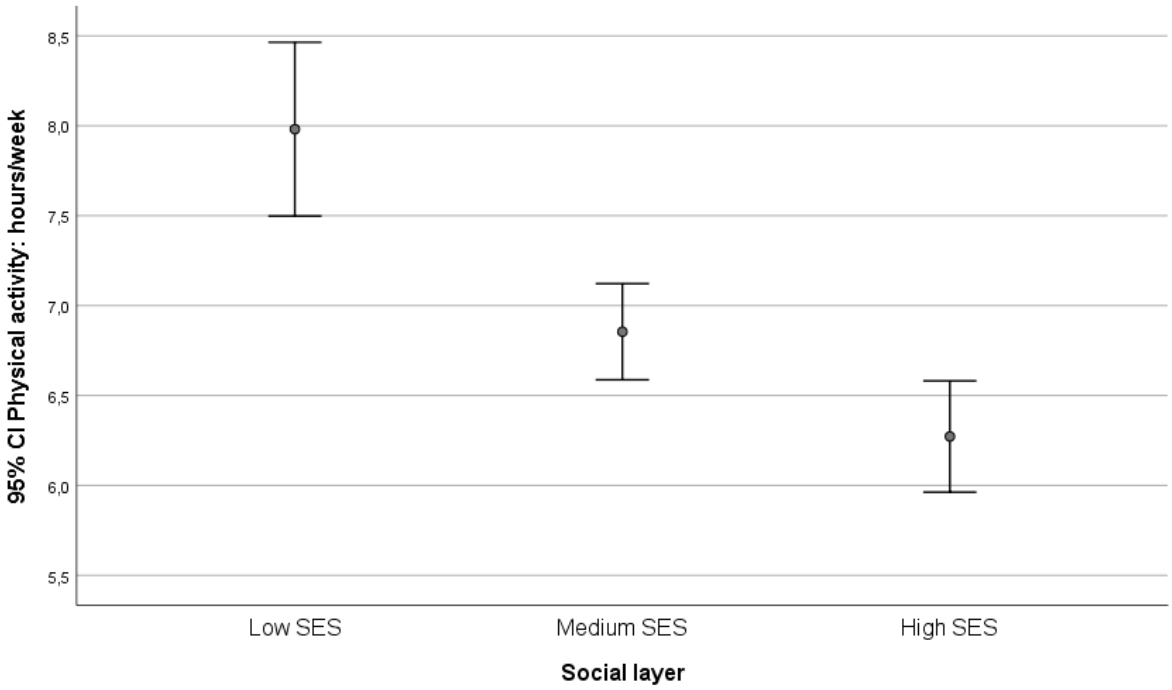

Figure 4: Mean effects of SES on physical activity

4.3 Multivariate analysis of physical activity of children and adolescents

To find out if there are differences in the influence on physical activity levels between different SES indicators (for example: does the educational level of the mother have a larger influence on physical activity levels than the educational level of the father?), a multiple linear regression with five SES indicators, sex and age was used. The SES indicators that were used are:

- Monthly household income (ordinal)
- Occupational status mother (nominal)
- Occupational status father (nominal)
- Educational level mother (nominal)
- Educational level father (nominal)

All of the above-mentioned variables were transformed into dummy variables, because of their nominal and ordinal level of measurement. Subsequently, a six-step hierarchical linear regression was conducted. Based on the theoretical findings, it was expected that the intrapersonal domain influences physical activity levels of children and adolescents (Sallis &

Owen, 1999). Age and sex of the respondents were therefore added in the first model, to control for the effects of demographic characteristics. The other five models add one SES indicator at a time.

Hierarchical Regression Analysis of Predictors of Physical Activity of Children and Adolescents

