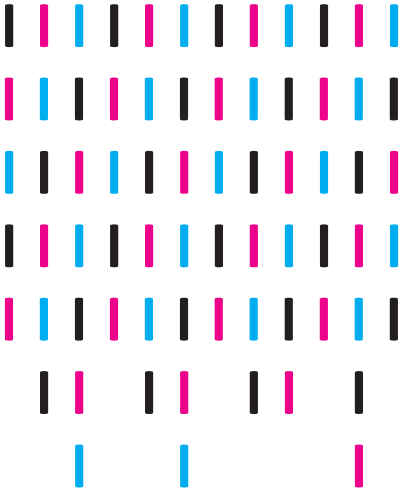

NEPS *SURVEY PAPERS*

Jacqueline Kroh, Michael Gebel and Guido Heineck

HEALTH RETURNS TO EDUCATION ACROSS THE LIFE COURSE: MEASURING HEALTH IN CHILDREN AND ADOLESCENTS IN THE NATIONAL EDUCATIONAL PANEL STUDY

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Health Returns to Education Across the Life Course: Measuring Health in Children and Adolescents in the National Educational Panel Study

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Health Returns to Education Across the Life Course: Measuring Health in Children and Adolescents in the National Educational Panel Study

Abstract:

Health is an important non-monetary outcome of education surveyed by the National Education Panel Study (NEPS). In addition to its effects in adulthood (see Lettau et al., 2020), the interplay between education and health also plays a role for children and adolescents. For this reason, the NEPS provides longitudinal data on various aspects of health, education, relevant control variables, and mechanisms for the starting cohorts that focus on younger age groups. This allows data users to analyze the impact of education on individual health and relevant mechanisms for children and adolescents. This survey paper introduces the measurement concept for health in the NEPS starting cohorts 1 to 4 and provides first descriptive analyses.

Keywords:

returns to education, health, subjective health status, BMI, health-related behavior, children and adolescents

Content

1. Introduction

The National Educational Panel Study collects longitudinal data in order to provide a rich source for diverse research disciplines (NEPS, 2021). Taking into account different theoretical perspectives, the NEPS also provides data on returns to education (Blossfeld and Roßbach, 2019). In this context, the primary research question asks how education affects monetary/economic and non-monetary/non-economic returns in different stages of the life course. With a focus on labor market outcomes, civic engagement, health, and subjective well-being, the NEPS Working Unit "Returns to Education Across the Life Course" has developed and implemented a rich survey program for all starting cohorts (for an overview see Bela et al., 2018).

To address education's effects on health in different life stages, we focus on individuals' health-related behavior and health status. Considering differences within the life course, we repeatedly collect health-related information. Since the consolidation of the program in 2017, we have focused on more relevant constructs and higher measuring frequency (see also Lettau et al., 2020), and have also adapted the program to specific age groups to provide suitable data for all starting cohorts. While in adulthood, individuals' educational attainment is expected to have strong effects on their health and health-related behavior, parental education is more important for determining health inequalities in early ages. Children are, for instance, highly dependent on their parents' health and health-related behavior, the living conditions, and the resources provided. Moreover, adults often make choices for their children, including health-related ones. Parental educational attainment thus should be highly relevant for children's health and health-related behavior.

Complementing the concept outlined in Lettau et al. (2020), this paper provides additional information about the measurements and their validation for the NEPS starting cohorts for children and adolescents. We briefly summarize the relevant definitions of health, discuss differences in health perceptions in children and adolescents, and describe underlying theories on causal or non-causal relationships between individual or parental education and the health of children or adolescents. We then present the measurement concept after its consolidation in 2017, considering not only current health status and health-related behavior but also birth-related health outcomes. We show descriptive results for starting cohorts 1, 2, and 3 for both children's and parents' responses. For external validation, we compare our results with data of the "German Health Interview and Examination Survey for Children and Adolescents" (KiGGS) or the World Health Organization (WHO), wherever possible.

2. Theoretical background

Measuring health as an educational return in children and adolescents requires a profound understanding of health's different dimensions and of the theoretical concepts that explain health inequalities by education. For that purpose, we define individual health in Section 2.1 by considering the specifics of understanding health and illness in children. Moreover, we address health inequalities that relate to children's education in Section 2.2 and parents' education in Section 2.3.

2.1 Health: Definition, children's development, and adolescents' perceptions

In line with Lettau et al. (2020), we define health by accounting for *biomedical*, *social,* and *individual subjective* perspectives. For children and adolescents, we focus mainly on self-perceptions of *physical* and *mental health* as well as *daily functioning*. From this perspective, we define children's and adolescents' *physical health* as their self-perceived functional status that is based on the capabilities of the organism to resist external stressors, such as bacteria or virus infections, as well as to recover from illness or injury. We define children's *mental health* as their perceived capacity to cope with daily life. This includes individuals' assessments of positive and negative events, their daily mood, gratification of daily needs, individual vulnerability, and confidence. Based on Wilson and Cleary (1995), Bircher (2005), and Huber et al. (2011), we define children's level of *daily functioning* as their capability to meet daily needs, to tap their full potential, fulfill obligations, manage their lives, and to participate in social activities with an age-appropriate degree of independency. Furthermore, we also take into account their daily requirements, perceived potential, and existing resources.

Asking children about their health proves to be challenging since perceptions of health vary considerably by age and cognitive development. Because of children's changing perceptions of reality and information processing, their definition of health and their subjective views of their health status change at different stages of life (Lohaus and Ball, 2006; Natapoff, 1982). As their idea of health changes, their understanding of health and disease becomes more abstract and complex. For instance, children aged two to six have an egocentric perception of reality and rely on immediate temporal reference. Asking children at this age about their health leads them to evaluate their health by recognizable symptoms or diseases; they do not, however, compare themselves to other children, nor do they have a relative sense of health or illness. Therefore, children's perceptions of health at early ages are based on current pain or injuries. With increasing age and growing cognitive maturity, children from the age of seven onwards are more able to recognize temporal sequences and to include other experiences in their judgment. Although children aged seven to eleven still rely on their own experiences, they develop a more complex understanding of health and illness, by, for instance, considering previous diseases or other health-related events. This development continues in adolescence when life circumstances and past experiences are integrated into a higher logic (Lohaus and Ball, 2006), resulting in an understanding of health and illness as complex concepts.

These different understandings of health in specific age groups are accompanied by children's increasing responsibilities for self-care as well as by the impact of parents on their children's health through various health-related behaviors. Thus, early differences in health-related behaviors and parental health-related actions are of particular interest for research on education's effect on health. Going beyond measuring children's health, the NEPS therefore also provides information on health-related behavior as an important mechanism in the causal

relationship between education and health. Health-related behaviors can be also studied as an outcome, i.e., as a return to education. Such behaviors refer to actions taken by individuals which are believed to affect health. These actions might have either a positive or negative effect on an individual's health and may relate either to the person themselves or to others who are responsible for them (Kasl and Cobb, 1966; Kolbe, 1998).

2.2 A theoretical overview on the relationship between individual education and health in children and adolescents

Different disciplines offer various theoretical approaches for explaining the causal effect of education on health (Bartley, 2004; Grossman, 2006; Ross and Wu, 1995). In line with the overall concept of educational returns in NEPS (Bela et al., 2018) and with the theoretical concept for measuring health as an educational return in adult cohorts (Lettau et al., 2020), we concentrate on human and social capital theories to explain the causal effect of individual education on health in children and adolescents (see Figure 1). We account for the specifics of children and adolescents, add perspectives from self-determination theory, and emphasize reverse causality and potential confounding bias in the education-health relationship.

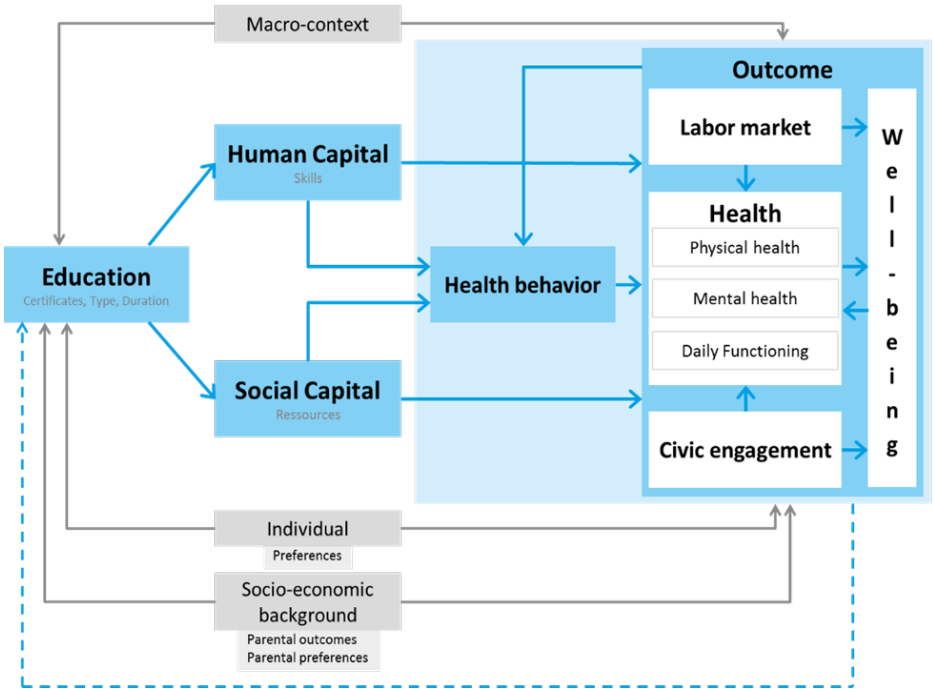


Figure 1. Theoretical concept of the effect of education on health.

Source: Illustration based on the general concept of educational returns in NEPS (Bela et al., 2018).

2.2.1 Human capital theory and skill-related feedback

Based on a skill-related focus on education's effect on health, two different theoretical approaches explain why education affects health. While the first of these refers to human capital theory (Grossman, 2000), the second refers to self-determination theory (Ryan and Deci, 2000). According to human capital theory, education enhances one's health via the initial

causal mechanism of higher cognitive and non-cognitive skills. We expect four mediating causal chains[1]:

(1) Leading to more health knowledge, education should result in higher investments in a healthy life by focusing on positive and avoiding negative health-related behaviors, which results in better health (Grossman, 2006; Ross and Wu, 1995).

(2) Education has an impact on an individual's health, as higher skills help to invest in one's health at an early stage via positive health behaviors and to identify health problems in time (Abel and Frohlich, 2012; Deaton, 2002; Grossman, 2006).

(3) A higher level of education leads to higher abilities in using given resources (such as income and time) more efficiently so that individuals achieve higher levels of an expected outcome. For example, investing more strategically in positive health behaviors, such as healthy nutrition, physical fitness, or medical care, results in better health (Grossman, 2006).

(4) More education increases the chances of attaining higher levels of income and better job positions. Higher income, in turn, allows for a healthier lifestyle and higher living standards, which translates into better health. Better job positions also lower the risks of being exposed to health-damaging factors at work (Grossman, 2006; Hoven and Siegrist, 2013; Ross and Wu, 1995; Berkman et al., 2014).

These mechanisms are different for children and adolescents and change with age. In the following, we describe the specific theoretical expectations for children and adolescents. Mechanism (4) becomes relevant once young people begin working, as adolescents and young adults earn their own income and find a suitable job only after the transition from school to the labor market. The other three mechanisms (1)–(3), however, set in earlier in life and become increasingly important with age, when children and adolescents gain more autonomy and independence from their parents so that their own preferences become more relevant. For example, young children rely heavily on their parents' investments in their health and parental consumption choices related to diet and physical activity, while legal restrictions limit children's access to harmful substances, such as tobacco products, alcohol, and drugs. As children grow older, they take more responsibility for their own health-related behavior. Older children and adolescents are thus better able to use the skills they have acquired in education to make positive investments in their health-related lifestyles and health.

Following self-determination theory, a further skill-related mechanism is expected to be particularly salient for children and adolescents during their time in the education and training system: the effect of education on health through education-related feedback on competencies (Ryan and Deci, 2000). Children and adolescents in education or training receive feedback on their skill-related performances in terms of high or low grades, repeating or skipping classes, and non-successful or successful transitions. This positive or negative feedback can have a direct impact on the mental health of children and adolescents because it affects their self-esteem and, given a positive outcome, satisfies their need for competence.

[1] For detailed information see Lettau et al. (2020).

2.2.2 Social capital

Based on social capital theory, education enhances individual health via the initial causal mechanism of higher individual social capital (Bourdieu, 1983; Verba et al., 1993). From this perspective, we expect three mediating causal chains[2]:

(1) Education promotes establishing or expanding social networks because it offers opportunities to connect with others. This translates into higher levels of social capital, which we define here in line with Granovetter (1973) and Lin (1999) as the accessibility of resources through social networks. In turn, social capital is assumed to increase individual health by offering health-related resources, such as feelings of being loved and cared for, stimulating positive health-related behavior, better coping with negative life events, assistance in daily needs and decision making, or financial and informational support (Bartley, 2004; Berkman et al., 2000; Ross and Wu, 1995).

(2) Furthermore, education affects the composition of social networks. Following the principle of homophily, individuals with higher levels of education are more likely to associate with others who are similar to them (McPherson et al., 2001). This offers normative and behavioral guidance, which among other things, is assumed to prevent negative health-related behavior, translating into better health (Thoits, 2011).

(3) Moreover, education leads to higher levels of civic engagement via higher skills and social capital (Gesthuizen et al., 2008; Hoskins et al., 2008; Lin, 1999). Civic engagement positively affects health because it provides opportunities for regular physical or mental activities and comes along with positive social roles and meaningful tasks as well as with interpersonal attachment (Kawachi and Berkman, 2001; Thoits, 2011).

Similar to human capital theories, however, the existence, strength, and scope of these mechanisms will vary with age. For instance, although there are already opportunities to participate in social clubs and groups (such as sports clubs) during childhood, mechanism (3) will first unfold in adolescence as opportunities for adolescents to be socially engaged increase. With growing age, legal age restrictions cease to apply and adolescents can take more active and leading roles in social clubs and groups, including political and work-related associations. In addition, mechanisms (1) and (2) primarily play out in the context of education institutions. The institutional context affects children's opportunities to meet others and shapes the size and composition of their social networks. Thus, children most likely correspond to peers who attend the same school or, more specifically, are in the same class, resulting in more homogeneous networks during the educational process. While in primary school, children with different background characteristics and skill levels attend the same class, tracking into secondary schools leads to increased homogeneity. Children with comparable abilities and background characteristics are most likely to be placed in the same school and class, affecting the quality of social networks (McPherson et al., 2001). This has an impact on children's health-related behavior because peers act as role models who, depending on attitudes and behavior, support either negative or positive health-related behavior (Blatchford and Baines, 2010; Ennett et al., 2008). Peer pressure results in behavioral changes that are either beneficial or harmful (Berkman et al., 2000). Thus, being in the company of peers who have started smoking or drinking alcohol might result in higher levels

[2] For detailed information see Bömmel et al. (2020) and Bömmel et al. (forthcoming).

of one's own consumption, which, in turn, influences an individual's health perceptions. Therefore, mechanism (2) is expected to become stronger when children and adolescents proceed in tracked education systems. Similarly, mechanism (1) gains relevance with age as adolescents with higher levels of education have more opportunities to expand their social networks if they, for example, study at universities, which are on average much larger than elementary and secondary schools. Attending a post-secondary educational institution is also often associated with studying in (and moving to) a different location, leading to new contacts due to regional mobility. This effect is intensified when adolescents with higher levels of education enter the labor market and take higher-status jobs that offer more opportunities to interact with others in comparison to lower-status jobs typically taken by those with lower levels of education. Smaller social networks for children and adolescents with low levels of education put them at a higher risk for lower levels of social integration and lack of friendship. This may translate into lower self-esteem, a decreased sense of social belonging, and lower levels of perceived and received social support, all of which negatively affect health behavior and health outcomes (Cacioppo et al., 2002; Thoits, 2011). In sum, we expect mechanisms (1) to (3) to intensify with age, leading to stronger effects of education on child and adolescent health outcomes.

In addition to the mechanisms mentioned before, a further specific mechanism for children and adolescents may come into play within the specific setting of educational institutions. Individual school performance can directly impact the social integration of children and adolescents through bullying, which may, in turn, have a negative impact on their health. Recent research has shown that lower educational achievement, in particular, is associated with higher levels of victimization and bullying by peers (e.g., Bergold et al., 2020; Wolter and Seidel, 2017). This is associated with poorer mental and physical health outcomes in childhood and adolescence, and also affects later life outcomes (e.g., Nishina et al., 2005; Wolke et al., 2013). Therefore, we hypothesize that lower levels of education are associated with poorer health outcomes through peer harassment.

2.2.3 Reversed causality and confounding

In addition to education's causal effect on health, reversed causality and non-causal associations between education and health may exist due to confounding variables (see Bela et al., 2018; Elwert and Winship, 2014; Lettau et al., 2020). First, there may be reversed causality in the sense of a causal effect of health on education, as early health limitations affect brain functioning and cognitive development, which in turn affects the process of educational attainment (for a review see Case and Paxson, 2008). Second, non-causal (or spurious) pathways between education and health are likely due to confounding variables at the family and individual levels. As a result of early inequalities caused by the socioeconomic status of their parents, children grow up in unequal conditions, leading to differences in health and educational attainment (Bartley, 2004; Ben-Shlomo and Kuh, 2002; Shuey and Willson, 2014). In addition, parental health and health behavior may influence both the health and education of children and adolescents (Bratti and Mendola, 2011; Case and Paxson, 2009; Grossman, 2006). The association between education and health may, moreover, be spurious, as individual characteristics of children and adolescents, such as personality traits (e.g., Big Five) or genes, may influence both education and health (Komarraju et al., 2009; Laidra et al., 2007; Turiano et al., 2012).

From a methodological perspective, different identification strategies aim to purge an observed association of all non-causal (spurious) components so that the causal effect is isolated (Elwert & Winship, 2014). These include using exogenous variation in a quasi-experimental design, longitudinal within-estimators, or controlling for observed confounding variables to eliminate observed confounding bias. The NEPS therefore provides variables such as parental health, parental socioeconomic status, individual personality, and parental and children's preferences, that can serve as control variables.

2.3 A theoretical overview on the relationship between parental education and children's health

While parental education is a critical confounding variable to control for when estimating the causal effect of children's and adolescent education on health, we also consider it as a causal variable of interest in NEPS. How parental education affects children's health is thus a key research question. In this regard, variables on parental health and health-related behavior which are confounders in the association between offspring's education and health become mediators of the effect of parental education on the latter. Therefore, theories on the causal effect of parental education on child/adolescent health as well as theories on the non-causal association are discussed in the following (for an illustration, see Figure 2).

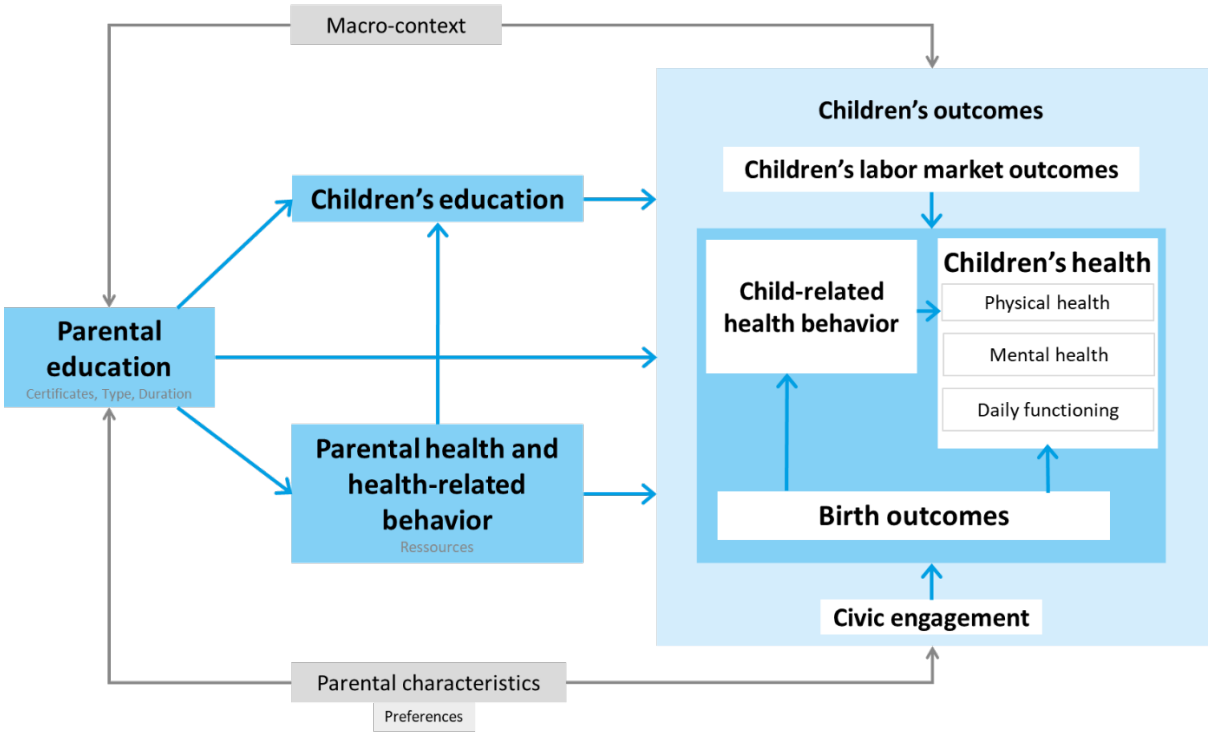


Figure 2. Theoretical concept of the effect of parental education on child health.

Source: Illustration based on the general concept of educational returns in NEPS (Bela et al., 2018).

2.3.1 Theories on the causal effect of parental education on children's/adolescents' health

Parental education affects the health of children and adolescents through several causal mechanisms. First, one causal chain runs through children's/adolescents' education. According to various theories explaining the intergenerational transmission of education across generations, a strong effect of parental education on the education of their offspring

can be expected (Breen and Goldthorpe, 1997; Stocké et al., 2011). This may provide a mediating chain for the effect of parental education on offspring health. As discussed in detail in Sections 2.2.1 and 2.2.2, several mechanisms produce an effect of education on health and health behavior. This effect initially begins in childhood, develops in adolescence and intensifies as adolescents become more autonomous and independent from their parents.

Second, based on similar arguments in sections 2.2.1 and 2.2.2, we expect an effect of parental education on parental health behavior and their health, both of which are transmitted across generations (e.g., Coneus and Spiess, 2012; Wickrama et al., 1999). Poor parental health and health behavior are likely to have a negative impact on child health, beginning during pregnancy and affecting birth outcomes. In addition, it is assumed that parents either act as role models for health behavior or that children learn from their parents' negative health behavior in order to avoid adopting the same bad habits (e.g., Wickrama et al., 1999). There may also be a secondary mechanism that runs through children's education if the health situation of parents is a burden on children's educational careers (e.g., Kristiansen, 2021). Hence, parental educational attainment not only affects children's health and health-related behavior by directly transmitting health outcomes, but also influences children's academic achievement via poor parental health.

Third, parental education may also directly affect the health of children and adolescents according to the mechanisms outlined in Sections 2.2.1 and 2.2.2, as parents' educational advantages lead them to take actions that promote children's positive health behavior and health. Higher-educated parents are assumed to know more about how their health-related behavior and health positively or negatively affect their children. They are thus more likely to avoid harmful effects of poor health habits on their children's health from the beginning of pregnancy onward (e.g., Desai and Alva, 1998; Kramer et al., 2001; Luo et al., 2006). For example, higher-educated parents are generally less likely to smoke, more likely to avoid smoking during pregnancy, and more likely to prevent passive exposure to tobacco smoke to protect their children's prenatal and early childhood development (e.g., Prickett and Augustine, 2016). In addition, higher levels of (health-related) knowledge due to education increase parents' ability to identify their children's health problems early on, to invest in preventive health care in a timely manner, and to be mindful of children's positive health behavior, such as promoting healthy nutrition practices or physical activity (e.g., Bøe et al., 2014; Lindeboom et al., 2006; Prickett and Augustine, 2016). More highly educated parents may also exhibit greater productive and allocative efficiency in making better investments in healthy living conditions that benefit the health of their offspring, such as adequate housing, quality nutrition, or valuable medical care. They are also more likely to have increased financial resources, allowing them to afford healthier lifestyles and higher health care costs. In addition, higher parental education leads to an increase in parental social capital, which also positively impacts children's health (Berkman et al., 2000; Berkman et al., 2015). For example, better-educated parents may benefit from higher levels of social support when needed, preventing negative consequences for children's health during critical life events, such as unemployment or parental conflict. Moreover, social networks also promote parental access to health-related knowledge that enables them to positively influence their children's health status (Afzal, 2013; Berkman et al., 2000; Currie, 2009). In addition to the increased size and quality of social networks, children may also benefit from the civic engagement of their parents if this translates into higher levels of civic engagement among children, which would also benefit

children's health. We therefore hypothesize that parental educational attainment is associated with child health through multiple pathways.

2.3.2 Confounding

However, apart from the causal mechanisms listed in Section 2.3.1, some theoretical arguments suggest a spurious correlation between parents' education and children's health, corresponding to the arguments made for confounding bias in the relationship between education and individual health.[3] Parental characteristics that are formed before educational attainment, such as intelligence, personality traits, and preferences, may influence both parental education and children's health, inducing a non-causal (spurious) relationship (Komarraju et al., 2009; Laidra et al., 2007; Turiano et al., 2012). For instance, parents' time preferences can affect parental education, their health behavior, and health (Farrell and Fuchs, 1982) as well as their children's health. Parents who are less able to accept current costs in favor of future benefits may have lower levels of education and may invest less in their children's health. These arguments also extend to the impact of grandparents and their health behavior if they are involved in the care of their grandchildren.

To address the potential confounding bias, different causal identification strategies such as using an exogenous source of variation (e.g., instrumental approaches), within-estimators for panel data, or controlling for confounding factors, can be employed (for a brief overview, see Section 2.2.3). However, in the case of parental education's effect on their children's health, the options for using within-estimators are very limited. This is firstly because there is almost no longitudinal measurement of parental education in the NEPS, and secondly because we would not expect substantial variation in parental education over time, as the process of parental education attainment is completed in most cases before children are born. Moreover, the options to control for observed biases in the relationship between parental education and children's health in NEPS are also limited. While some variables available in the NEPS, such as parental preferences, could be used strategically to control for such confounding variables, many confounding variables are not included in the NEPS, because it is not designed as a household survey, which would also ask parents a series of detailed questions and test their competencies. Additionally, almost no information is available on grandparents. This is, however, justified by the NEPS' focus on the determinants, measurements, and outcomes of respondents. Thus, from a causal inference perspective, the NEPS is better suited for analyzing the effect of children's education on their health than for analyzing the effect of parental education on children's health.

Despite this specific focus, the NEPS provides valuable opportunities to examine the mediation of parental education's effect on children's health as described in Section 2.3.1, because it provides measures of parental mediator variables. The NEPS, for example, contains information on parents' income, employment status, or family structure. Therefore, we address the relationship between parental education and children's health by providing (limited) information on parent's health and health behaviors as well as additional confounders, such as parents' risk and time preferences.

[3] In contrast to the effect of children's education on children's health (see Section 2.2.3) the effects of parental education on children's health are not expected to pose substantial reverse causality problems. This is because the process of parental education attainment is usually completed before the children are born. There might be cases where the parents' education career is negatively affected by poor health of the children, but this is not likely to be a common phenomenon.

3. Birth-related health outcomes in NEPS

Birth-related health outcomes are important determinants of children's cognitive development and healthy growth. In addition, they are strongly associated with parents' educational levels and may act as important mechanisms linking parental educational attainment to child health and cognitive growth (Hack et al., 2005; Mu et al., 2008; Parker et al., 1994; Tong et al., 2006). For instance, maternal educational attainment is strongly associated with preterm birth, low birth weight and size, adverse birth-related health outcomes, and infant breastfeeding (e.g., Bertini et al., 2003; Parker et al., 1994). These early health outcomes, in turn, relate to children's cognitive development (e.g., Mu et al., 2008; Shenkin et al., 2004; Sørensen , 1977; Tong et al., 2006) and various health outcomes later in life (e.g., Gale and Martyn, 2004; Hack et al., 1995; Mick et al., 2002). Therefore, we measure these respective health outcomes to account for early health inequalities. In addition, we address the mediating effect of birth outcomes on the impact of parental education on child health and consider them as potential control variables for analyses of education's effect on children and adolescents health.

3.1 Measurement concept

To measure birth-related outcomes, we include questions about gestational age, birth weight and size, and infant health at birth. In addition, we ask about breastfeeding behavior to consider one of the most important mechanisms for the effect of parental education and early child health. However, there are some differences in the measurement concepts of SC1, SC2, SC3, and SC4. For SC1, we collected information on gestational age, birth-related body measurements, birth-related health problems, and hospitalization in the first panel wave and asked about breastfeeding behavior in the second. In SC2, we surveyed birth-related health outcomes and postpartum hospitalization for all parents in Wave 1 (2011) and for first-wave respondents in Wave 3 (2013), but did not ask about breastfeeding. In SC3 and SC4, we included only birth-related body measurements and birth-related health impairments and hospitalizations in the parent survey due to limited survey time (see Table 1). In future surveys we will ask parents only about gestational age, birth weight and size, and breastfeeding behavior.

Table 1: *Measurement Concept of Birth-Related Health Outcomes*

		Wave														
SC	**Measurements**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
1	Gestational age				P											
	Birth size and weight				P											
	Health impairments after				P											
	birth Hospitalization				P											
	Breastfeeding					P										
2	Gestational age[1]			P		P										
	Birth size and weight			P		P										
	Health impairments after			P		P										
	birth Hospitalization			P		P										
	Breastfeeding															
3	Gestational age															
	Birth size and weight			P												
	Health impairments after						P									
	birth Hospitalization						P									
	Breastfeeding															
4	Gestational age															
	Birth size and weight				P											
	Health impairments after							P								
	birth Hospitalization							P								
	Breastfeeding															

[1] In SC2, we did not ask directly about gestational age. The parents are asked whether the child was born premature or not.
Note: Years in which no survey was conducted in the respective starting cohort are shaded gray. "P" stands for parents' response.

3.1.1 Gestational age

To capture *gestational age*, we ask parents 'At how many weeks of pregnancy was <target child's name> born?' (see Table 2), which is in line with other large-scale surveys such as the German Socio-Economic Panel (SOEP), the German Health Interview and Examination Survey for Children and Adolescents (KiGGS), and the British Millennium Cohort Study. We took the corresponding question from the KiGGS and extended the item by including the children's names in the question. This item is only available in SC1. In SC2, we directly ask whether the child was born prematurely or not. In future surveys, however, we will combine both questions by first asking about gestational age and then supplementing this question with a direct measure of preterm birth for all parents who do not know the exact gestational age of the child (see Table 3). This is because the exact gestational age should be the more valuable information but may be difficult to answer for parents of children aged ten years and older. Therefore, we provide a closed option to obtain a minimum of information about the children's gestational age from all parents.

Table 2: *Measurement of Gestational Age*

SUF-File	Variable	German text	English text
pParent	p529100	In welcher Schwangerschaftswoche wurde <Name des Zielkindes> geboren?	At how many weeks of pregnancy was <name of the target child> born?
		_ _ Woche	_ _ week
		-97 - Verweigert	-97 - Refused
		-98 - Weiß nicht	-98 - Don't know

Table 3: *Measurement of Gestational Age (closed)*

SUF-File	Variable	German text	English text
pParent	p529121	Es würde uns schon weiterhelfen, wenn Sie uns sagen können, ob <Name des Zielkindes> ein frühgeborenes oder reifes Kind war?	It would be quite helpful if you could tell us whether <name of target child> was a premature or mature child?
		Bitte vorlesen: Unter einem frühgeborenen Kind verstehen wir Kinder, welche mindestens 3 Wochen vor dem errechneten Termin geboren wurden. Unter einem reifen Kind verstehen wir hingegen Kinder, welche zwischen 3 Wochen vor und 2 Wochen nach dem errechneten Termin geboren wurden.	Please read aloud: A premature child is a child born at least 3 weeks before the expected date of delivery. A mature child is a child born between 3 weeks before and 2 weeks after the expected date of delivery.
		1 - ein Frühgeborenes	1 - a premature baby
		2 - ein reifes Kind	2 - a mature baby
		-97 - Verweigert	-97 - Refused
		-98 - Weiß nicht	-98 - Don't know

3.1.2 Birth size and weight

To collect birth-related body measurements, we surveyed measurements of *birth size and weight* in SC1 to SC4. In line with other large-scale panel surveys, we rely on self-reported information from parents (see Table 4). However, in the case of SC1, we include interviewer instructions that refer to the child's documented medical records to determine exact birth weight and size.

Table 4: *Measurement of Birth Size and Weight*

SUF-File	Variable	German text	English text
pParent	p529001	Wie groß war <Name des Zielkindes> bei der Geburt? _ _ cm -97 - Verweigert -98 - Weiß nicht	What size was <name of the target child> when she/he was born? _ _ cm -97 - Refused -98 - Don't know
	p529000	Wie schwer war <Name des Zielkindes> bei der Geburt? _ _ _ _ Gramm -97 - Verweigert -98 - Weiß nicht	What was the weight of <name of target child> at birth? _ _ _ _ Gram -97 - Refused -98 - Don't know

3.1.3 Health impairments after birth and hospitalization

To examine children's physical health after birth, we survey parents about children's *early health impairments* and *hospitalization* soon after birth in most starting cohorts. This is consistent with the Millennium Cohort Study (MCS), which tracks hospitalizations for a variety of reasons including accidents, injuries, or illness and health problems (National Centre for Social Research, 2003). However, we scaled down the instrument provided by the MCS to two simple questions – taking into account the time constraints in each wave of the survey. First, we ask whether the target child suffered from any health impairment in the first four weeks (see Table 5). Second, we ask about hospitalizations due to these early health impairments (see Table 6). We introduced these questions in SC1 and SC2 to observe early health inequalities in children's lives. In SC3 and SC4, these measures account for potentially confounding relationships between early health inequalities and educational outcomes. However, even when following this strategy, conceptual differences between starting cohorts must be taken into account. While both items are available in SC2, SC3, and SC4, we asked parents in SC1 only for hospitalizations due to early health impairments.[4]

[4] This required adjustments to the wording in the instrument in SC1. In SC1 we asked: 'Did <name of the target child> have to be admitted to hospital due to health problems during the first three months of their life?' Moreover, in SC1 we additionally ask about overnight stays in the hospital.

Table 5: *Measurement of Physical Health at Birth - Health Impairments after Birth*

SUF-File	Variable	German text	English text
pParent	p529102	Sind bei <Name des Zielkindes> in den ersten 4 Lebenswochen nach der Geburt gesundheitliche Probleme aufgetreten?	Did <name of target child> suffer from health problems during the first 4 weeks after birth?
		1 - ja	1 - yes
		2 - nein	2 - no
		-97 - Verweigert	-97 - Refused
		-98 - Weiß nicht	-98 - Don't know

Table 6: *Measurement of Physical Health at Birth - Hospitalization*

SUF-File	Variable	German text	English text
pParent	p529108	Musste <Name des Zielkindes> deswegen in einem Krankenhaus stationär aufgenommen werden?	Did <name of target child> have to be admitted to a hospital for in-patient treatment because of that?
		1 - ja	1 - yes
		2 - nein	2 - no
		-97 - Verweigert	-97 - Refused
		-98 - Weiß nicht	-98 - Don't know

3.1.4 Breastfeeding

To measure differences in *breastfeeding*, we ask parents, following the KiGGS (Robert Koch Institute, 2003), "How long was <name of the target child> breastfed only, i.e., was not given any additional bottle, infant formula or solid food?" (see Table 7). In doing so, however, we shortened the KiGGS questions, as we only directly ask about exclusive breastfeeding instead of using multiple questions that refer to different types of breastfeeding. Information on the duration of exclusive breastfeeding is recorded in months and weeks.[5] In SC1, we asked parents in the second panel wave. In future surveys, parents will be asked in the first wave of the panel study, and first wave respondents in later waves will also receive this question.

[5] There are two separate variables in the scientific use files. One contains information about the duration in months and another about the number of weeks. To obtain the total duration of breastfeeding, both values must be combined.

Table 7: *Measurement of Breastfeeding*

SUF-File	Variable	German text	English text
pParent	p526200/ p526201	Wie lange wurde <Name des Zielkindes> ausschließlich gestillt, also ohne zusätzliche Gabe von Flaschennahrung, Säuglings-anfangsnahrung oder Beikost? Als ausschließlich gestillt gilt es auch, wenn Muttermilch abgepumpt und diese an <Name des Zielkindes> mit der Flasche gefüttert wurde. Falls <Name des Zielkindes> nie ausschließlich gestillt wurde, bitte „trifft nicht zu“ eingeben. Für Werte unter einem Monat bitte 0 Monate eintragen. Gibt Befragte z.B. 5 1/2 Monate an, bitte 5 Monate und 2 Wochen eingeben. _ _ Monate _ _ Wochen -97 - Verweigert -98 - Weiß nicht	How long was <name of the target child> breastfed only, i.e. was not given any additional bottle, infant formula or solid food? Breastfed only also applies to breast milk that is pumped and fed to <name of the target child> by bottle. If <name of the target child> was never breastfed only, please state "not applicable". For values under one month, please enter 0 months. If the respondent answers with, for example, 5 ½ months, please enter 5 months and 2 weeks. _ _ Months _ _ Week -97 - Refused -98 - Don't know

3.2 Empirical results

To examine the validity of the birth-related health measurements, we show distributions of each item, present missing values, and compare our results with external data where possible. For birth-related weight, size, and breastfeeding, we compare our data with results of the representative German Health Interview and Examination Survey for Children and Adolescents (KiGGS) of the Robert-Koch Institute (RKI) (Neuhauser et al., 2013), among others. In addition, for birth-related body measures, we compare the shares of children with very low/ very high birth weight with the data from the 2013 official birth register of the Federal Statistical Office, provided by the RKI (Robert Koch Institute, 2018).