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Predictor variables						
Age (ref. 11-13 years)						
14-17 years	-0,071	-0,037	-0,030	-0,040	-0,042	-0,040
Sex (ref. female)						
Male	**3,023****	**3,011****	**3,012****	**3,013****	**3,013****	**3,018****
Household income (ref. <=1500€)						
1500 - < 3000€		**-0,869***	**-0,771***	**-0,737***	**-0,744***	**-0,734***
>= 3000€		**-1,240****	**-1,010***	**-0,701***	-0,699	-0,603
Occupational status mother (ref: low SES jobs)						
Moderate SES jobs			**-0,533***	-0,432	-0,364	-0,396
High SES jobs			-0,674	-0,443	-0,371	-0,390
Upper SES jobs			-1,333	-1,069	-1,015	-1,015
Occupational status father (ref: low SES jobs)						
Moderate SES jobs				-0,137	-0,152	-0,168
High SES jobs				-0,831	**-0,832***	-0,658
Upper SES jobs				-0,786	-0,778	-0,578
Educational level mother (ref: lower secondary education)						
Medium secondary education					-0,392	-0,331
Polytechnic secondary education					-0,363	-0,446
Vocational secondary education					-0,500	-0,378
Gymnasium					-0,289	-0,063
Other degree					-0,065	-0,310
No degree					-0,713	-0,522
No degree yet					-0,792	-0,568
Educational level father (ref: lower secondary education)						
Medium secondary education						-0,138
Polytechnic secondary education						0,122
Vocational secondary education						-0,528
Gymnasium						-0,634
Other degree						0,626
No degree						-0,530
No degree yet						-0,433
R^2	0,042	0,045	0,045	0,046	0,046	0,045
R^2 change	**0,042****	**0,003***	0,001	**0,002***	0,001	0,001

p<0,05; **p<0,001.

Table 3: Results hierarchical linear regression. (Dependent variable: Physical activity hours/week)

4.3.1 Relationship between demographic characteristics and physical activity

Table 3 shows the results of the hierarchical linear regression models. As displayed in Table 3, The hierarchical multiple regression revealed that in model 1, age and sex and accounted for 4,2% of the variation in physical activity levels. As represented in the results of the regression in Table 3, the age group “14 to 17 years” does not differ from the reference category (“11 to 13 years”) significantly, as p>0,05. Therefore we can conclude that for this research sample, age does not correlate with physical activity levels for children and adolescents.

The results from the multiple linear regression also show that sex does influence physical activity levels of children and adolescents significantly (B = 3,023, *p*< ,001). Male respondents therefore tend to have three more hours of physical activity per week than their female counterparts. Figure 5 shows the mean amount of physical activity in hours per week for both sexes. In this graph, the differences between age groups can also be observed for boys and girls.