3.2.1 Gestational age

We illustrate findings for gestational age with data from SC1 and SC2, examining the distribution of parents' reports on gestational age in SC1 and the shares of children born prematurely in both starting cohorts. In SC1, the distribution is slightly skewed to the left and the reported mean in SC1 is about 39 weeks. About 50 percent of parents reported that their child was born between week 38 and 41 (see Figure 3). In addition, about 12 percent of parents stated that their child was born prematurely, which corresponds to birth before week 37 of the pregnancy (see Table 8). Similarly, in SC2, about 11 percent reported that the child was born prematurely. Compared to official statistics, results of SC1 and SC2 are close to the reported proportion of premature births. As presented by Delnord et al. (2018), official data for Germany from 2010 show that while children were born at week 39 on average, about 10 percent of children were born prematurely.

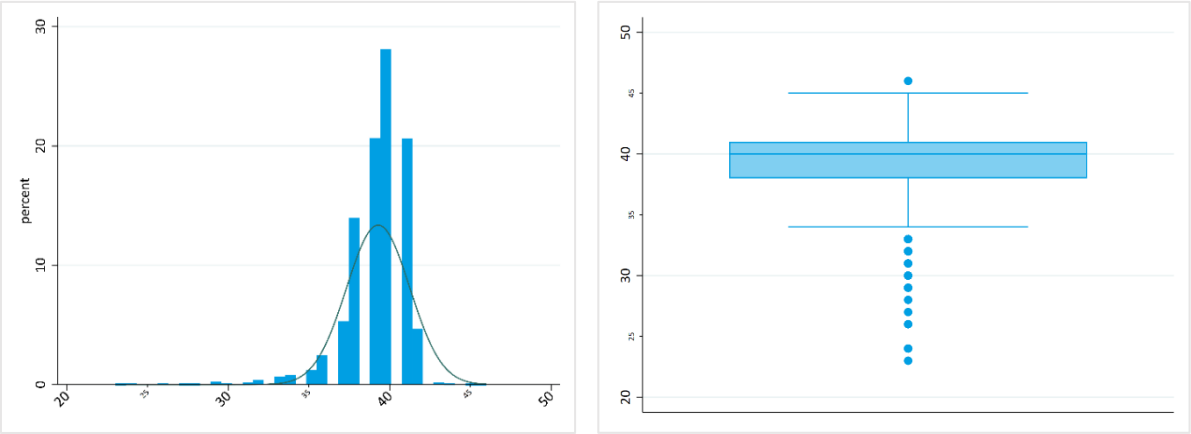


Figure 3. Gestational age in SC1 (2011).

Source: NEPS-Network (2020a). National Educational Panel Study, Scientific Use File of Starting Cohort Newborns. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC1:7.0.0.

Table 8: *Proportion of Preterm Birth in SC1 (2012/2013) and SC2 (2011)*

	SC1		SC2	
	Freq.	**Percent**	**Freq.**	**Percent**
normal birth	3,071	88.35	2083	89.02
preterm birth	405	11.65	257	10.98

Source: NEPS-Network (2020a). National Educational Panel Study, Scientific Use File of Starting Cohort Newborns. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC1:7.0.0, N=3,476; NEPS-Network (2020b). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:8.0.1, N=2,340.

Based on these descriptive results, we conclude that the direct measurement of gestational age and the question about preterm births yield similar results. However, the direct measurement could potentially provide a more accurate answer to the question of preterm birth, because respondents do not need to know the medical definition of preterm birth. In addition, the direct question about gestational age provides more detailed information about the different gradations of preterm birth.

3.2.2 Birth size and weight

Regarding birth size and weight, we provide a descriptive overview of the data available in SC1 to SC4. Table 9 presents mean values, standard deviations, medians, 25th and 75th %-percentile, and the percentage of missing information. For birth size, the mean is about 51cm and 52cm, respectively, and the standard deviations range between 3.0cm in SC1 and 3.6cm in SC3. We see similar distributions in all samples. About 50 percent of parents reported that children were born with a body size between 50 and 53cm. For birth weight, distributions differ only slightly among the four starting cohorts, with means between 3348g in SC2 and 3404g in SC4. The standard deviations differ only slightly and range from 567g in SC1 and 641g in SC3, respectively. Moreover, percentiles show no remarkable differences.

Table 9: *Descriptive Statistics of Birth Size and Weight in Starting Cohorts 1 to 4*

	Birth Size in cm						Birth Weight in Gram						N
SC	A.m.	Sd	Med	25th	75th	Miss.	A.m.	Sd	Med	25th	75th	Miss.	
SC1	51.3	3.0	51	50	53	0.1	3372	567	3410	3065	3730	0.1	3,481
SC2	51.4	3.5	52	50	53	9.0	3348	604	3380	3010	3700	7.8	8,221
SC3	51.5	3.6	52	50	53	38.1	3371	641	3400	3000	3750	37.3	8,317
SC4	51.7	3.3	52	50	53	79.6	3404	595	3450	3040	3770	79.1	16,425

Source: NEPS-Network (2020a). National Educational Panel Study, Scientific Use File of Starting Cohort Newborns. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC1:7.0.0; NEPS-Network (2020b). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:8.0.1; NEPS-Network (2019a). National Educational Panel Study, Scientific Use File of Starting Cohort Grade 5. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC3:9.0.0; NEPS-Network (2019b). National Educational Panel Study, Scientific Use File of Starting Cohort Grade 9. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC4:10.0.0.

However, we observe different ranges of missing information on children's size at birth. While we have information on at least 90 percent of children in SC1 and SC2, we do not know the size at birth of about 38 percent and 80 percent of children in SC3 and SC4, respectively. This is primarily because a large proportion of parents in SC3 and SC4 did not participate in the survey. Furthermore, the proportions of item nonresponse are lower compared to the total number of cases without information on body weight and size at birth (see Table 10), and we also note differences between the starting cohorts. Parents of older children are less likely to remember the child's birth measurements compared to parents of younger children or newborns. While only 0.1 percent of parents in SC1 did not know the birth weight and size of their children, about 4.6 and 6.7 percent of parents in SC4 could not answer these questions, respectively. These differences indicate that it is more difficult for parents of older children to remember the information. In sum, although the proportions of missing values are higher in starting cohorts 3 and 4, the missing values are within an acceptable range, and interviewing parents with older children also yields valuable data.

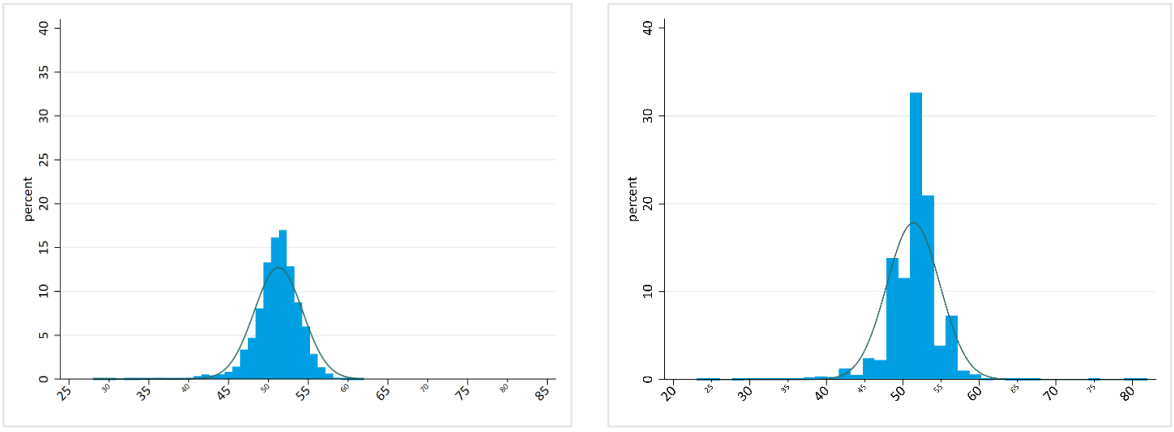
Table 10: *Missing Values of Valid Parental Interviews over SC1 to SC4 in %*

		Birth Weight		Birth Size		N
SC	Wave	Don't know	Refused	Don't know	Refused	
SC1	2012	0.1	0.0	0.1	0.00	3,481
SC2	2011	0.9	0.0	2.3	0.00	2,340
	2013	1.6	0.0	2.8	0.02	5,364
SC3	2010	2.5	0.0	3.8	0.05	4,154
	2012	3.2	0.0	3.8	0.00	1,226
SC4	2012	4.6	0.1	6.7	0.03	3,597

Source: NEPS-Network (2020a). National Educational Panel Study, Scientific Use File of Starting Cohort Newborns. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC1:7.0.0; NEPS-Network (2020b). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:8.0.1; NEPS-Network (2019a). National Educational Panel Study, Scientific Use File of Starting Cohort Grade 5. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC3:9.0.0; NEPS-Network (2019b). National Educational Panel Study, Scientific Use File of Starting Cohort Grade 9. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC4:10.0.0.

In addition to higher shares of item-nonresponse in SC3 and SC4, it might be also easier to answer the question accurately when additional material is available. Reference to the children's documented medical records in SC1 may helped parents to provide a valid response. Therefore, we further focus on SC1 and SC2 data to show response patterns with and without references to medical records. We compare the percentile values of girls and boys of SC1 and SC2 with the reference percentiles provided by the Robert Koch Institute (RKI). For birth size, the distribution is slightly skewed to the left in both starting cohorts (Figure 4). In addition, the mean in SC1 and SC2 is about 51 cm, and about 50 percent of the children were born with a size of more than 51 cm and 52 cm, respectively. Only 20 percent of the children were born with a birth size below 48 cm or above 55 cm in both starting cohorts. In contrast to the SC1 results, we see higher shares of specific values, indicating less precise measurement in SC2. For instance, about 18 percent of parents in SC2 reported a birth size of 52cm, and 16 percent report a birth size of about 51cm. In contrast, the data in SC1 shows a higher variation. To sum up, except for the extreme outliers in SC2 and higher proportion of certain values, measuring birth size with and without medical records among parents with younger children in NEPS yields comparable results.

We reach the same conclusion when comparing NEPS data to the external data of the Robert Koch-Institute. Compared to the official statistics, there are only minor differences between NEPS data and the values provided by the RKI, regardless of whether birth size is measured with (SC1) or without (SC2) reference to the medical records (see Table 11). For both starting cohorts, SC1 and SC2, the percentile values are almost identical to the official data, except for some minor differences. Similar to the RKI, we observe higher values for boys in comparison to girls. We thus conclude that the NEPS data show valid values with respect to the birth size of children in SC1 and SC2.



SC1 SC2

Figure 4. Distribution of birth size in SC1 and SC2.

Source: NEPS-Network (2020a). National Educational Panel Study, Scientific Use File of Starting Cohort Newborns. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC1:7.0.0 (remote), N=3,476; NEPS-Network (2020b). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:8.0.1, N=7,483, including only children without missing values.

Table 11: *Birth Size in SC1 and SC2 Compared to the RKI Reference Percentiles*

	Girls			Boys		
	SC1	**SC2**	**RKI**	**SC1**	**SC2**	**RKI**
	2011-2012	**2004-2007**	**2002-2006**	**2011-2012**	**2004-2007**	**2002-2006**
P10	47	48	48	49	48	49
P25	50	49	50	50	50	51
P50	51	51	51	52	52	52
P75	53	53	53	53	53	54
P90	54	54	54	55	56	55
N	1,771	3,765	8,408	1,705	3,819	8,671

Source: NEPS-Network (2020a). National Educational Panel Study, Scientific Use File of Starting Cohort Newborns. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC1:7.0.0 (remote), weighted data, including only children without missing values; NEPS-Network (2020b). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:8.0.1, weighted data, including only children without missing values; Neuhauser et al. (2013).

With respect to birth weight, the different measurements in starting cohorts 1 and 2 yield similarly valid results. The distributions are also slightly skewed to the left in both starting cohorts (see Figure 5). For SC1, the mean is about 3400 grams and about 50 percent of the children were born with a body weight between 3065 to 3730 grams. In contrast, only 2 percent were born with an extremely high weight (more than 4500 grams). Analogous results are observed for SC2. However, compared to the detailed information in SC1, parents in SC2 more often report rounded values in increments of tens or hundreds, resulting in higher proportions of specific values. Thus, for birth weight, reference to the medical records helped to improve data quality. Compared to the reference percentiles provided by the RKI, the values are somewhat smaller (see Table 12). This is particularly relevant for the boys in SC2. Compared to the RKI data, the differences are between 10 and 300 grams and are higher for the 10^{th}-, 25^{th}-, and 50^{th} percentile than for the higher percentiles. This supports the impression that, compared to the version used in SC1, asking parents about children's birth weight without using medical records leads to more inaccurate values. However, these inaccuracies are likely to be of rather minor importance in identifying children with extremely low or high birth weight. Thus, both measurements should identify children at higher risk for poor health outcomes. We conclude that, although we observe small differences in data quality between starting cohorts 1 and 2, both measures can provide adequate information on children's birth weight. In sum, asking parents about children's birth size and weight seems to be a sufficient strategy; however, especially the questions about body weight lead to a more valid response when children are younger and parents have their children's medical records at hand.

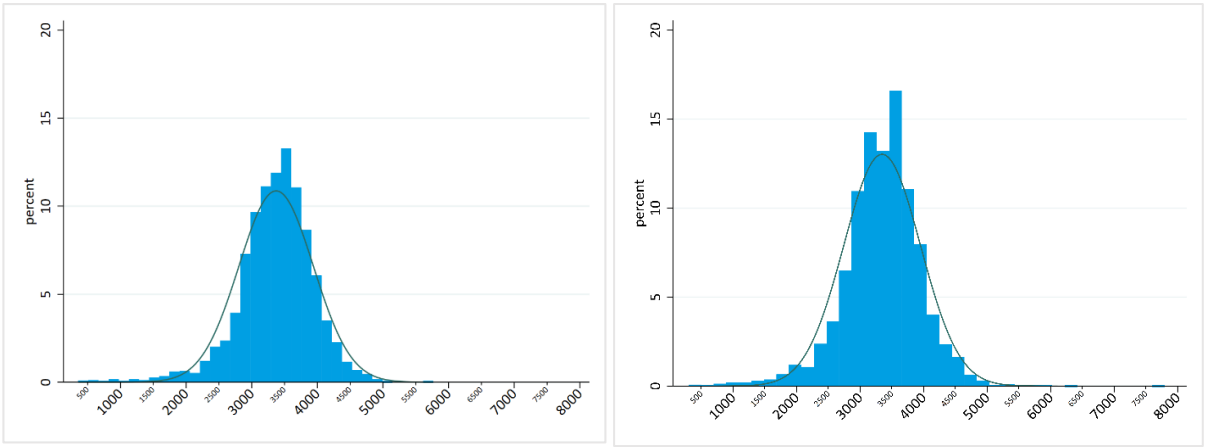


Figure 5. Distribution of birth weight in SC1 and SC2.

Source: NEPS-Network (2020a). National Educational Panel Study, Scientific Use File of Starting Cohort Newborns. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC1:7.0.0 (remote), N=3,479; NEPS-Network (2020b). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:8.0.1, N=7,578, including only children without missing values.

Table 12: *Birth Weight in SC1 and SC2 Compared to the RKI Reference Percentiles*

	Girls			**Boys**		
	SC1	**SC2**	**RKI**	**SC1**	**SC2**	**RKI**
	2011-2012	**2004-2007**	**2002-2006**	**2011-2012**	**2004-2007**	**2002-2006**
P10	2670	2600	2840	2870	2660	2960
P25	3010	3000	3100	3120	3060	3230
P50	3350	3300	3390	3470	3400	3530
P75	3670	3640	3670	3800	3780	3820
P90	3965	3950	3930	4050	4100	4090
N	1,706	3,715	8,408	1,773	3,758	8,761

Source: NEPS-Network (2020a). National Educational Panel Study, Scientific Use File of Starting Cohort Newborns. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC1:7.0.0 (remote), weighted data, including only children without missing values; NEPS-Network (2020b). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:8.0.1, weighted data, including only children without missing values; Neuhauser et al. (2013).

3.2.3 Health impairments and hospitalization after birth

To examine the validity of the measures of postpartum health impairments and hospitalizations, we present results from SC2, SC3, and SC4. With respect to the slightly different version of the hospitalization question in SC1, we also present descriptive statistics for the single-item (see Table 13).

About 10 to 15 percent of parents in SC2, SC3, and SC4 reported health problems after birth. The proportions are higher for children in SC2 compared to children in SC3 and SC4. While about 14 percent of parents in SC2 reported that their child had health problems in the first

four weeks of life, this was the case for only 12 percent and 11 percent of parents in SC3 and SC4, respectively. This could be due to the high proportion of missing information in SC3 and SC4, which is primarily reflected in selective participation of specific groups of parents, such as parents with higher socio-economic status, without migration background, and without children in special needs schools, all of which have been associated with better early health outcomes (e.g., Chen et al., 2006).[6]

Regarding hospitalization, between 6 and 14 percent of parents in SC1, SC2, SC3, and SC4 reported postpartum hospitalization, again with notable differences between the starting cohorts. While only 6.4 percent of parents in SC4 reported hospitalization of their child, the percentages were 13.5 in SC1 and about 8 percent in both SC2 and SC3. These differences persist even when we weighted the samples for better comparability, indicating that parents report different levels of hospitalizations depending on the measurement used. In addition, the question about postpartum health impairments appears to capture a substantial number of children who were not hospitalized for such problems. This implies that the NEPS identifies different children depending on the survey instrument. Because no comparable measurements are available in official statistics, the different response patterns cannot be compared to external data in order to validate our measures. For postpartum health impairments and hospitalizations, we thus conclude that only cohorts using similar measurements are comparable.

Table 13: *Health Impairments and Hospitalization after Birth in SC1, SC2, SC3, and SC4 in %*

	Health impairments after birth		**Children experienced hospitalization after birth**		
SC	**yes**	**no**	**yes**	**no**	**N**
SC1	-	-	13.5 (13.6)	86.5 (86.4)	3,481
SC2	14.3 (14.2)	85.7 (85.5)	8.3 (8.1)	91.7 (91.9)	7,767
SC3	12.3 (12.5)	87.7 (87.5)	8.1 (8.2)	91.9 (91.8)	4,170
SC4	11.1 (10.3)	88.9 (89.7)	6.4 (5.5)	93.6 (94.5)	3,583

Source: NEPS-Network (2020a). National Educational Panel Study, Scientific Use File of Starting Cohort Newborns. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC1:7.0.0; NEPS-Network (2020b). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:8.0.1; NEPS-Network (2019a). National Educational Panel Study, Scientific Use File of Starting Cohort Grade 5. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC3:9.0.0; NEPS-Network (2019b). National Educational Panel Study, Scientific Use File of Starting Cohort Grade 9. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC4:10.0.0, including only children without missing information; results of weighted data in parentheses.

3.2.4 Breastfeeding

For breastfeeding, we show descriptive results for SC1. About 86 percent of parents reported exclusively breastfeeding their child for at least one week. About 2 percent of parents reported that their child was breastfed for one week or less, and about 12 percent of the parents in SC1 reported that they did not breastfeed at any time (see Table 14). If a child was

[6] Despite unit-nonresponse, however, we observe negligible numbers of missing values due to item-nonresponse (see Table A-1 in Appendix).

breastfed, about 50 percent of parents reported that their child was breastfed for about 20 weeks or longer, 24 percent for about 24 weeks, and about 5 percent of parents reported that the child was breastfed for about 36 weeks or longer (see Figure 6). The other 50 percent of the sample reported breastfeeding for a maximum of 19 weeks, 5 percent for about 12 weeks, and about 10 percent reported breastfeeding for a maximum of 4 weeks. This suggests that the measurement captures both children that were not breastfed and children with varying degrees of breastfeeding.

To validate our measurement of breastfeeding, we compare our data with results from the second wave of the KiGGS, which includes information on children born in 2011 and 2012, and thus refers to the same birth cohorts included in the NEPS SC1. Results are presented in Table 15. Compared to the breastfeeding rates in KiGGS, we observe higher shares of breastfeeding: while about 72 percent of parents in KiGGS reported breastfeeding their child, about 85 percent of parents in NEPS did so. Parents in SC1 also reported a higher duration of exclusive breastfeeding. While in KiGGS, only 11 percent of parents reported exclusively breastfeeding for more than 6 months, about 16 percent of parents in SC1 did so. A reason for this might be that in KiGGS respondents were asked more than one question about exclusive breastfeeding: first, about breastfeeding in general; second, whether they gave supplemental bottle feeding, infant formula or solid food; and third, in which week or month they started supplemental feeding. The duration of exclusive breastfeeding can then be estimated by the researcher by using the relevant information. In contrast, we ask about exclusive breastfeeding with only one question in NEPS, explaining our definition of exclusive breastfeeding. The processing of all information from the question requires a high cognitive effort before answering it. Thus, respondents in NEPS may overrate the duration of exclusive breastfeeding, because they do not consider the same exclusion criteria as in KiGGS. As a result, we will include additional interview instructions explaining these criteria in more detail in future surveys.

Table 14: *Missing Values in Duration of Breastfeeding in SC1*

	Abs. Frequency	**Percent**
valid value (>0)	2,445	85.82
less than one week	67	2.35
don't know	5	0.18
refused	2	0.07
does not apply	330	11.58
Total	2,849	100

Source: NEPS-Network (2020a). National Educational Panel Study, Scientific Use File of Starting Cohort Newborns. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC1:7.0.0, N=2,849.

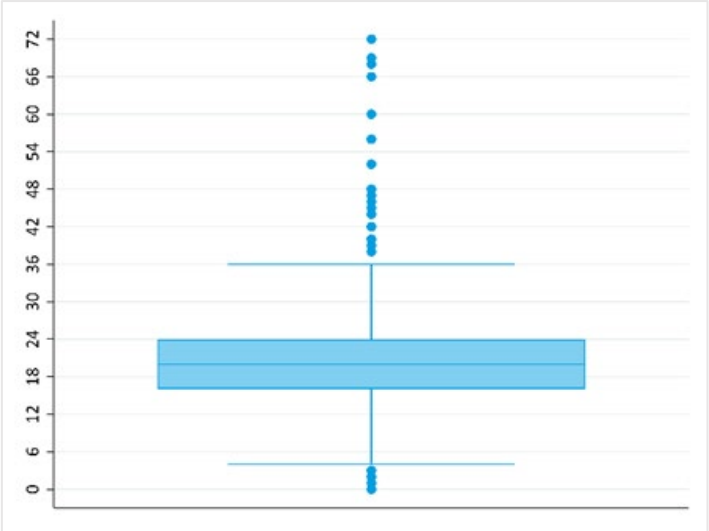


Figure 6. Duration of breastfeeding in SC1.

Source: NEPS-Network (2020a). National Educational Panel Study, Scientific Use File of Starting Cohort Newborns. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC1:7.0.0, N=2,512.

Table 15: *Breastfeeding in SC1 Compared to Results of the KiGGS*

	KiGGS 2011/2012	**SC1**
ever exclusively breastfed	72.3	84.8
at least 6 months	11.0	16.0

Source: NEPS-Network (2020a). National Educational Panel Study, Scientific Use File of Starting Cohort Newborns. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC1:7.0.0, N=2,848, weighted data; Brettschneider et al. (2018).

4. Children's and adolescents' health status in NEPS

Child health status is the main outcome of NEPS when considering health as a return to education in starting cohorts on children and adolescents. This includes individuals' mental and physical health as well as their daily functioning, all of which are associated with education (Cutler and Lleras-Muney, 2006). Thus, in order to provide data for causal analyses on education's effects on health, we provide different measurements for the target child's health.

4.1 Measurement concept

To measure the health of children and adolescents in the NEPS, we capture physical and mental health aspects as well as daily functioning, focusing on individuals' self-perceptions. We take into account the age of the target person and use age-specific instruments, additionally using the parents' information as a proxy when children are too young and cannot be interviewed directly. In addition to these subjective assessments, we ask about medically diagnosed health limitations in several areas and consider children's body weight and height. Table 16 shows a summary of all instruments. Instruments aimed at parents are marked with "P", while measurements that directly address the target child are marked with "T" and "T_{indv}".

Table 16: *Measurement Concept of Current Health Status*

SC	Measurements	Wave 2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	Self-rated health				P	P	P	P	P	P	P	P	P	P, T	P, T	P, T
	Body height and weight				P	P	P	P	P		P	P	P	P	P	P
	Subjective physical health status															
	Subjective mental health status													T		T
	Medically diagnosed health restriction					P	P		P	P						
2	Self-rated health			P	P	P	P	P, T	P, T	P, T	T	P	T	T		
	Body height and weight			P			P		P	T	T	P	T			
	Subjective physical health status															
	Subjective mental health status															
	Medically diagnosed health restriction															
3	Self-rated health		T	P, T	P, T	T	P, T	P, T, T_{indv}	T, T_{indv}	T, T_{indv}	T_{indv}	T_{indv}	T_{indv}	T_{indv}		
	Body height and weight				T			T			T_{indv}		T_{indv}	T_{indv}		
	Subjective physical health status [1]															
	Subjective mental health status [1]										(T_{indv})		(T_{indv})	(T_{indv})		
	Medically diagnosed health restriction															
4	Self-rated health			T, T_{indv}	T, T_{indv}	T, T_{indv}	T, T_{indv}	T, T_{indv}	T, T_{indv}		T_{indv}	T_{indv}	T_{indv}	T_{indv}	T_{indv}	T_{indv}
	Body height and weight			T			T, T_{indv}					T_{indv}				T_{indv}
	Subjective physical health status[1]															
	Subjective mental health status[1]											(T_{indv})		(T_{indv})		(T_{indv})
	Medically diagnosed health restriction															

[1] In SC3 and SC4, subjective physical and mental health status is measured by the Healthy Days-Instrument, which refers to the measurement concept of adults only (see Lettau et al., 2020).
Note: Indicators referring to the measurement concept of adults are shaded in grey.

4.1.1 Self-rated health

To measure the overall subjective health status of children and adolescents, we implemented a common and valid measurement of overall *self-rated health* (see Table 17). This indicator provides valid and reliable responses on individuals' overall health status. Responses are highly correlated with, for example, chronic illnesses, physical health limitations, and problems in daily performance (Abdulrahim and El Asmar, 2012; Lundberg and Manderbacka, 1996; Singh-Manoux et al., 2006). In line with the KIGSS, we ask children to rate their general health through response categories ranging from 'very good' to 'very poor' (Kuntz et al., 2018). We use a smiley-faced Likert-scale for children up to the age of 10 (grade 4) to address challenges in responses by younger children following suggestions by, for example, Hall et al. (2016) and Eiser et al. (2000) (see Table 18). Although it is highly important to interview children directly, we complement the target's response with information based on parents' perceptions as recommended by De Bruin et al. (1996) or Szilagyi and Schor (1998).

Table 17: *Measurements for Children's Overall Subjective Health Status – Self-Rated Health*

SUF-File	Variable	German text	English text
pTarget	t521000	Nun habe ich eine kurze Frage zu deiner Gesundheit. Wie würdest du deinen Gesundheitszustand im Allgemeinen beschreiben?	I now have a brief question about your health. How would you generally describe your state of health?
		1 - Sehr gut	1 - Very good
		2 - Gut	2 - Good
		3 - Mittelmäßig	3 - Average
		4 - Schlecht	4 - Poor
		5 - Sehr schlecht	5 - Very poor
		-90 - nicht spezifizierbar fehlend	-90 - unspecific missing
		-95 - unplausibler Wert	-95 - implausible value
		-98 - Weiß nicht	-98 - don't know
pParent	p521000	Nun möchte ich Ihnen einige Fragen zur Gesundheit von <Name des Zielkindes> stellen. Wie würden Sie den Gesundheitszustand von <Name des Zielkindes> im Allgemeinen beschreiben?	And now I would like to ask you a couple of questions about the health of <name of the target child>. How would you describe the health condition of <name of the target child> in general?
		1 - Sehr gut	1 - Very good
		2 - Gut	2 - Good
		3 - Mittelmäßig	3 - Average
		4 - Schlecht	4 - Poor
		5 - Sehr schlecht	5 - Very poor
		-97 - Verweigert	-97 - Refused
		-98 - Weiß nicht	-98 - Don't know

Table 18: *Smiley-faced Likert-Scale for Children up to the Age of 10 (English Translation)*

I now have a brief question about your health. How would you generally describe your state of health?		
Please mark only one answer.		
	very good	☐
	good	☐
	average	☐
	poor	☐
	very poor	☐

4.1.2 Subjective physical and mental health

Even though self-rated health has been shown to be an effective measure of individual health status, validation studies reveal that respondents relate more strongly to their self-perceived physical health and daily functioning than to their mental health (Krause and Jay, 1994). This also applies to children. A cognitive pretest conducted by the NEPS indicates that children primarily refer to their general well-being, physical health, and daily limitations.[7] In addition, physical health components and daily limitations explain a larger part of the children's self-rated health in quantitative assessments (Boardman, 2006). Thus, for a more accurate assessment of health, it seems highly valuable to add further questions to more directly capture children's *subjective physical health* and *mental health*. We therefore refer to short subscales of the German version of the Kid-KINDL that measures children's subjective physical health and psychological well-being, both of which are highly correlated with children's actual physical and mental health outcomes (Bullinger et al., 2008). The physical health subscale complements the self-rated overall health status, and the psychological wellbeing subscale adds to other, more specific questions in NEPS that address children's strengths and problems regarding behavioral issues, prosocial behavior, and hyperactivity. Using eight items, we ask children how they felt during the past week, referring to illness, headache and abdominal pain, exhaustion and weakness, strength and stamina, fun and laughter, boredom, loneliness, and scaredness (see Table 19) (Ravens-Sieberer and Bullinger, 1998; Ravens-Sieberer and Bullinger, 2000). Due to time constraints in most starting cohorts that include children, we include these questions biennially in SC1 and in future surveys. In addition, we only ask for the subjective mental health dimension in SC1.[8]

Using only the subscales for physical and emotional well-being of the Kid-KINDL, however, has its limitations. First, measuring physical and mental health with only four items each may only provide rough measurements of children's actual physical and mental health status. Second, Kid-KINDL provides four additional subscales related to physical health, self-esteem, family, friends, and school, rendering the use of only one group of items no longer comparable to the

[7] Detailed information is provided in chapter 4.2.1 and is available on request.

[8] In SC2, a school-related version of the Kid-KINDL was implemented in waves 6 and 7. However, this does not measure overall health status as it refers to the school context only. In future surveys, we plan to refer to the original version by Ravens-Sieberer and Bullinger (2000).

original version (Ravens-Sieberer and Bullinger, 2000). Therefore, direct comparability with the Kid-KINDL may be limited. However, to the best of our knowledge, it is the shortest and most effective instrument suitable for NEPS.

Table 19: *Measurement of Children's Subjective Physical and Mental Health Status*

SUF-File	Variable	German text	English text
pTarget		Nun möchten wir etwas darüber wissen, wie du dich fühlst. In der letzten Woche …	First of all, we would like to know something about how you've been feeling in general …
	t521401	… habe ich mich krank gefühlt.	… I felt ill.
		1 - nie 2 - selten 3 - manchmal 4 - oft 5 - immer -90 - nicht spezifizierbar fehlend -95 - unplausibler Wert -98 - Weiß nicht	1 - never 2 - seldom 3 - sometimes 4 - often 5 - all the time -90 - unspecific missing -95 - implausible value -98 - don't know
	t521402	… hatte ich Kopfschmerzen oder Bauchschmerzen.	… I had a headache or tummy-ache.
	t521403	… war ich müde und schlapp.	… I was tired and worn-out.
	t521404	… hatte ich viel Kraft und Ausdauer.	… I felt strong and full of energy.
	t521405	… habe ich viel gelacht und Spaß gehabt.	… I had fun and laughed a lot.
	t521406	… war mir langweilig.	... I was bored.
	t521407	… habe ich mich allein gefühlt.	... I felt alone.
	t521408	… habe ich Angst gehabt.	... I was scared.

Source: Ravens-Sieberer and Bullinger (1998; 2000).

4.1.3 Medically diagnosed health restrictions

To complement these subjective assessments of health status, we include some more objective indicators in all starting cohorts. Until the instrument revision in 2017, we collected questions related to *medically diagnosed health restrictions* (see Table 20), asking parents whether their child had been diagnosed by a doctor as having a health-related limitation, such as a limitation in vision, hearing, mobility, physical or mental performance.[9] Additionally, we included chronic illnesses for measuring persistent health limitations and asked about other health limitations in an open text format.[10] However, due to time restrictions in SC2 to SC4, these questions are only available in SC1, and they are also no longer included in NEPS after 2017 because of limitations that require a revision of the instrument (see section 4.2 for detailed information). Thus, for future surveys, we will develop an improved version in line with the MCS, the SOEP and KiGGS that asks directly for medical diagnoses.

Table 20: *Measurement of Medically Diagnosed Health Restrictions*

SUF-File	Variable	German text	English text
pParent	p524400	Es gibt ja Kinder, die bereits in diesem Alter gesundheitliche Einschränkungen haben, zum Beispiel Seh- oder Höreinschränkungen, körperliche oder geistige Einschränkungen oder chronische Krankheiten, wie Neurodermitis oder Asthma. Ist bei <Name des Zielkindes> irgendeine dieser Einschränkungen durch eine Ärztin bzw. einen Arzt !!festgestellt!! worden?	There are children that already have health impairments at this age, for example, vision or hearing impairments, physical or mental impairments or chronic illnesses, such as neurodermatitis or asthma. Has <name of the target child> been !!diagnosed!! with any of these impairments by a doctor?
		1 - ja 2 - nein -97 - Verweigert -98 - weiß nicht	1 - yes 2 - no -97 - Refused -98 - Don't know
	p52440	Welche Einschränkungen sind bei <Name des Zielkindes> durch eine Ärztin bzw. einen Arzt !!festgestellt!! worden?	Which limitations has <name of the target child> been !!diagnosed!! with by a doctor?
		1 - Genannt 0 - Nicht genannt -97 - Verweigert -98 - Weiß nicht	1 - Specified 0 - Not specified -97 - Refused -98 - Don't know

[9] Note that some other versions are available for SC1. For detailed information, see Table A-2 and Table A-3 in the Appendix.

[10] For higher usability, open response are recoded based on categories of the ICD-10.

Table 20: *Measurement of Medically Diagnosed Health Restrictions (continued)*

SUF-File	Variable	German text	English text
	p524401	Seheinschränkungen	Visual impairments
	p524402	Höreinschränkungen	Hearing impairments
	p524403	motorische Einschränkungen	Motor impairments
	p524404	chronische Krankheiten, wie Asthma oder Neurodermitis	Chronic illnesses such as asthma or neurodermatitis
	p524405	sonstige körperliche Einschränkungen	Other physical impairments
	p524406	geistige Einschränkungen	Mental impairments
	p524407	andere Einschränkungen	Other impairments

4.1.4 Body height and weight

We included *body height* and *weight* into all NEPS starting cohorts and surveyed either parents or children themselves (see Table 21 and Table 22). Body height is an important indicator of infant and child health. Low growth rates reflect unfavorable conditions, such as insufficient nutrition, deprivation, or early childhood infectious diseases (Onis, 2008; Ulijaszek, 2006). The weight-to-height ratio provided by the Body Mass Index (BMI) measures children's physical constitutions, and changes in age-standardized scores are an indicator for changes in body fatness (Centers for Disease Control and Prevention, 2014). These indicators are strongly associated with socio-economic background characteristics such as parental education or income (e.g., Lamerz et al., 2005; Murasko, 2009; Svensson et al., 2014; Wang and Zhang, 2006). In addition, individuals' educational levels are associated with higher BMI and higher risk of obesity and being overweight at older ages (e.g., Ailshire and House, 2011; Brunello et al., 2016; Devaux and Sassi, 2013; Kemptner et al., 2011).

However, in large-scale surveys that rely on individuals' subjective responses, body measurements are often biased by systematic misreporting (Kroh, 2005). To achieve higher data quality, we therefore refer to regular medical check-ups where possible. We ask parents of children up to the age of 5 to report the child's height and weight based on the annual medical check-up (see Table 21). For older children such as in starting cohorts 3 and 4, for whom medical check-ups are no longer required, we can rely only on reports from children and parents (see Table 22).

Table 21: *Measurements for Children's Body Height and Weight Based on Medical Health Check Ups*

SUF- File	Variable	German text	English text
pParget	p5290XX	Wann war die X. Vorsorgeuntersuchung, die UX? Bitte nennen Sie Monat und Jahr. Monat _ _ Jahr _ _ _ _ -96 - Trifft nicht zu -97 - Verweigert -98 - Weiß nicht	When was the Xth medical checkup (the UX)? Please tell me the month and year. Month _ _ Year _ _ _ _ -96 - Does not apply -97 - Refused -98 - Don't know
	p5290XX	Wie groß war <Name des Zielkindes> bei der X. Vorsorgeuntersuchung, der UX? _ _ _ cm -97 - Verweigert -98 - Weiß nicht	How tall was <name of the target child> at the Xth medical checkup (the UX)? _ _ _ cm -97 - Refused -98 - Don't know
	p5290XX	Wie schwer war <Name des Zielkindes> bei der X. Vorsorgeuntersuchung, der UX? _ _ _ kg -97 - Verweigert -98 - Weiß nicht	What was <name of the target child>'s weight at the Xth medical checkup (the UX)? _ _ _ kg -97 - Refused -98 - Don't know

Note: For each medical checkup new variables are generated for three items. Thus, we insert 'X' exemplarily.

Table 22: *Individuals and Parents Ratings of Body Height and Body Weight without Reference to Medical Check-Ups*

SUF- File	Variable	German text	English text
pTarget	t520001	Wie groß bist du? _ _ _ cm -90 - nicht spezifizierbar fehlend -95 - unplausibler Wert -98 - Weiß nicht	How tall are you? _ _ _ cm -90 - unspecific missing -95 - implausible value -98 - don't know
	t520000	Wie viel wiegst du ohne Kleidung? _ _ _ kg -90 - nicht spezifizierbar fehlend -95 - unplausibler Wert -98 - Weiß nicht	What is your body weight excluding clothes? _ _ _ kg -90 - unspecific missing -95 - implausible value -98 - don't know
pParget	p520001	Wie groß ist <Name des Zielkindes> ohne Schuhe gemessen? _ _ _ cm -97 - verweigert -98 - weiß nicht	How tall is <target child's name> approximately with no shoes on? _ _ _ cm -97 - Refused -98 - Don't know
	p520000	Wie viel wiegt <Name des Zielkindes> ohne Kleidung? _ _ _ kg -97 - verweigert -98 - weiß nicht	How much does <target child's name> approximately weigh with no clothes on? _ _ _ kg -97 - Refused -98 - Don't know

4.2 Empirical results

To see whether the aforementioned measurements yield reliable and valid results for children's health status, we present descriptive results from parents' and children's reports for different starting cohorts, compare NEPS data with external information, and refer to external validation studies if data are not available in NEPS.