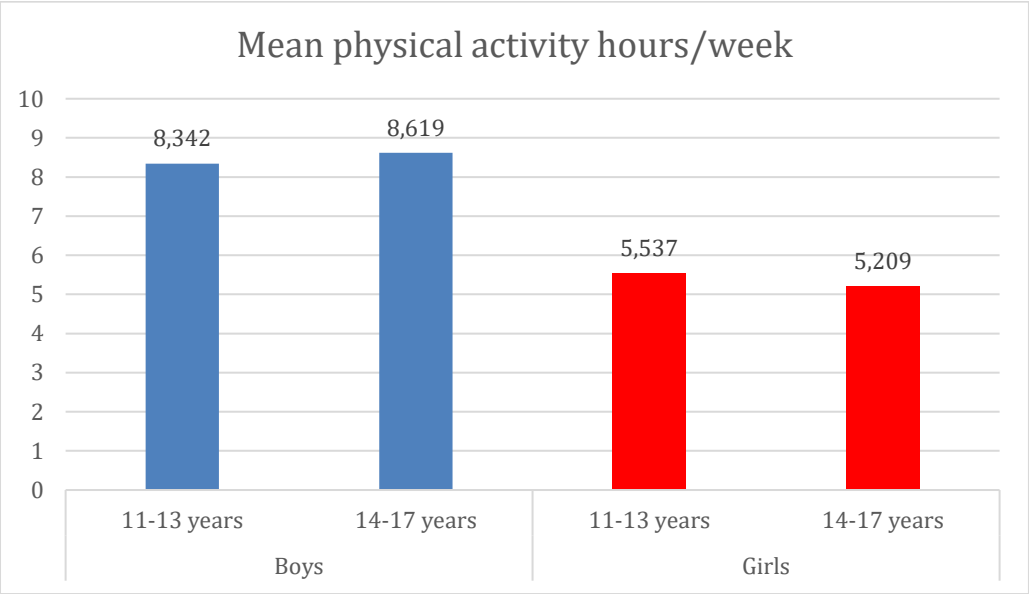

Figure 5: Mean physical activity levels (hours per week) by sex by age group

4.3.2 Relationship between SES indicators and physical activity

As represented in Table 3, introducing the monthly household income in model 2 explained an additional 0,3% of variation in physical activity levels and this change in R^2 was significant (p<0,05). Adding the occupational status of the mother to the regression model explained an additional 0,1% of the variation in physical activity levels. However, this change in R^2 was not significant (p>0,05). Joining the occupational status of the father to the regression model explained an additional 0,2% of the variance in physical activity levels and this change in R^2 was significant (p<0,05). Finally, introducing the educational level of both the mother and the father both did not significantly add to the explanation of the variation of physical activity levels of their children (p>0,05). Together the independent variables accounted for 4,6% of variance in physical activity levels of children and adolescents.

The hierarchical linear regression also shows that the reference category of the monthly household income (<=1500€) differs from higher income groups significantly. From the negative B values, it can be derived that a higher household income is significantly linked to lower physical activity levels of children and adolescents. When taking a look at the 95% confidence intervals of the household income in Figure 6, it can also be observed that children from families with a lower household income tend to have higher physical activity levels. However, in Model 5 and 6, the highest income group does not differ from the lowest income group significantly. This indicates that after correcting for the influence of the educational level of the mother and the father, children from the highest household income category do not have significantly lower physical activity levels than children from the lowest household income category.

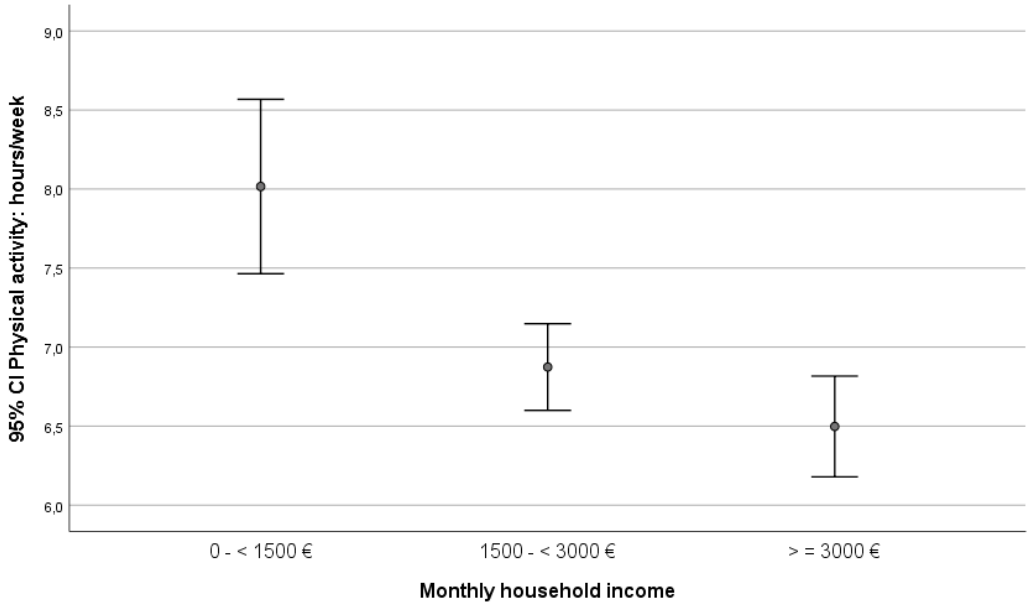

Figure 6: Mean effects of monthly household income on physical activity

Table 3 also shows us that there are few differences in physical activity levels based on the job category of both the mother and the father. The only significant difference that was found for mothers was that moderate SES jobs are linked to lower physical activity levels than low SES job (B=-0,533, p<0,05). For fathers, high SES jobs are significantly linked to lower physical activity than low SES jobs (B=-0,832, p<0,05). This can also be observed in the 95% confidence intervals of physical activity levels based on the occupational status of the mother and the father, as represented in Figure 6 and Figure 7. Although there does seem to be a negative relationship between physical activity levels and jobs with a higher corresponding SES, most of the confidence intervals overlap, indicating that most of the differences are not significant.