4.2.1 Self-rated health

For children's and adolescents' self-rated health, we show descriptive results from target and parent reports. Since responses are available in SC2 and SC3, we use data from both cohorts.[11] The overall mean of self-rated health ranges between 1.4 and 1.8, and parents' ratings are on average slightly lower than children's ratings in both starting cohorts, indicating more positive parental assessments of their child's health (see Table 23). Overall standard deviations are similar in both starting cohorts, and the between-individuals variances are slightly larger than

[11] Detailed descriptions of the sample are provided in Table A-4 and Table A-5 of the Appendix.

the within-individuals variances, suggesting that the differences between individuals over time are larger than those within individuals.

Regarding the response behavior of parents and children, Figure 7 and Figure 8 show that both groups predominantly rated children's health status as 'very good' or 'good'. Less than 10 percent of parents and 20 percent of targets rated child's health as equal to or worse than 'average'. However, parents are somewhat more optimistic about their children's health than the target persons themselves. While more than half of parents reported 'very good' child health, this was only the case for about 40 to 50 percent of children (see Table 23). Paired t-tests indicate that reported differences between parents and children are statistically significant at the 1 percent-level in all waves and both starting cohorts (see Table 24). These results are consistent with other surveys that use self-rated health measures as an overall assessment of children's health status (Robert Koch Institute, 2014).

Table 23: *Descriptive Results of Targets and Parents Reports of Self-Rated Health in SC2 and SC3 (all relevant waves)*

SC			Mean	Std. Dev.	Min	Max	Observations
SC2	Target	overall	1.708	0.779	1	5	N = 20,339
		between		0.617	1	5	n = 7,376
		within		0.526	-0.542	4.708	T-bar = 2.76
	Parents	overall	1.414	0.599	1	5	N = 32,100
		between		0.498	1	5	n = 8,221
		within		0.378	-0.586	4.842	T-bar = 3.91
SC3	Target	overall	1.818	0.788	1	5	N = 50,239
		between		0.589	1	5	n = 8,156
		within		0.561	-0.848	5.374	T-bar = 6.12
	Parents	overall	1.528	0.669	1	5	N = 15,905
		between		0.570	1	5	n = 5,293
		within		0.382	-0.972	4.528	T-bar = 3.01

Source: NEPS-Network (2020b). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:8.0.1 (download); NEPS-Network (2019a). National Educational Panel Study, Scientific Use File of Starting Cohort Grade 5. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC3:9.0.0.

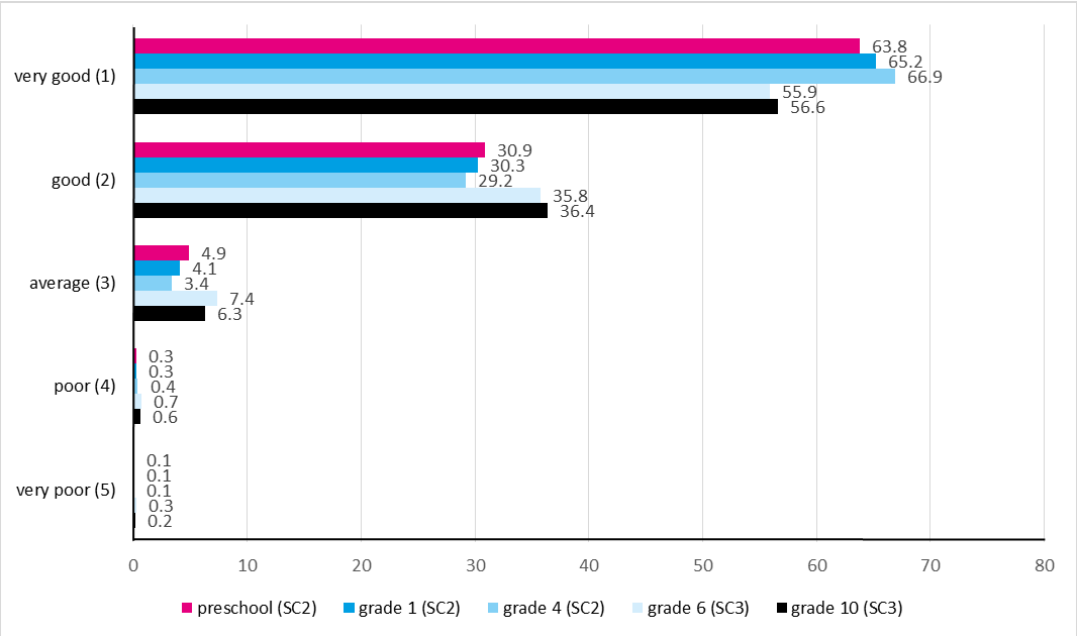


Figure 7. Parents' ratings of children's overall health status in SC2 and SC3.

Source: NEPS-Network (2020b). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:8.0.1 (download); NEPS-Network (2019a). National Educational Panel Study, Scientific Use File of Starting Cohort Grade 5. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC3:9.0.0 (download).

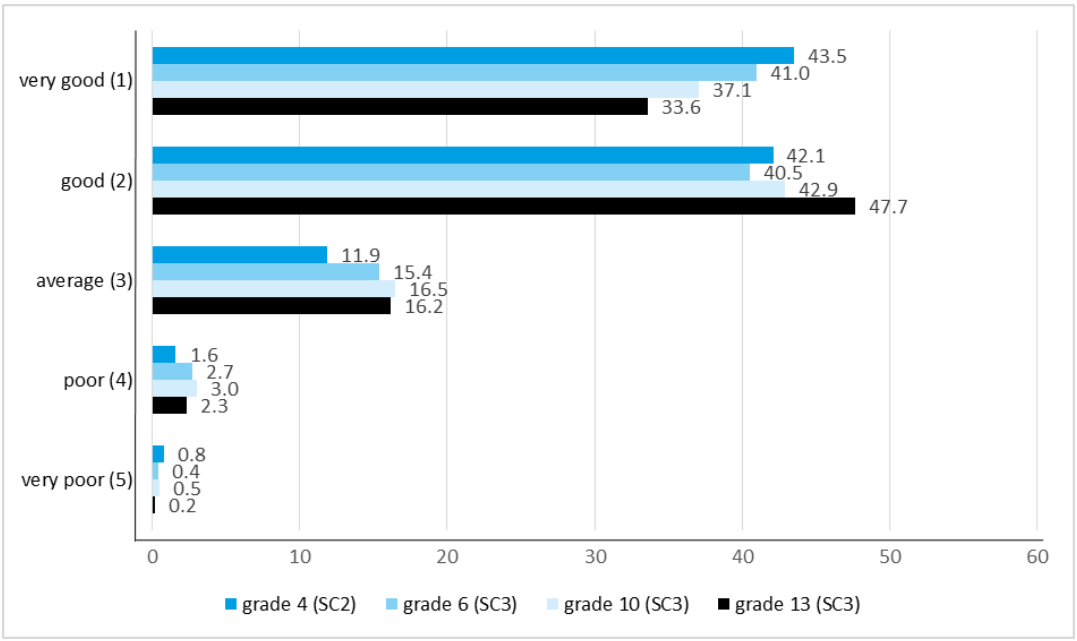


Figure 8. Targets' ratings of their overall health status in SC2 and SC3.

Source: NEPS-Network (2020b). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:8.0.1 (download); NEPS-Network (2019a). National Educational Panel Study, Scientific Use File of Starting Cohort Grade 5. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC3:9.0.0 (download).

Table 24: *Paired t-Test for Differences in Targets and Parents Ratings in SC2 and SC3*

SC	wave	Targets	Parents	Δ	p-value
SC2	2015	1.86	1.38	0.48	0.000
	2016	1.74	1.36	0.38	0.000
	2017	1.58	1.45	0.13	0.000
SC3	2011	1.82	1.51	0.31	0.000
	2012	1.76	1.52	0.24	0.000
	2013	1.81	1.50	0.31	0.000
	2015	1.85	1.50	0.35	0.000

Source: NEPS-Network (2020b). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:8.0.1 (download); NEPS-Network (2019a). National Educational Panel Study, Scientific Use File of Starting Cohort Grade 5. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC3:9.0.0 (download).

We also tested the reliability of self-rated health status in target subjects and parents' assessments and show polychoric correlations between all waves, separately for SC2 and SC3. We used child and parent assessments observed in all corresponding panel waves, and present results in tables 25 to 28. Polychoric correlations in parent responses show moderate correlations between panel waves, indicating sufficient reliability but also variance between panel waves, which may reflect health changes over time. In contrast, children's and adolescents' assessments of their overall health status correlate only weakly to moderately with previous responses to the same questions. Children's assessments between 2015 and 2017 in SC2 particularly indicate lower reliability when compared to parents' assessments and adolescents' response in SC3, suggesting lower reliability especially among younger children.

Table 25: *Correlations over Panel Waves in Parent's Ratings in SC2*

	Wave	2011	2012	2013	2014	2015	2016	2017
Wave	Age	4	5	6	7	8	9	10
2011	4	1.00						
2012	5	0.67	1.00					
2013	6	0.58	0.66	1.00				
2014	7	0.57	0.58	0.71	1.00			
2015	8	0.50	0.51	0.61	0.62	1.00		
2016	9	0.43	0.50	0.63	0.62	0.67	1.00	
2017	10	0.40	0.44	0.49	0.53	0.57	0.64	1.00

Source: NEPS-Network (2020b). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:8.0.1 (download), N=694.

Table 26: *Correlations over Panel Waves in Target's Ratings in SC2*

	Wave	2015	2016	2017	2018
Wave	**Age**	**8**	**9**	**10**	**11**
2015	8	1.00			
2016	9	0.36	1.00		
2017	10	0.29	0.42	1.00	
2018	11	0.27	0.38	0.55	1.00

Source: NEPS-Network (2020b). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:8.0.1 (download), N=2,439.

Table 27: *Correlations over Panel Waves in Parent's Ratings in SC3*

	Wave	2011	2012	2013	2015
Wave	**Age**	**11**	**12**	**13**	**15**
2011	11	1.00			
2012	12	0.68	1.00		
2013	13	0.60	0.66	1.00	
2015	15	0.56	0.64	0.65	1.00

Source: NEPS-Network (2019a). National Educational Panel Study, Scientific Use File of Starting Cohort Grade 5. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC3:9.0.0 (download), N=2,075.

Table 28: *Correlations over Panel Waves in Target's Ratings in SC3*

	Wave	2010	2011	2012	2013	2014	2015	2016	2017	2018
Wave	**Age**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
2010	10	1.00								
2011	11	0.51	1.00							
2012	12	0.43	0.54	1.00						
2013	13	0.39	0.49	0.56	1.00					
2014	14	0.36	0.46	0.48	0.61	1.00				
2015	15	0.34	0.41	0.47	0.54	0.68	1.00			
2016	16	0.26	0.38	0.37	0.48	0.62	0.67	1.00		
2017	17	0.25	0.28	0.37	0.41	0.53	0.57	0.63	1.00	
2018	18	0.25	0.30	0.35	0.41	0.53	0.55	0.58	0.65	1.00

Source: NEPS-Network (2019a). National Educational Panel Study, Scientific Use File of Starting Cohort Grade 5. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC3:9.0.0 (download), N=1,783.

These results suggest a change in children's self-evaluated health, which may reflect a change in their health status, but also a change in their understanding of the question. For this reason, we examined both the validity of children's responses to the global subjective evaluation of

their health status and the understanding of the question among children in this age group, when preparing for a new cohort of fifth graders. We conducted cognitive pretests among children aged between ten and fourteen years, corresponding to children in grades four to seven. We interviewed 54 children attending different school tracks about their current health status and examined how children understand the wording of the question. Except for one child, who did not know the meaning of "health status", all children gave valid responses to the question and most of them were able to explain their answer, indicating that they considered their current and longstanding physical health status, their health-related behavior, and limitations in daily activities when evaluating their current health status.[12] In addition, when asked how they define the term "health status", most children indicate that health means feeling well, being in good overall health, having no temporary symptoms or longstanding illnesses, having good health-related behavior, and being sick less often. This highlights that while, in comparison to adults, children between the ages of ten and fourteen do not directly include mental health in their overall health assessment, they have a similar understanding of the question. We conclude that the global measurement of overall health status is a valid measurement of children's overall physical health status for children up to ten years and that, furthermore, changes between panel waves may indicate changes in health perceptions.

To sum up, responses to children's and adolescents' self-rated health show differences between parents and target subjects for both patterns and reliability. Similar to other health surveys, parents' assessments are more positive than those of the children themselves are. This suggests that parents and children differ in underlying perceptions of health and might indicate some bias in proxy measures. However, this bias does not question the overall validity of parental responses because it does not relate to severe health problems (De Bruin et al., 1996). We also observe notable changes in responses over time for younger children, indicating lower reliability up to age ten, but this may reflect changes in subjective health status and health perceptions. Despite these shortcomings, our cognitive pretest shows that an understanding of the question appears to be more reliable at older ages. Therefore, we keep the single-item measure to be comparable with other surveys. Nevertheless, we complement this information with additional measures referring to children's health status.

4.2.2 Subjective physical and mental health status

One further measurement of child health refers to the subscales of the Kid-KINDL-R, which reflect individual physical and emotional well-being (Ravens-Sieberer and Bullinger, 1998). For the latter, we show the results of SC1, in which we implemented the subscale of emotional wellbeing in 2020, corresponding to children's mental health. Only a small number of values is missing for the four aspects surveyed. All items show variation among children and indicate different levels of mood, boredom, loneliness, and anxiety. However, most children reported that they had fun and laughed a lot, often or all the time, were sometimes or seldom bored, never felt alone, or were never or seldom scared in the week preceding the survey (see Table 29).

[12] Detailed information is available upon request. A separate report on the cognitive pretest will be published in the near future.

Table 29: *Distribution of Children's Response to the Mental Health Subscale of the Kid-KINDL-R in SC1*

	I had fun and laughed a lot	I was bored	I felt alone	I was scared
Never	0.4	18.1	66.8	65.4
Seldom	2.6	39.0	22.1	23.9
Sometimes	16.4	31.6	6.5	6.8
Often	58.7	8.1	2.3	1.7
All the time	19.8	1.9	0.8	0.7
Unspecified missing	2.15	1.2	1.5	1.5

Source: NEPS SC1, preliminary data (wave 10), target response, N=1,209.

For the psychometric evaluation of the subscale, we tested for internal consistency and reliability by focusing on factor loadings, Cronbachs-α and the correlation with children's self-rated health, life satisfaction, and school-related anxiety, all of which measure related constructs. Factor analysis shows that three of the four items load on one factor (see Table 30). Only the first item does not uniquely correspond to the others, as the factor loading on factor one is below the values provided by the other items. Overall, the scale yields a Cronbachs-α of about 0.49, which indicates only a mediocre quality of the scale.[13] However, the eigenvalue of the first subscale supports the assumption that it refers to one specific aspect of children's health, namely mental health status. The correlations with self-rated health, life satisfaction, and school-related anxiety also support the assumption that the subscale refers to a distinct aspect of health (see Table 31). As expected, the correlation with children's self-rated health status indicates only a very weak association between the Kid-KINDL-R subscale and their overall health perceptions. The correlation with individuals' life satisfaction and school-related anxiety also shows only a weak association between the concepts. Although we observe some limitations in the quality of the subscale, we conclude that surveying children to assess various aspects of mental health complements the measures already available and provides further insights into child health status.

Table 30: *Results of the Factor Analysis for the Mental Health Subscale of the Kid-KINDL-R*

	Factor 1	Factor 2	Uniqueness
I had fun and laughed a lot	-0.278	0.210	0.879
I was bored	0.440	-0.058	0.803
I felt alone	0.532	0.024	0.716
I was scared	0.418	0.170	0.797
Eigenvalue	0.728	0.077	

Source: NEPS SC1, preliminary data (wave 10), target response, N=1,209.

[13] Excluding the first item leads to a Cronbachs-α of about 0.5.

Table 31: *Correlations between the Mental Health Subscale of the Kid-KINDL-R and Self-Rated Health, Life Satisfaction and School-Related Anxiety*

	Self-rated health	General life satisfaction	School-related anxiety
Mental Health (Kid-KINDL-R)	0.249	-0.395	0.350
N	1,142	1,155	1,145

Source: NEPS SC1, preliminary data (wave 10), target response.

Our results of the subscale measuring mental health are largely consistent with several evaluation studies, which also include the physical health component. In different samples, analyses suggest moderate reliability for children in different age groups (for a review, see Ravens-Sieberer, 2000). Using a sample of children aged 11 to 17 years surveyed by the KIGSS study, Erhart et al. (2009) show that the internal consistency (Cronbach-α) of the short form of the two subscales ranges from 0.52 to 0.62, depending on the age of respondents. Moreover, factor analyses indicate generally good reliability, and a direct comparison between parental and children's assessments shows that they also largely coincide. Similarly to self-assessed global health, only the assessment of the physical health dimension shows a slightly more pessimistic assessment among the children compared to their parents (Erhart et al., 2009). In addition, the results reported by Erhart et al. (2009) indicate satisfactory performance, compared to other measures of subjective mental health status in children and given the small number of items. Cronbach- α values for both subscales are only slightly lower in comparison to other measures for physical and mental health that include more items. For instance, studies assessing the reliability of the subscale "emotional symptoms" of the Strength and Difficulties Questionnaire, which includes five items, show Cronbach-α values ranging from 0.65 to 0. 71 (Goodman, 2001; Mellor, 2004; Muris et al., 2003). Analyses of the Child Health Questionnaire (CHQ) show Cornbach- α values ranging from 0.70 to 0.74 for the subscale of physical functioning, which includes six items (Raat et al., 2002). The subscales of the Kid-KINDL-R that measure physical and mental health components show expected correlations with other measures indicating similar health aspects, but differ from other health domains. For example, the physical health subscale correlates moderately with "physical well-being" as measured by the KIDSCREEN instrument, but only weakly with the other sub-dimensions captured by this instrument, such as "psychological well-being" or "moods and emotions". The subscale for "emotional wellbeing" also discriminates between different levels of mental health. For instance, children report significantly lower levels of the sub-dimension of the KINDL-R if it is likely that they are considered mentally ill based on detailed assessments of anxiety, emotional and behavioral problems, and official diagnoses (Ravens-Sieberer et al., 2008). We conclude that, despite the mentioned limitations, measuring subjective physical and mental health in children by using the concise Kid-KINDL-R measurement is an effective and efficient strategy to assess in detail children's self-perceived physical and mental health in NEPS.