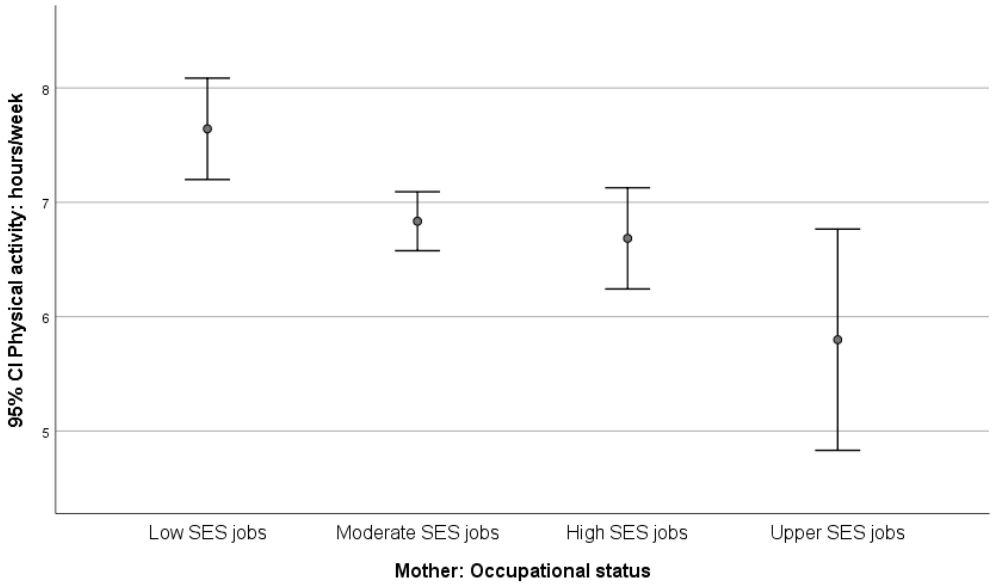

Figure 6: Mean effects of occupational status mother on physical activity

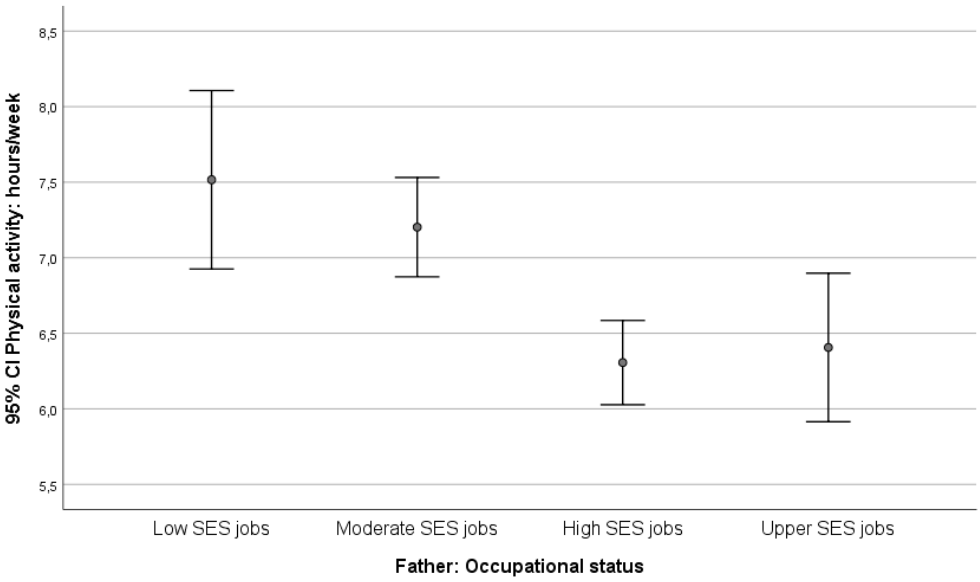

Figure 7: Mean effects of occupational status father on physical activity

Finally, Table 3 shows us that after correcting for demographic characteristics, income and occupational status, educational level of both the mother and the father does not influence physical activity levels of their children significantly. Figure 8 and Figure 9 represent the mean effects of the educational level of both the mother and the father. The overlapping confidence intervals indicate that there are no significant differences between the educational level categories.

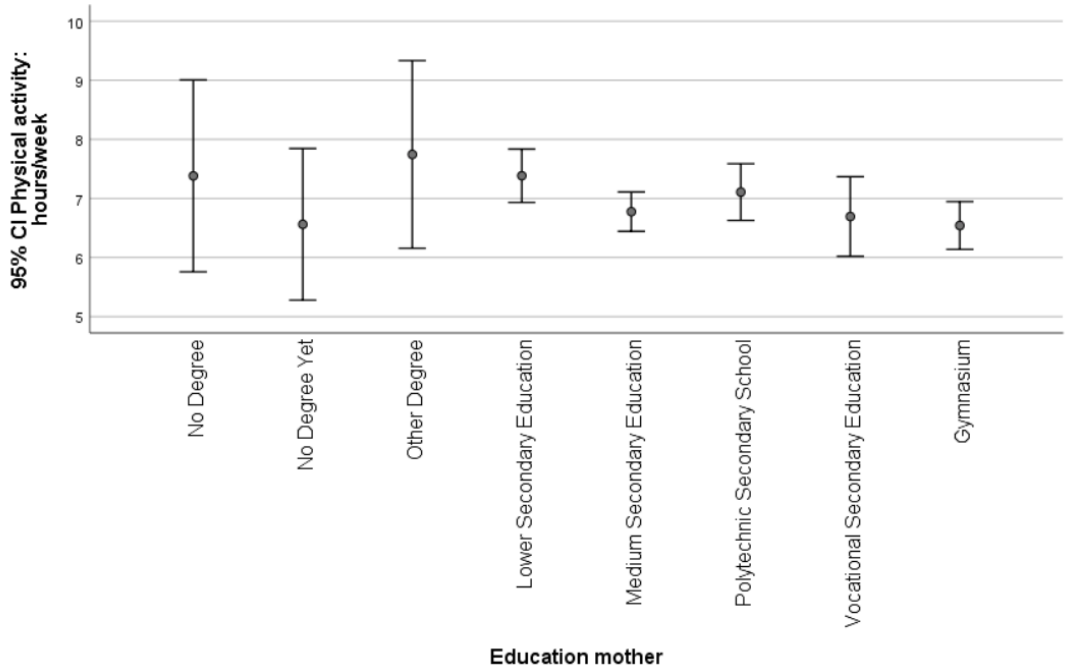

Figure 8: Mean effects of educational level mother on physical activity

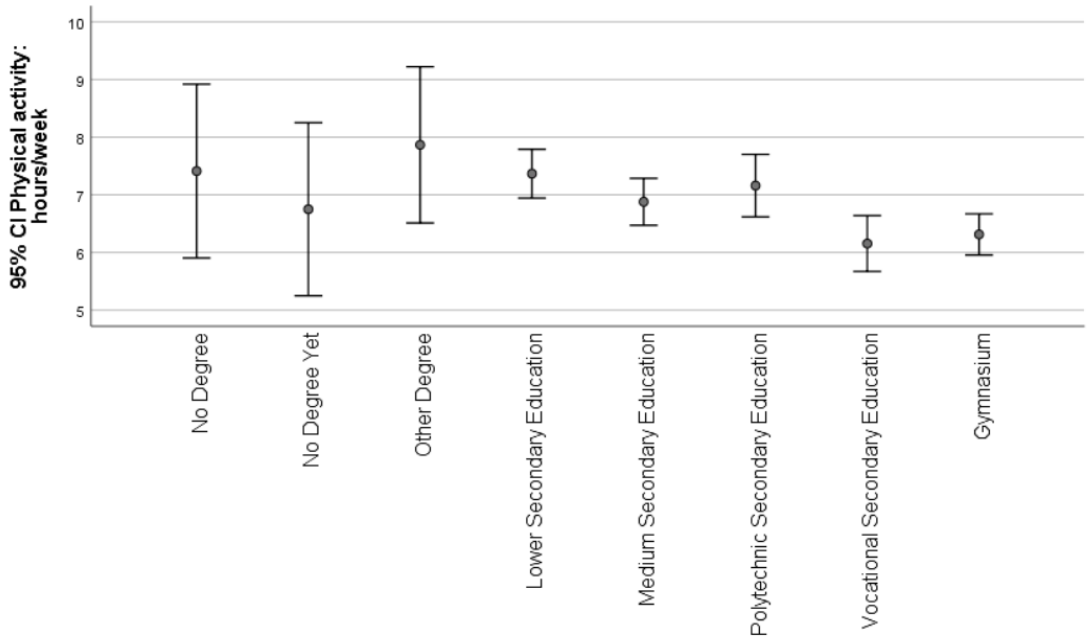

Figure 9: Mean effects of educational level father on physical activity

5. Discussion

5.1 Relationship between SES and physical activity

Based on the theoretical findings, it was expected that socioeconomic status influences physical activity levels of children and adolescents positively, because of environmental characteristics, financial abilities and physical activity of the parents, which are all linked to the socioeconomic status of the family (Spence & Lee, 2003). However, as represented in Table 2, for this research sample, the effect of socioeconomic status (B = -0,136, p<0,001) is significant and its coefficient is negative, indicating that the higher the socioeconomic status, the lower the physical activity levels.

A possible explanation for this unexpected result is the multi-dimensional nature of both physical activity and SES, which might create measurement difficulties (O'Donoghue et al., 2018). For example, the components of the SES index (income, occupation & education) are unstable, since they can differ over the lifetime of the parents (Shavers, 2007).

Shavers (2007) also argues that entitlement programs for persons with a lower socioeconomic status might reduce disparities in health behaviors. In Germany, parents with a lower socioeconomic status are often legally entitled to assistance for sports participation. This entitlement covers a subsidy of ten euros per month for sports participation of children (Keitel, 2015). Also, there are multiple programs that promote physical activity for economically disadvantaged youth in Germany, like: "Sport: Alliances!", "ZI:EL+" and "No child without sport" (European Commission, 2019). These benefits might be the cause of the reduction or even reversal of differences in physical activity levels between children and adolescents from higher and lower SES families.

A final reason for the contradictory result is that the research sample mainly consists of older children because the available data is only about the respondents from the age groups "11 to 13 years" and "14 to 17 years". Other studies have found that for older youth, the relationship between SES and physical activity might be negative (Stalsberg & Pedersen, 2010). One possible explanation for this negative relationship is that children from lower SES families might have more active ways of transportation (e.g. walking instead of car use), because of a lack of financial resources for other transportation options, like car-use (Pabayo & Gauvin, 2008). The reason that this correlation is not found for younger children, might be that younger children have other, less active ways of transportation. They might, for example, be brought on a bicycle by their parents, or commuting with a school bus. Another reason that might reduce disparities in adolescent's physical activity between low SES and high SES families, is that occupational training in Germany already starts at the age of 14 to 16 years old, depending on the school results (Hockenos, 2018). Therefore, children with a lower SES might already be in (manual) labor, while children with a higher SES are still in high school, where physical activity occurs less.