4.2.3 Medically diagnosed health restriction

For medically diagnosed health limitations, we show results of SC1 parents who participated in Wave 2 (2013) and Wave 3 (2014). About 7 percent of parents reported in 2013 that their child had a medically diagnosed health impairment; twice as many parents did so in 2014 (see

Table 32), and reports in 2014 only partially include the same children as in 2013. About one third (n=56) of the children who were reported to have some medically diagnosed health impairment in 2013 were no longer in this category in 2014. In addition, about 9 percent (n=194) of children who did not have a reported medically diagnosed health impairment in 2013 were reported as having such an impairment in 2014. The majority of parents reported a physical or chronic health impairment in both waves, whereas a very small proportion of parents indicated mental health impairments or cognitive delays (see Figure 9).

Table 32: *Proportion of Children with any Medical Diagnosed Health Impairment in SC1 Waves 2 and 3 (Parent Reports)*

	2013		2014	
	abs.	**%**	**abs.**	**%**
yes	166	6.9	304	12.6
no	2,241	93.1	2,103	87.4
N	2,407	100.0	2,407	100.0

Source: NEPS-Network (2020a). National Educational Panel Study, Scientific Use File of Starting Cohort Newborns. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC1:7.0.0, unweighted data.

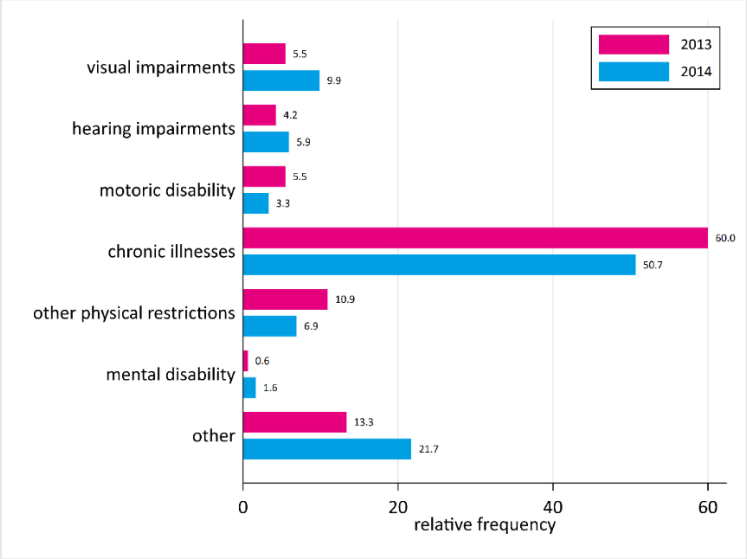


Figure 9. Medical diagnosed health impairments in SC1.

Source: NEPS-Network (2020a). National Educational Panel Study, Scientific Use File of Starting Cohort Newborns. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC1:7.0.0, N=469, unweighted data.

Despite providing initial interesting insights into child health, these items have some content-related and procedural limitations that affect their reliability. Like all other available versions in the NEPS, they place a heavy burden on respondents and provide some room for interpretation, which affects parents' response behavior. First, since we asked respondents about health limitations diagnosed by a physician, we forced an individual interpretation of what "limitations" signifies. These interpretations may vary due to parental characteristics such as socioeconomic status and migration background, as perceptions and reports of

different types of diseases differ among subgroups depending on the prevalence of diagnosis (Currie, 2009). Thus, parents' responses could vary according to their understanding of limitations and depend on the perceived degree of health limitation due to diagnosed diseases. Second, some parents had difficulties in classifying existing diagnoses into one of the categories presented. Complex medical conditions posed particular challenges for respondents. In some cases, for instance, respondents did not know how to classify a disease with more than one health limitation, which resulted in misclassification, lack of documentation of the disease, or multiple assignments in closed and open response categories.

Given these limitations, the responses to the question may not be valid and reliable, and interpretations of the limitations and response patterns could vary systematically across subgroups. Furthermore, respondents' interpretations of limitations could vary over time, which results in differences in response across panel waves. In this case, changes across panel waves would only be due to differences in individual interpretations of the question, rather than to actual changes in children's health conditions. Therefore, responses to the questions should be treated with caution and as a result, we do not longer implement these questions in surveys addressing children, instead planning to replace these measures with a new instrument following the SOEP, the KiGGS, and the Millennium Cohort Study to avoid such limitations.

4.2.4 Body height and weight

We survey individuals' body height and weight in all NEPS studies. For descriptive results and the validity of the construct in children and adolescents, we focus on measurements based on early health checkups (SC1), parents subjective reports (SC2), and adolescent self-reports for children aged between 10 and 16 (SC3) as examples.

We observe a high quality of information on children's body height and weight in SC1. For instance, we observe no missing values in this cohort, which indicates that asking parents about their children's height and weight based on documented values of body measures at regular medical checkups is a very effective survey method. Distributions of body weight and height based on early health checkups in SC1 are presented in Figure 10. Boxplots of body height and weight show a lower variance in the early health checkups and increasing variance for later ones. While the distribution of body height does not change between U4 and U7a, we observe an increasing variance in body weight between U6 and U7a. In addition, in all waves, we observe only a small number of children who are either exceptionally small or large, or lightweight or heavy. Compared to official statistics based on results of the WHO, SC1 data suggest a high reliability of parents' responses to these questions (see Table 33). Comparable to WHO growth standards, children in SC1 have similar averages in height and weight by age and sex, with girls being slightly smaller and weighing slightly less than boys. Apart from minor differences, the values for girls and boys are similar in the age groups considered. The lack of missing values and results that are similar to WHO findings underline the high quality of this information in SC1.

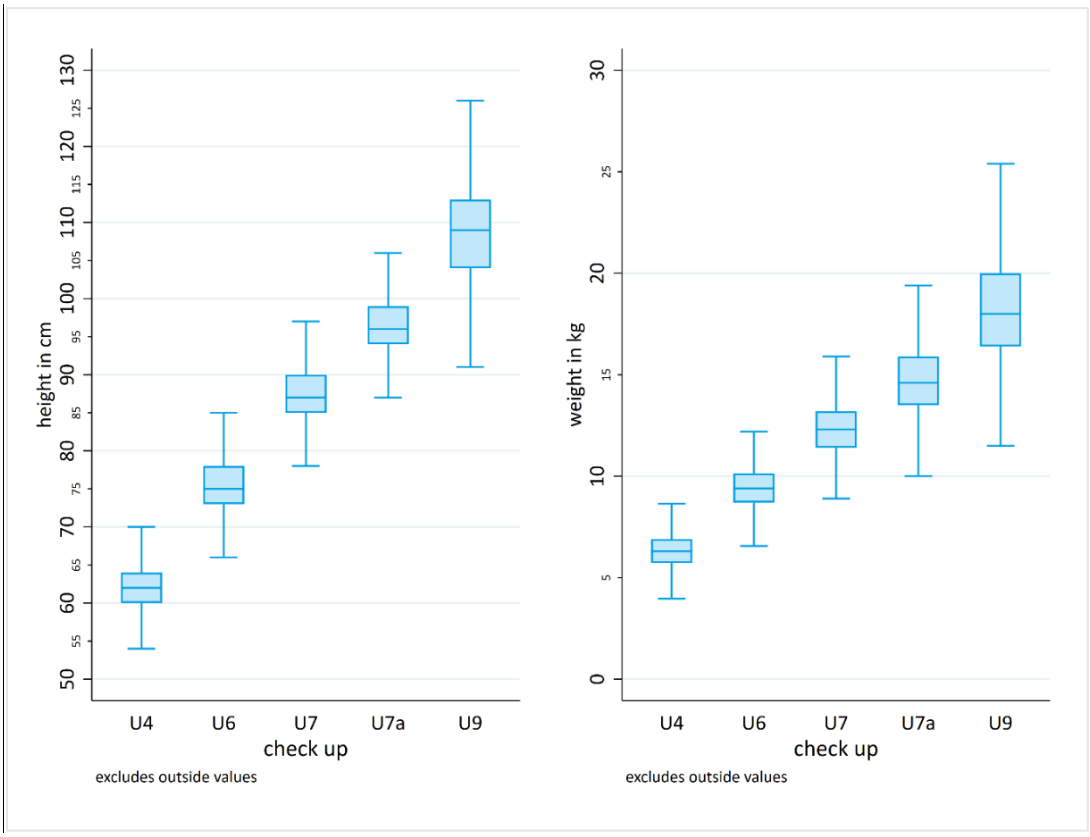


Figure 10. Body height and weight by health checkup in SC1.

Source: NEPS-Network (2021). National Educational Panel Study, Scientific Use File of Starting Cohort Newborns. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC1:8.0.0; U4: N=3,435; U6: N=2,541; U7: N=2,453; U7a: N=2,256; U9: N=3,778.

Table 33: *Body Height and Weight by Gender in SC1 Compared to the WHO Growth Standards (Median)*

	Body height in cm				Body weight in kg			
	Girls		Boys		Girls		Boys	
Months	**SC1**	**WHO**	**SC1**	**WHO**	**SC1**	**WHO**	**SC1**	**WHO**
6	61	66	64	68	5.9	7.3	6.6	7.9
12	74	74	76	76	9.2	8.9	9.7	9.6
25	86	87	88	88	12.1	11.7	12.5	12.4
38	95	94	97	95	14.4	14.2	14.9	14.7
50	104	104	104	104	16.7	16.4	16.1	16.7

Source: NEPS-Network (2021). National Educational Panel Study, Scientific Use File of Starting Cohort Newborns. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC1:8.0.0, weighted data; World Health Organization (2006).

Interviewing parents without reference to the medical record also leads to only minor quality limitations in the collection of body measurements. Figure 11 shows the distributions of the body measurements in SC2 by wave. For body height, we observe a mean of about 112cm, 130cm, and 138cm in 2011, 2014, and 2015, respectively. About 50 percent of the parents

reported that their child's height was between 108 and 117cm in 2011, between 128 and 135cm in 2014, and between 133 and 142cm in 2015. The mean body weight was about 19kg, 26kg, and 30kg in 2011, 2014, and 2015, respectively. 50 percent of parents reported that their children's weight was between 17 and 21kg in 2011, between 24 and 30kg in 2014, and between 27 and 35kg in 2015.[14] Compared to official statistics presented by the WHO 2006 (World Health Organization, 2006), the information provided by parents in SC2 shows little difference (see Table 34). Most parents in SC2 tend to report higher values of body height compared to the WHO growth standards. Parental information on their children's body weight is very similar to the WHO findings. Except for boys aged 7 years, the median values largely coincide. We conclude that asking parents about children's body height and weight also yields coherent results without reference to the medical record.

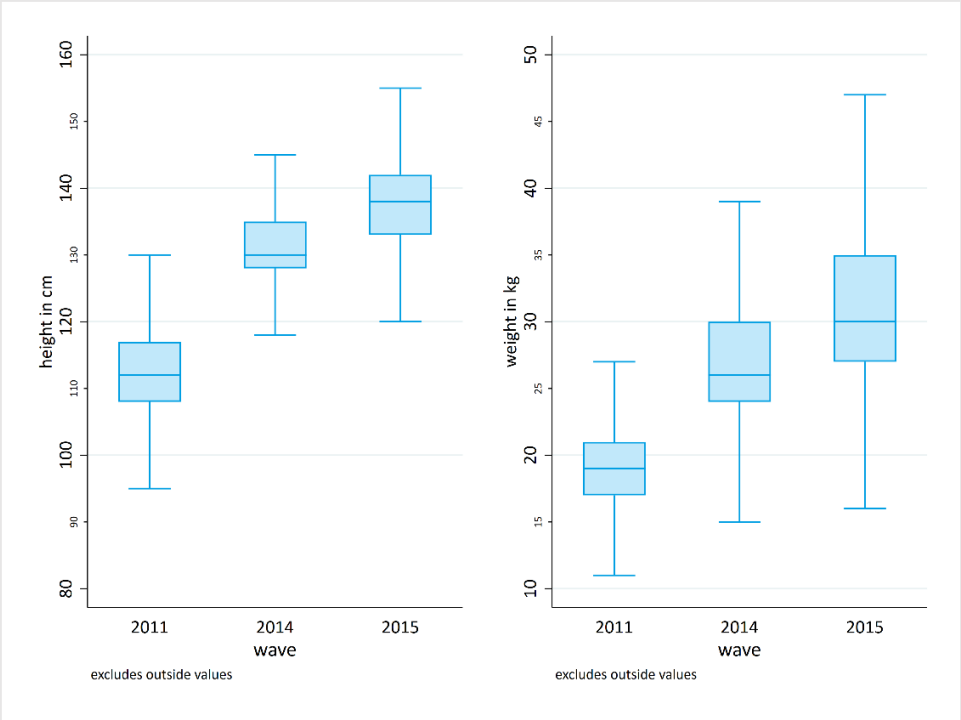


Figure 11. Body height and weight of parent reports in SC2.

Source: NEPS-Network (2020b). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:8.0.1.

[14] We also observe some implausible values and extremely high or small values, which should be treated with caution in empirical analyses.

Table 34: *Body Height and Weight by Gender in SC2 Compared to the WHO Growth Standards (Median)*

	Body height in cm				Body weight in kg			
	Girls		Boys		Girls		Boys	
Years	**SC2**	**WHO**	**SC2**	**WHO**	**SC2**	**WHO**	**SC2**	**WHO**
5	111	109	112	110	18	18	19	18
6	115	115	115	116	19	20	20	20
7	125	121	130	122	23	22	27	23
8	130	127	130	127	25	25	26	25
9	135	133	135	133	28	28	29	28
10	140	139	140	138	30	32	31	31

Source: NEPS-Network (2020b). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:8.0.1, weighted data; World Health Organization (2006).

While the results for data provided by parents suggest high quality, the same does not necessarily apply to data provided by children. In the following, we show results of children and adolescents surveyed in NEPS SC2 and SC3 and compare these results with the WHO growth standards. We calculated the BMI of children and adolescents because BMI is available from WHO as the only growth reference for higher age groups. Results for body height are depicted in Table 35. The older the children are, the higher their reported body height. In addition, girls in higher ages and later survey waves tend to report smaller height compared to boys. Regarding BMI, we find that self-reported body measures result in a median BMI ranging from 16.9 for girls aged 11 to a median BMI of 22.8 for boys aged 18. We observe a steady increase in BMI by age and small differences by gender. Compared to the findings of the WHO, however, children in SC2 and SC3 reported higher values for body height. In addition, the BMI values in the NEPS cohorts deviate more frequently from those of the WHO. For example, while the WHO results indicate an average BMI of 17.6 for girls aged 11, which increases by about one BMI point each year until age 13, the BMI for girls in SC2 and SC3 are 0.5 points lower on average. The WHO also reports a slight increase in BMI of girls aged 15 to 18, but there is no such increase in NEPS. We conclude that asking children about body height and weight leads to some inaccuracy in the data.

Table 35*: Body Height and BMI - Children's Reports in SC2 and SC3 Compared to WHO Results*

			Body height in cm						BMI					
			Girls			Boys			Girls			Boys		
SC	**grd.**	**age**	**NEPS**		**WHO**	**NEPS**		**WHO**	**NEPS**		**WHO**	**NEPS**		**WHO**
				N			*N*			*N*			*N*	
2	6	11	152	*1,498*	148	152	*1,300*	146	16.9	*1,451*	17.6	17.1	*1,273*	17.2
	7	12	158	*874*	154	159	*716*	152	17.8	*840*	18.4	18.0	*702*	17.9
		13	161	*843*	158	161	*884*	160	18.4	*799*	19.2	17.9	*858*	18.6
3	9	15	167	*1,489*	162	175	*1,296*	171	20.1	*1,342*	20.5	20.1	*1,213*	20.1
		16	166	*989*	163	178	*1,121*	174	20.3	*872*	20.9	20.8	*1,062*	20.8
	12	17	168	*999*	163	182	*742*	176	21.5	*954*	21.2	22.2	*728*	21.4
		18	168	*510*	163	182	*493*	176	20.3	*475*	21.3	22.8	*489*	22.0

Source: NEPS-Network (2020b). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:8.0.1, weighted data; NEPS-Network (2020d). National Educational Panel Study, Scientific Use File of Starting Cohort Grade 5. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC3:10.0.0, weighted data; World Health Organization (2006).

[1] WHO results are based on exact calculations by age in months. This is not feasible with SC2 and SC3 data, so we use 11.5, 12.5, and 18.5 as reference values.

Lower measurement quality of self-reported height and body weight does not only occur due to respondents' systematic over- and underestimation of body height and weight, but also due to systematically missing values and implausible values. Therefore, we investigated the item-nonresponse in children. We distinguish between implausible values due to misuse of the survey instrument (e.g., responses with text instead of numbers), recoded implausible values, which include extremely high (more than 300kg or higher than 250) or low values (less than 15kg or smaller than 99cm), and unspecified item-nonresponse due to a missing response of the child. For SC3, we observe a high prevalence of missing values as well as implausible values (see Table 36). For body height, we observe about 7 percent and 5 percent unspecified missing as well as about 5 percent of reported implausible values in 2012/2013 and 2015, corresponding to Wave 3 and Wave 6, respectively. In addition, about 1 percent of students reported implausibly high or low values in both waves analyzed. For body weight, we observe about 20 percent missing values in 2012/2013 and 14 percent in 2015. In Wave 3, about 15 percent are unspecific missing, 3 percent are implausible values and 0.5 percent recoded implausible values. In 2015, about 11 percent did not answer the question and about 0.8 percent have missing values due to implausible values. Consequently, the data suggests a lower measurement quality of self-reported body height and weight, especially among younger children.

Table 36: *Missing Values in Self-Reported Body Height and Weight in SC3*

	Height		Weight	
	2012/2013 (grade 7)	**2015 (grade 9)**	**2012/2013 (grade 7)**	**2015 (grade 9)**
Valid value	87.2	93.7	81.3	88.0
Implausible value (recoded)	0.8	0.9	0.5	0.7
Implausible value	4.9	0.0	2.9	0.0
Unspecified missing	7.2	5.4	15.2	11.3

Source: NEPS-Network (2020d). National Educational Panel Study, Scientific Use File of Starting Cohort Grade 5. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC3:10.0.0.

Since the data shows a high number of missing values in children's responses to the questions, systematic missing values might bias empirical investigations. Thus, we investigated how missing values are distributed in the sample, focusing especially on differences between school types, by gender, and by migration background. Figure 12 and Figure 13 present the results of the related OLS regression model. Missing values in body height and weight are differently distributed depending on the type of school and gender. Children attending a lower secondary school track or a comprehensive school have a higher probability of missing values in body weight and height than students of the middle secondary school level. Children attending a higher secondary school track as well as students in an unspecific type of school have a lower probability of missing values in both measures compared to middle secondary track students. The differences in assessments of body height, however, become smaller by panel wave. Regarding gender, females have a higher probability of missing values in body weight than males. However, females have a lower probability to show missing values in body height in 2015. For body weight, we observe the same selectivity in missing values in 2015 compared to 2012/2013. We conclude that missing values are more dominant in lower educated, younger, and female children.

In sum, and in contrast to the high quality of parental reports, the analysis of children's and adolescents' subjective measurements of body height and weight highlights some challenges. Especially in younger age groups, asking children for body height and weight reveals high numbers of missing values and invalid response patterns. In line with prior results of SC4, we find remarkable shares of missing values in both panel waves in SC3 (Carstensen et al., 2016). This implicates that answering such questions may be a difficult task for younger children, either because they might not actually know their weight and height, or because they might not want to answer because of expected negative consequences (such as peer harassment) or social desirability. In addition, we observe differences by subgroups which highlight that certain groups of students appear to be more susceptible than others to the influence of the survey setting on the validity of their responses. Thus, these limitations might somewhat affect empirical analyses using such measurements, and, as a result, they will partially be addressed in future surveys. Since the NEPS plans to implement more online and tablet-based instruments, we will be able to use technological programming to reduce invalid response and item-nonresponse.