5.2 Predictors of physical activity

It was hypothesized that age is negatively related to physical activity levels because physical activity levels tend to decrease as children get older (Craggs et al., 2011). However, for this research, no connection was found between age and physical activity. A potential explanation for this result might be that the data consists of children aged 11 to 17 years old. This means that there is not a lot of variance between ages and that the respondents are mostly older children. Therefore, differences between younger and older age groups cannot be calculated. Apparently, for this research, differences between physical activity levels of 11 to 13 years old children and 14 to 17 years old children are small. However, this does not mean that there is no connection between age and physical activity at all because it is plausible that differences between younger and older age groups are larger. This research also shows that boys tend to have higher physical activity levels than girls. This result further supports the idea of Telford et al. (2016), who found that girls have lower physical activity levels than boys because they tend to participate less in extracurricular sports.

Based on the theoretical framework, it was expected that SES influences physical activity of children and adolescents positively. Therefore, it was expected that separate SES indicators also influence physical activity positively. Besides, it was hypothesized that there would be no differences between the influences of the separate SES indicators. However, for this research, a negative relationship between SES and physical activity levels was found. Therefore, one can also expect to find negative relationships between SES indicators and physical activity levels. The first SES indicator that was examined (monthly household income), did indeed influence physical activity levels negatively. However, no consistent effects were found for the occupational status of the mother and the father or the educational level of the mother and the father. A plausible explanation for this result might be that after correcting for the influence of age, sex and household income, the educational level and occupational status of the parents do not have such a strong effect on physical activity. Also, as mentioned in the theoretical framework, a combination of multiple SES indicators might give a better picture of socioeconomic status than separate SES indicators (Bradley & Corwyn, 2002). This might be the reason that the SES index, which is a combination of the separate SES indicators, does show a significant correlation, while the educational level and occupational status of the parents do not show correlations. A final explanation for why household income is significantly negatively related to physical activity while parental educational level and occupational status are not, might be that a higher income makes it easier for parents to make use of a car and a domestic helper (Dargay & Gately, 1999; Wang & Li, 2009). These factors may be responsible for low physical activity levels of children from high-income families because they might make children’s ways of transportation less active and reduce the necessity for children to do chores in the household.