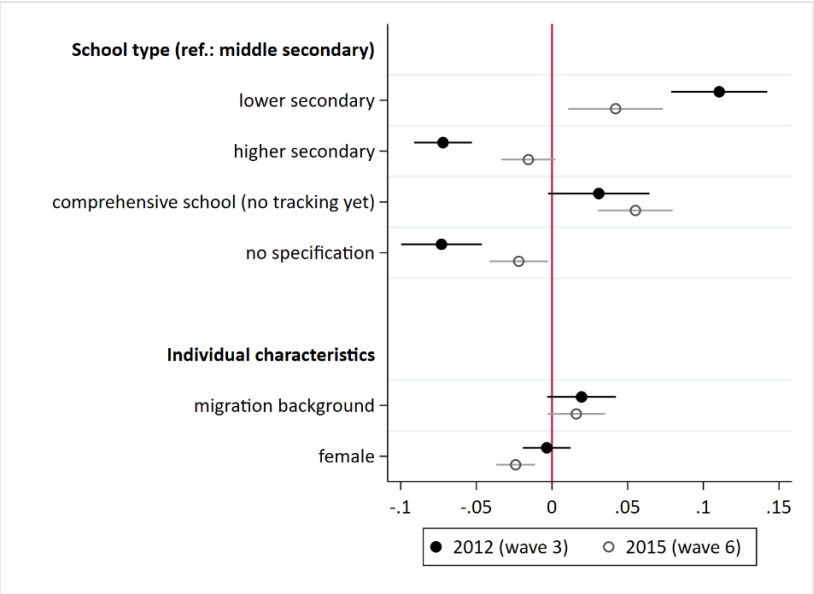


Figure 12. Associations of missing values in body height in SC3 in 2012/2013 and 2015 with school type, migration background, and gender.

Source: NEPS-Network (2020d). National Educational Panel Study, Scientific Use File of Starting Cohort Grade 5. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC3:10.0.0.

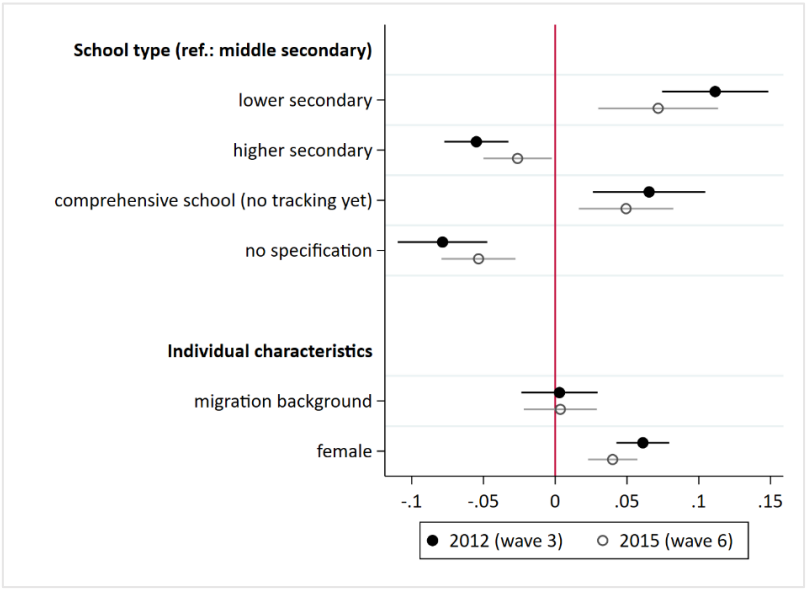


Figure 13. Associations of missing values in body weight in SC3 in 2012/2013 and 2015 with school type, migration background, and gender.

Source: NEPS-Network (2020d). National Educational Panel Study, Scientific Use File of Starting Cohort Grade 5. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC3:10.0.0.

5. Children's and adolescents' health-related behavior

One important mechanism linking an individual's educational outcomes to their health are health-related behaviors such as, for example, individual levels of smoking, alcohol consumption, physical activity, and diet (Mirowsky and Ross, 2015). Empirical evidence suggests that such behaviors explain a very high proportion of the educational variation in health-related outcomes in adulthood (e.g., Brunello et al., 2016), and appears to be associated with early mental health outcomes in children and adolescents (e.g., Moor et al., 2014). In addition, these health-related behaviors also serve as outcome variables when estimating the returns to education. Therefore, since early behavior in childhood and adolescence is highly predictive of later behavioral patterns in life and is assumed to have a lasting influence on health, it is particularly interesting to collect initial indicators of health-related behavior in this age group.

5.1 Measurement concept

We include measurements of physical activity, early smoking behavior, and alcohol consumption as a special focus in the NEPS (Table 37).[15] Since empirical studies particularly emphasize the importance of regular *physical activity* for children and adolescents growing up healthy, NEPS includes indicators related to participation in sports from the beginning in all starting cohorts covering children and adolescence. We collect information annually, either by asking parents (SC1, SC2) or their children (SC2, SC3, SC4). In the older age groups (thirteen years and older), we also capture risky health behaviors, which are known to have strong negative effects on health and mortality risk, and are highly associated with the individual's level of education (e.g., Bahrs and Schumann, 2020; Doll et al., 2004; Ho and Fenelon, 2015; Marshall, 2014). We ask for *smoking behavior*, which has a significant and high impact on individual life expectancy (e.g., Doll et al., 2004) and is known to increase the risk of being a daily smoker in adulthood (e.g., Bahrs and Schumann, 2020; Barrington-Trimis et al., 2020; Nuyts et al., 2018). In addition, we include questions referring to early *alcohol consumption*, which is strongly associated with early mental health impairments, limitations in brain development, and neuro-cognitive problems as well as later life alcohol addiction (Marshall, 2014). We survey children's smoking and drinking behavior from the age of about eighteen (grade twelve) in SC3 and 4, and survey the questions from the age of 13 (grade 7) in SC2.

[15] In SC2 to SC4 we also asked for nutrition values and behavior. However, these measurements showed only a small variation in dietary behavior and empirical research suggests using much more complex measurements to capture variation in individuals' diet. Thus, we decided to focus more on smoking, alcohol drinking behavior, and physical activity, which not only have a longer-lasting effect, but are also less likely to be approximated by alternative measurements. For example, body measurements are also available to detect extremely poor dietary behavior.

Table 37: *Measurement Concept for Health-Related Behavior in Children and Adolescents in NEPS*

		Wave															
SC	**Measurements**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
1	Physical ativity										P		P		P		
	Smoking Behavior																
	Alcohol consumption																
2	Physical activity				P[1]	P[1]		T[1]		T	T		T				
	Smoking behavior										T		T				
	Alcohol consumption										T		T				
3	Physical Activity									T, T_{indv}	T, T_{indv}						
	Smoking behavior									T	T, T_{indv}						
	Alcohol consumption									T	T, T_{indv}						
4	Physical Activity										(T_{indv})	T_{indv}	T_{indv}			T_{indv}	
	Smoking behavior					T	T	T_{indv}				T_{indv}	T_{indv}			T_{indv}	
	Alcohol consumption					T	T	T_{indv}				T_{indv}	T_{indv}			T_{indv}	

[1] These measurements of Physical Activity refer to other instruments compared to later waves.

Note: T=Target (main sample); T_{indv}=Target (field of individual retracking); Years in which no survey was conducted in the respective starting cohort are shaded in grey; waves, where respondents were over the age of 18 are highlighted in grey.

5.1.1 Physical activity

As a first measurement of health-related behavior among children and adolescents, the NEPS provides some superficial information on general physical activity levels and sports activities to be comparable in all starting cohorts. Even though the importance of regular physical activity for an individual's physical and mental health is well known and appears to be a crucial mediator of education's effect on health, an accurate measurement would need to cover a great many facets, such as the frequency and type of physical activity, the exact duration, and the level of exertion. Survey instruments that capture individual levels of physical activity in such detail are very complex and contain many items, which makes them unsuitable for large-scale surveys such as the NEPS. For this reason, De Bruin et al. (1996) suggest asking only for basic information on physical activity levels to enable a reasonable distinction between active and inactive individuals. We therefore decided to simply refer to the question of "How often do you do sports?" in all starting cohorts and request children not to count the physical education classes at school (see Table 38). This simple question reduces the cognitive burden for the respondents and makes their answers more comparable across starting cohorts, as we assume a common understanding of what "sports" means among children, adolescents, and adults. Nevertheless, the single-item measurement does not provide different levels in duration and degree of physical exertion, which limits a differentiated view.

Table 38: *Measurement of Children's Level of Physical Activities (Target)*

SUF- File	Variable	German text	English text
pTarget	t261000	Wie häufig machst du Sport? Zähle dabei den Sportunterricht in der Schule nicht mit!	How often do you do sports? Do not count the physical education classes at school!
		1 - nie	1 - never
		2 - einmal im Monat oder seltener	2 - once a month or less frequently
		3 - mehrmals pro Monat oder einmal pro Woche	3 - several times a month or once a week
		4 - mehrmals pro Woche	4 - several times a week
		5 - (fast) täglich	5 - (almost) daily
		-90 - nicht spezifizierbar fehlend	-90 - unspecific missing

Along with the information available in children's surveys, different measurements in parents' questionnaires are available for SC1 and SC2. However, since they all refer to either regular domestic or outside activities, and because information diverges between starting cohorts, the data are no longer comparable (see Table A-6 and Table A-7 of the Appendix). In order to improve the comparability of data, we will develop a new instrument which more consistently measures children's participation in sports, including the frequency and context of activity.

5.1.2 Smoking behavior

Measuring individual smoking behavior requires the distinction between different smoking patterns (De Bruin et al., 1996). To distinguish between different levels of smokers and nonsmokers, we ask for children's and adolescents' smoking status as well as for the level of tobacco consumption by implementing a measurement firstly developed by the KiGGS into all starting cohorts. We ask: "Do you currently smoke?" and request information about regular

and non-regular smoking (see Table 39). If children respond that they smoke either daily or at least once a week, we elicit additional information about the extent of cigarette use by asking: "How many cigarettes do you currently smoke?".[16] In doing so, we allow responses for both daily and weekly levels of cigarette smoking. In addition, we provide a missing category for smokers of other tobacco-related products or children who did not follow the instructions to skip the question.

Table 39: *Measurements for Children's Smoking Behavior*

SUF- File	Variable	German text	English text
pTarget	t525026	Rauchst du zurzeit? 1 - nein 2 - täglich 3 - mehrmals pro Woche 4 - einmal pro Woche 5 - seltener -90 - nicht spezifizierbar fehlend	Do you currently smoke? 1 - no 2 - daily 3 - several times a week 4 - once a week 5 - less frequently -90 - unspecific missing
	t525031/ t525032/ t525034	Wie viele Zigaretten rauchst du zurzeit? Je nachdem, wie viele Zigaretten du rauchst, kannst du entweder die tägliche oder die wöchentliche Anzahl der Zigaretten eintragen. _ _ Stück pro Tag _ _ _ Stück pro Woche keine -90 - nicht spezifizierbar fehlend -99 - filterbedingt fehlend -95 - unplausibler Wert	How many cigarettes do you currently smoke? Depending on how many cigarettes you smoke, you can enter either the daily or the weekly number of cigarettes. Please enter numbers right-aligned. _ _ cigarettes per day _ _ _ cigarettes per week none -90 - Unspecific missing -99 - filtered -95 - implausible value

5.1.3 Alcohol consumption

To measure early patterns of alcohol consumption, it is highly important to distinguish between abstainers and drinkers (De Bruin et al., 1996). Therefore, in line with KiGGS, we first ask children if they ever have drunk alcohol and if so, how often they drink regularly. We provide the children with categories ranging from never to daily, including monthly as well as weekly differences (see Table 40). Unlike KiGGS, however, we do not ask for the number of drinks consumed on a normal day or the frequency with which someone consumes more than six drinks at one time. Although these additional questions would provide deeper insights into children's alcohol consumption behavior, given the educational focus of the NEPS and the time

[16] To reduce the cognitive burden on children by asking a large number of questions as well as due to limitations in survey time available, we focus on cigarette smoking and do not collect more detailed information on other smoking items (e.g., e-cigarettes, pipes, shisha, etc.).

constraints this imposes, we concentrate on basic information about the differences in alcohol consumption, thus covering the most important dimensions of drinking behavior.

Table 40*: Measurements for Children's Level of Alcohol Consumption*

SUF- File	Variable	German text	English text
pTarget	t525214	Hast du schon einmal Alkohol getrunken?	Have you ever drunk alcohol?
		1 - ja	1 - yes
		2 - nein	2 - no
		-90 - nicht spezifizierbar fehlend	-90 - unspecific missing
	t525215	Wie häufig trinkst du normalerweise Alkohol?	How often do you usually drink alcohol?
		1 - nie	1 - never
		2 - einmal im Monat oder seltener	2 - once a month or less
		3 - zwei- bis dreimal im Monat	3 - twice or three times a month
		4 - einmal in der Woche	4 - once a week
		5 - mehrmals in der Woche	5 - several times a week
		6 - täglich	6 - daily
		-90 - nicht spezifizierbar fehlend	-90 - Unspecific missing
		-99 - filterbedingt fehlend	-99 - filtered
		-95 - unplausibler Wert	-95 - implausible value

Beyond the current measurement presented, we also used a different set of instruments to measure alcohol consumption among children and adolescents in previous waves of the NEPS study. For example, we asked respondents in SC4 how many times per week they drank, the age of first consumption, and whether they had ever been drunk (see Table A-8 of the Appendix). However, since these questions are less comparable to the instruments in other starting cohorts, we replaced the questions in the process of the 2017 revision and harmonized them with the measurement concept for adults (see Lettau et al. 2020).

5.2 Empirical results

In the following, we present some descriptive results on physical activity levels, smoking behavior, and alcohol consumption among children and adolescents. We focus primarily on the SC2 data since this sample includes children aged between eight and sixteen years and all instruments related to children's health behaviors are available.

5.2.1 Physical activity

With respect to children's physical activity, we present information by parents and children. Parents' reports in SC2 initially provide vague information, but are later supplemented by more detailed measurements available for children. They only indicate whether a child regularly participates in physical activities, but they do reveal initial differences. Parents' responses demonstrate that approximately 9 percent of five-year-olds did not participate in such activities, while 91 percent were involved in regular physical activity. They also indicate that the proportion of physically active children was significantly lower among second graders

compared to the preschoolers surveyed, with more children not participating in any such regular activities (see Table 41).

Table 41: *Regular Participation in Physical Activities by Age (Parents' Reports)*

	2012 (preschool, 5 years old)	**2013/2014 (grade 2)**
No regular participation	8.8	19.8
Regular participation	91.2	80.2

Source: NEPS-Network (2020c). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:9.0.0, 2012: N=170, 2013/2014: N=1,462, unweighted data.

Table 42: *Distribution of Frequency of Physical Activity in Children of the SC2 by Wave (Children's Response)*

	2015/2016 (grade 4)	**2017/ 2018 (grade 6)**	**2018/2019 (grade 7)**
Never	1.6	4.7	2.5
Once a month or less frequently	2.5	2.7	5.1
Several times a month or once a week	18.3	21.0	21.3
Several times a week	35.0	44.7	44.0
(almost) daily	42.7	26.9	27.1

Source: NEPS-Network (2020c). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:9.0.0, N= 2,010, unweighted data, including children observed in all three waves.

Compared to the parents' question in the first waves, the children's measurement allows a more precise distinction between no physical activity, less frequent physical activity, and more irregular or regular physical activity. This is because, in contrast to the parents, children are asked about any physical activity either in an institutionalized or self-organized setting. Thus, for example, in 2015/2016 corresponding to children in grade 4, only 4.5 percent of children claimed that they were physically active a maximum of once a month. The largest proportion of the sample stated that they did some sports at least several times a month, and more than 50 percent in each panel wave available claimed to be active at least several times a week. Regarding changes in children's response by panel wave, we observe a significant shift between grade 4 and grade 6.[17] While in grade 4, about 40 percent of children reported that they are physically active on an (almost) daily basis, only 27 and 26 percent did so in grade six and seven, respectively (see Table 42). This is in line with results about age-specific physical activity levels presented by the KiGGS. The older the children, the lower the reported levels of physical activity (Finger et al., 2018).

[17] We tested for significance of these differences in ordered logit regression model that includes only children with participation in all three panel waves. The regression results confirm significant descriptive differences between grades four and grades six and seven.

To validate children's responses to the question, however, we cannot compare our results with external data, such as the KiGGS or the information given by the Cross-National Survey on Health Behaviour in School-aged Children (HBSC) in Germany, because we neither measure the actual time spent on physical activity nor consider only physical activities which last at least 60 minutes. Therefore, we merely check whether children's reports show a variation by subgroups that is similar to what external data suggests. For example, the KiGGS reports and the factsheets of the HBSC studies show gender differences that reveal lower levels of physical activity among girls compared to boys. In addition, both datasets highlight differences by children's age. Therefore, we investigate whether our measurement shows a comparable distinction between females and males and a similar pattern by age. For this purpose, we weighted our data to be more representative compared to official statistics, and we tested differences between all subgroups for each wave separately. By doing so, we estimated ordered logit regression models, considering sample selectivity by including longitudinal weights. For comparability between panel waves, we only included children with participation in all NEPS surveys in grade four, six, and seven. Descriptive results suggest that in all panel waves, females tend to report lower levels of physical activity than males (see Figure 14). For instance, while about 48 percent of the boys reported being physically active on an (almost) daily basis in grade four, only 36 percent of the girls did so. Although the difference grows smaller with age, this pattern is also observable in grade six and grade seven. In addition, we observe lower physical activity levels by age, as a smaller proportion of children in grade six and seven reported being physically active on an (almost) daily basis. These differences are all significantly different from zero. Thus, we conclude that, even if the measurement is less precise compared to the measurements in other surveys, it shows similar variation by gender and age and thus seems to identify different levels of physical activity.