6. Conclusions & recommendations

6.1 Conclusions

The results from this research showed that there is a significant, negative relationship between the SES index score and physical activity levels of children and adolescents. Also, boys tend to have higher physical activity levels than girls and household income influences physical activity levels negatively. No consistent connections were found between the educational level and the occupational status of both the mother and the father and their children's physical activity levels. Also, no significant differences in physical activity between age groups were found.

The results do not support the hypothesis based on findings of many other studies, where a positive relationship between SES and physical activity of children and adolescents was found (Cohen et al., 2010). Possible explanations for the unexpected results are the multi-dimensional nature of SES and physical activity variables, the availability of German entitlement programs, and the fact that this research sample mainly contains older age groups.

Finally, the research question *"How do different socioeconomic status indicators influence physical activity levels of children and adolescents?"* can be answered. Monthly household income influences physical activity levels of children and adolescents negatively, while the educational level and occupational status of both the mother and the father are not significantly linked to physical activity. Therefore, from this research, it can be concluded that children and adolescents from German families with a lower socioeconomic status tend to have higher physical activity levels. This research also shows that not all separate SES measures are strong enough indicators to show a relationship between socioeconomic status and physical activity levels, while a combination of indicators, such as the SES index score, is.

Taking into consideration that at least 63,5% of the respondents do not reach physical activity guidelines, policymakers in Germany should find ways for creating effective strategies to increase physical activity of children and adolescents. Also, policies should focus mainly on increasing girls' physical activity levels, in order to reduce disparities between boys and girls. This research has shown that physical activity policies should not necessarily focus on children from lower social layers, because for this research sample, children with a higher SES tend to have lower physical activity levels.

6.2 Recommendations

Since this research demonstrated a negative relationship between SES and physical activity of children and adolescents, while many other studies found a positive relationship, more research on the connection is needed. Follow-up research could look further into the possible aspects that are responsible for the contradictory result, for example if children from lower SES groups are more active because they perform more physical labor. Although many other

studies found that age influences physical activity levels negatively, this result was also not found in this research. Research that focuses on younger age groups as well might produce different results. A limitation of this study was derived from the low R-square value, which indicates that other variables may be involved in predicting physical activity of children and adolescents. This limitation could be improved by including multiple indicators. Therefore, it is interesting to look into other factors that influence physical activity of children and adolescents, because SES is only one of the many factors that might be connected to physical activity levels of children and adolescents.

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Appendixes

Educational level	Occupational status	Household income	Point value
no school degree yet, dropout, no school degree, secondary school degree, Intermediate School Degree, 10th school degree (East), Technical School Degree	in education, apprentice, trainee, industry technology apprentice, trainee, intern, untrained worker	<1,249 Euro	1
dropout, no school degree, secondary school degree, other degree	untrained worker, semi-trained worker	1,250 – 1,749 Euro	2
intermediate school degree	foreman team leader, help in family business, employee with simple tasks, low-level civil service	1,750 – 2,249 Euro	3
technical school degree, 10th school degree (East)	qualified professional, middle-level civil service	2,250 – 2,999 Euro	4
Abitur/ college entrance exam (East) (upper secondary degree)	self-employed farmer or other self-employed, no co-workers – 9 coworkers	3,000 – 3,999 Euro	5
Abitur/ college entrance exam (East) (upper secondary degree)	free-lance professional, high qualified professional, high-level civil service	4,000 – 4,999 Euro	6
Abitur/ college entrance exam (East) (upper secondary degree)	self-employed farmer and other self-employed > 9 co-workers,	≥ 5,000 Euro	7

	managerial executive civil services		

Appendix 1: Calculation of the SES index score. According to “Dimensions of the socio-economic status according to Winkler and Stolzenberg”. Aue, K. & Roosen, J.