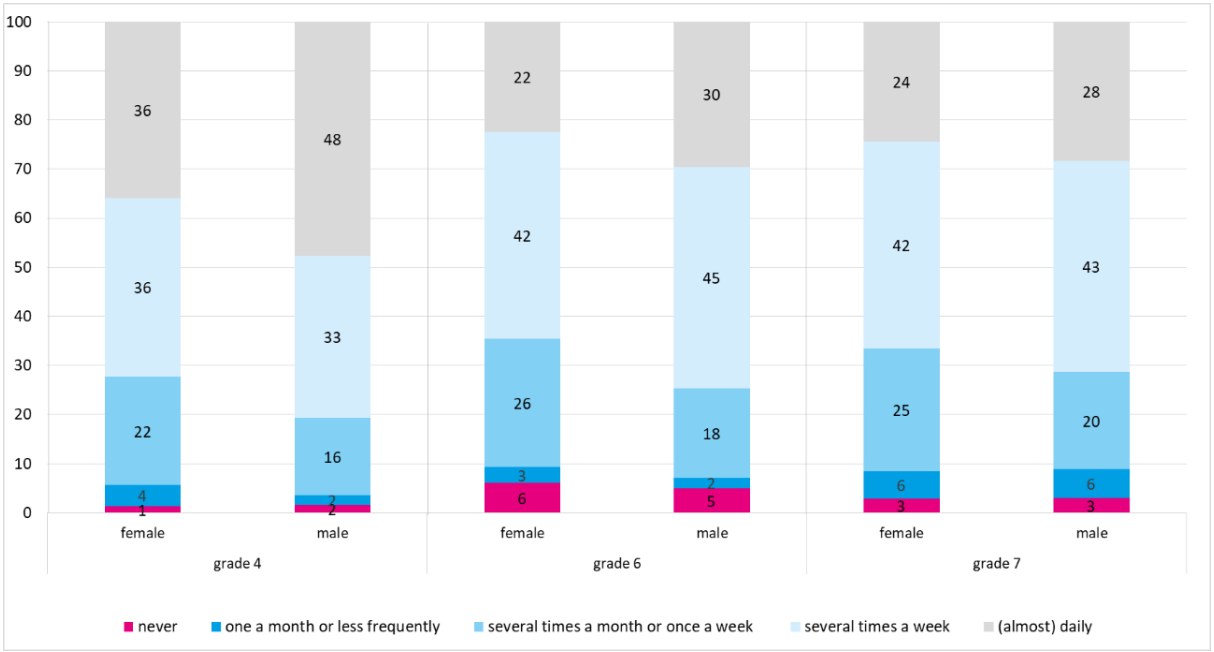


Figure 14. Children's reported levels of physical activity separated by grade and gender.

Source: NEPS-Network (2020c). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:9.0.0, N=2,010, weighted data.

5.2.2 Smoking behavior

To examine response behavior related to smoking, we also draw on data of SC2 in the following.[18] In SC2, questions regarding individual smoking behavior were firstly implemented in wave 9, corresponding to students in grade 7. We analyzed smoking patterns for children aged between eleven and thirteen in order to correspond to the official statistics. For children's smoking status, we observe about 97 percent of children who claimed that they did not smoke at this time and less than 1 percent who stated that they smoked daily, several times a week, once a week, or less frequently. In addition, about 3 percent did not answer the question. Compared to official statistics provided by the KiGGS, which corresponds to eleven- to thirteen-year-old children observed from 2014-2017, our results indicate a similar consumption pattern (see Table 43). The proportion of children who reported smoking in general is similarly high to the proportion of children who reported smoking regularly, i.e., at least once a week. However, we see a small difference between children's responses to daily smoking in the KiGGS and the NEPS SC2. While in the KiGGS, about 0.3 percent stated that they smoked daily, only a vanishingly small part of the children in SC2 did so. Furthermore, contrasting the results of the KiGGS (which indicate differences between girls and boys), girls and boys observed in SC2 show no differences in reported smoking behavior, as 0.9 percent of girls and 0.8 percent of boys reported smoking currently. Similarly, 0.4 percent of girls reported smoking regularly and 0.4 percent of boys did so. To sum up, with some exceptions, measuring smoking behavior in NEPS shows valid responses of children in the age between eleven and thirteen. In relation to the KiGGS data, we observe comparable proportions of children reporting current smoking, but contrasting the official statistics, we neither observe children reporting daily smoking, nor do we note differences between girls and boys. Nevertheless, we conclude that while we find small differences between the KiGGS and NEPS data, these do not fundamentally question the quality of the measurement. Only referring to children who smoke, smoking behavior surveyed provides an opportunity to use the NEPS to examine the early effect of education on initiating health-damaging behavior.

[18] Although similar instruments were also part of some earlier waves in SC3 and SC4, respondents in these starting cohorts were already about eighteen years old at the time, making them inappropriate for examining the validity of the items used at younger ages.

Table 43: *Comparison of Smoking Behavior Reported in KiGGS (wave 2) and NEPS SC2 (wave 9)*

	KiGGS (2014-2017) 11-13 years old N=6,599	NEPS SC2 (2018) 11-13 years old N=3,632
Total		
smoking currently	0.7	0.9
smoking regularly	0.4	0.4
smoking daily	0.3	0.0
Female		
smoking currently	0.6	0.9
smoking regularly	0.2	0.4
smoking daily	0.1	0.0
Male		
smoking currently	0.9	0.8
smoking regularly	0.6	0.4
smoking daily	0.5	0.0

Source: Zeiher et al. (2018); NEPS-Network (2020c). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:9.0.0, only including children aged between 11 and 13.

5.2.3 Alcohol consumption

For assessing the conformity of the measurement concept for alcohol consumption among children and adolescents, we again refer to the data of SC2. We investigate the validity of the answers using criteria for evaluating alcohol drinking patterns defined by De Bruin et al. (1996). We distinguish between abstainers and regular drinkers. To receive a comprehensive picture of the prevalence of children's alcohol consumption in SC2, we combine the information from both questions on alcohol consumption presented and define each child as abstainer if it either reported never having drunk alcohol in his or her life or reported never drinking alcohol in the second question. We observe about 3 percent of missing values, and about 91 percent of the children participating in wave 9 (2018) stated that they have never drunk alcohol at all or never drink alcohol. About 5 percent, however, claimed that they drank alcohol once a month or less frequently, and about 0.6 percent of children reported drinking alcohol at least two or three times a month.

To validate the measured prevalence of alcohol consumption, we again refer to results of the KiGGS study and focus on the question of whether a child has ever drunk alcohol or not, which was assessed equally in both studies. Thus, for the NEPS, we only refer to children who stated in the first question that they have ever consumed alcohol, and only consider children who are between 11 and 13 years old and therefore correspond to the lower age range of the KiGGS. Moreover, we show separate results by gender. Compared to KiGGS, we observe similar shares of children who reported that they have ever drunk alcohol (see Table 44). About 15 percent in both NEPS and KiGGS stated that they have drunk alcohol at least once in

their life. In addition, we observe small differences by gender, which is in line with results based on the KiGGS. Consequently, with regard to the first question, the NEPS seems to provide information that is of similar quality to that of the KiGGS.

To conclude, NEPS provides first valid insights into drinking patterns of children and adolescents for the measurement of alcohol consumption. Consequently, following a longitudinal assessment, it provides data for longitudinal analyses on education's impact on initiating alcohol consumption.

Table 44: *Shares of Children in SC2 (2018) Compared to KiGGS Wave 2 (2014-2017) Who Ever Have Drunk Alcohol, Separated by Gender*

	KiGGS (2014-2017) 11-13 years old	**NEPS SC2 (2018) 11-14 years old**
	N=6,599	**N=3,632**
Total	15.5	15.4
Female	15.0	13.8
Male	16.0	16.9

Source: NEPS-Network (2020c). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:9.0.0, unweighted data, only including children with valid response in school type, N=3,620; Zeiher et al. (2018).

6. Parental health and health-related behavior

To address the effect of parental education on children's and adolescents' health and health-related behavior, we ask parents for their own health and health-related behavior. In doing so, we allow for considering parental health and health-related behavior as important confounding variables in the relationship between the children's own educational levels and their health. We also enable analyses of parental education's effect on children's health and health-related behavior, since parental health and health-related behavior may act as mechanisms in this relationship.

6.1 Measurement concept

Due to time constraints in parental surveys, we primarily refer to basic measurements addressing aspects of health and health-related behavior that are similar to those for children (for an overview see Table 45). Thus, with regard to parental health, we firstly ask parents about their subjective health status captured by the item on *self-rated health*. Secondly, in future surveys, we will complement the overall assessment of an individual's health by asking parents about their *body height and weight*.[19] In analogy to children, we primarily refer to *physical activity*, *smoking behavior*, and *alcohol consumption* levels for parental health-related

[19] Complementing the core concept of pillar 5, in SC1, mothers were asked about their physical and mental health during the last weeks of pregnancy and after birth in the first two waves, and about mental health constraints by focusing on depressive symptoms. However, since the latter only refers to a special subgroup of parents, we concentrate on self-rated health and body height and weight in the following.

behavior.[20] All of these indicators are assumed to affect an individual's own health status as well as their children's health and are all unequally distributed by individual educational levels. In addition, these indicators are also known to cause differences in children's mental, physical, and cognitive growth, and they shape children's health-related behavior (for a review see Chen et al., 2002). Thus, in future surveys, we will regularly ask parents about their physical activity levels, smoking behavior, and alcohol consumption from the beginning.

[20] In the following section, we only describe the measurements of parental smoking behavior, alcohol consumption, and physical activity because information for breastfeeding and participation on medical health check-ups are provided in section 3.

Table 45: *Measurement Concept for Parent's Health-Related Behavior*

		Wave															
SC	**Measurements**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
1	Physical activity																
	Smoking behavior				(P)	(P[1])											
	Alcohol consumption				(P)	(P[1])											
2	Physical activity																
	Smoking behavior						(P)										
	Alcohol consumption																
3	Physical activity																
	Smoking behavior						(P)										
	Alcohol consumption																
4	Physical activity																
	Smoking behavior						(P)										
	Alcohol consumption																

Note: (P) indicates that some measurements related to the construct were surveyed but do not directly correspond to the measurement concept which we will present in the following.

[1] Only first-time respondents.

6.1.1 Parental health

In line with the concept of children's and adolescents' health status, we ask parents about their overall subjective evaluation of their own health. In the same vein, we ask 'How would you describe your general state of health?' and request for an evaluation corresponding to 5 categories ranging from 1 'very good' to 5 'very poor' (see Table 46).[21]

Table 46: *Measurement of Parental Self-Rated Health*

SUF-File	Variable	German text	English text
pTarget	t521000	Wie würden Sie Ihren Gesundheitszustand im Allgemeinen beschreiben?	How would you describe your general state of health?
		1 - Sehr gut	1 - Very good
		2 - Gut	2 - Good
		3 - Mittelmäßig	3 - Average
		4 - Schlecht	4 - Poor
		5 - Sehr schlecht	5 - Very poor
		-97 - Verweigert	-97 - Refused
		-98 - Weiß nicht	-98 - Don't know

We complement the overall rating of parental health status by self-reported body height and weight. We ask parents 'How tall are you?' and 'How much do you weigh?' (see Table 47). Both questions request for an open response of the respective value. This will allow the calculation of the individual body mass index and thus captures the parents' risk for various chronic health impairments (Pate et al., 2012).

Table 47: *Measurements of Parental Body Height and Weight*

SUF- File	Variable	German text	English text
pTarget	t520002	Wie groß sind Sie?	How tall are you?
		_ _ _ cm	_ _ _ cm
		-97 - verweigert	-97 - refused
		-98 - weiß nicht	-98 - don't know
	t520003	Wie viel wiegen Sie?	How much do you weigh?
		_ _ _ kg	_ _ _ kg
		-97 - verweigert	-97 - refused
		-98 - weiß nicht	-98 - don't know

6.1.2 Parental health-related behavior

Regarding parental health-related behavior, we firstly ask for individual levels of physical activity. In line with questions referring to children's physical activity level as well as the

[21] For detailed information about the instrument see Lettau et al. (2020).

measurement concept for adults in NEPS, parents are asked how often they do sports with values ranging from ‘never’ to ‘almost every day’ (see Table 48).

Table 48: *Measurement of Physical Activity of Parents*

SUF-File	Variable	German text	English text
pParent	p27102	Wie häufig machen Sie Sport?	How often do you do sports?
		1 - nie	1 - never
		2 - einmal im Monat oder seltener	2 - once a month or less
		3 - mehrmals pro Monat oder einmal pro Woche	3 - several times a month or once a week
		4 - mehrmals pro Woche	4 - several times a week
		5 - fast täglich oder täglich	5 - almost every day or daily
		-97 - verweigert	-97 - refused
		-98 - weiß nicht	-98 - don't know

For smoking, we follow the measurement concept for children’s smoking and, in line with the “GEDA - German Health Update” study (Robert Koch Institute, 2011), we ask parents, "Do you currently smoke – even if only occasionally?" taking into account information on both current regular smoking behavior and smoking cessation. In addition, we survey parental smoking levels by asking “How many cigarettes do you currently smoke per day on average?” (see Table 49).[22]

Table 49: *Measurement of Smoking Behavior of Parents*

SUF-File	Variable	German text	English text
pParent	p525008	Rauchen Sie zur Zeit – wenn auch nur gelegentlich?	Do you currently smoke - even if only occasionally?
		1 - Ja, täglich	1 - yes, daily
		2 - Ja, gelegentlich	2 - yes, occasionally
		3 - Nein, nicht mehr	3 - no, not anymore
		4 - Habe noch nie geraucht	4 - I have never smoked
		-97 - verweigert	-97 - refused
		-98 - weiß nicht	-98 - don't know
	p521051	Wie viele Zigaretten rauchen Sie derzeit durchschnittlich am Tag?	How many cigarettes do you currently smoke per day on average?
		_ _ _ Zigaretten pro Tag	_ _ _ cigarettes per day
		-97 - verweigert	-97 - refused
		-98 - weiß nicht	-98 - don't know
		-20 - rauche keine Zigaretten	-20 - don’t smoke cigarettes

[22] In previous studies, we asked mothers in particular if they had smoked during pregnancy or breastfeeding in first two panel waves in SC1, and asked parents if someone smokes in the household in SC2, SC3, and SC4. However, since these questions only capture special facets of parental smoking behavior, and because we consolidated our survey program in 2017, we no longer observe these aspects of smoking behavior and concentrate on general consumption patterns as described in Lettau et al. (2020) in future surveys.

Finally, to address parental alcohol consumption, we implement a measurement asking about the frequency of alcohol consumption in the past 12 months. For this purpose, we refer to the first item of an internationally recognized alcohol-screening questionnaire called AUDIT-C (see Table 50). Similar to the measurement concept for alcohol consumption in the NEPS starting cohorts including adults (SC3, SC4, SC5, and SC6), we retain only the first item of the AUDIT-C, covering the most important dimension of individual levels of alcohol consumption (for more detailed information see Lettau et al., 2020).[23]

Table 50: *Measurement of Alcohol Consumption of Parents*

SUF-File	Variable	German text	English text
pParent	p525209	Wie oft nehmen Sie alkoholische Getränke zu sich? Denken Sie bei Ihrer Antwort an den Durchschnitt der letzten 12 Monate.	How often do you consume alcoholic drinks? Think about the average over the last 12 months.
		1 - nie	1 - never
		2 - einmal im Monat oder seltener	2 - once a month or more rarely
		3 - zwei- bis dreimal im Monat	3 - two- to three times a month
		4 - einmal in der Woche	4 - once a week
		5 - mehrmals in der Woche	5 - several times a week
		6 - täglich	6 - every day
		-97 - verweigert	-97 - refused
		-98 - weiß nicht	-98 - don't know

6.2 Empirical results

Since no corresponding data is available in the NEPS starting cohorts 1 to 4, we show descriptive results of parents of SC6, thereby focusing on adults with children under the age of 14 and living in the same household. These respondents are on average 42 years old and make up about one-third of the sample. To see whether the measurements of respondents with at least one minor child in the household are comparable to those without minor children in the household, we compared the respondents of both subgroups. In doing so, we referred to individuals born between 1986 and 1964 to avoid large age differences between the subgroups. We investigated differences based on regression models in a twofold manner: in a first step, we predicted differences between respondents living with minor children and respondents without minor children in the household, only controlling for panel wave. In a second step, we additionally controlled for standard demographic variables such as gender, age, migration background, and individuals' highest level of education. Additionally, complementing the analyses below and providing more detailed information on the overall validity and reliability of measures of parental health and health-related behaviors, corresponding analyses and discussions in Lettau et al. (2020) provide further insights.

[23] In previous studies, we asked mothers in particular if they drank alcohol during pregnancy or breastfeeding in first two panel waves in SC1. However, since these questions only capture special facets of parents' alcohol consumption levels and we consolidated our survey program in 2017, we skipped these questions and implement the same questions addressing adults' health-related behavior as described in Lettau et al. (2020) in future surveys.

6.2.1 Parental health status

Regarding parental health status, parents with children under the age of 14 reported good health on average (mean = 2.11) in SC6. In addition, a major proportion of parents reported at least good health, with more than 15 percent of parents observed in SC6 reporting very good health. Only a very small proportion of parents stated that their health was poor or very poor. Descriptive panel analysis, however, suggests that there is some variation during the observation period. Levels of subjective health status vary by about 0.44 scale points within individuals. Compared to the individuals without minor children in the household, we see only small differences (see Table 51). Although we observe higher averages for respondents without minor children in the household, ordered logistic panel regression models with random effects suggest that these differences are not statistically significant and refer more strongly to other individual characteristics such as age or gender (see Table A-9 of the Appendix). Thus, we conclude that the measure of subjective health among parents shows a similar response pattern as among respondents who do not live in a household with a minor child.

Table 51: *Descriptive Statistics of Panel Data for Self-Rated Health Status in Respondents with and without Minor Children in the Household (SC6)*

		Mean	Std. Dev.	Min	Max	Observations
With minor children in the household	overall	2.09	0.75	1	5	N = 23,054
	within		0.65	1	5	n = 4,991
	between		0.45	0.09	5.38	T-bar = 4.62
Without minor in household	overall	2.12	0.80	1	5	N = 24,123
	within		0.72	1	5	n = 6,298
	between		0.46	-0.38	5.56	T-bar = 3.83

Source: NEPS-Network (2020e). National Educational Panel Study, Scientific Use File of Starting Cohort Adults. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. *https://doi.org/10.5157/NEPS:SC6:11.1.0*.

6.2.2 Parental health-related behavior

Regarding parental health-related behavior, we firstly focus on descriptive results of parental physical activity levels in SC6. We use data of wave 10 since the corresponding question was initially implemented in 2017. The larger proportion of respondents with minor children in the household stated that they are physically active at least several times a month or once a week (67.7 percent) (see Table 52). Moreover, about 8 percent reported being physically active on an almost daily basis. Compared to respondents without minor children in the household, the distribution differs only slightly. In addition, we observe only 5 individuals with missing values in the corresponding item, signaling a high acceptance level for the question in both groups. However, regression analyses based on ordered logistic regression models with robust standard errors highlight statistically significant differences in physical activity levels between both groups (see Table A-10 of the Appendix). Respondents with minor children in the household tend to report significantly lower levels of physical activity when compared to respondents without minor children in the household (p=0.000), however, these differences do not indicate lower validity and reliability of the question for parents with minor children.

Table 52: *Differences in Physical Activity Levels between Respondents with and without Minor Children in the Household*

	With minor children in the household	Without minor children in the household
Never	15.0	14.9
Once a month or less	17.4	13.4
Several times a month or once a week	34.0	31.4
Several times a week	25.8	31.4
Almost daily or daily	7.9	8.9

Source: NEPS-Network (2019c). National Educational Panel Study, Scientific Use File of Starting Cohort Adults. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. *https://doi.org/10.5157/NEPS:SC6:10.0.0*, only respondents observed in wave 10 without missing values (2017/2018), N=3,776.

For parental smoking behavior, we focus on respondents participating in wave 10. About 52 percent of respondents living with a minor child stated that they have never smoked (see Table 53). In addition, about 27 percent claimed that they had quit smoking. In contrast, about 14 and about 7 percent, respectively, reported smoking daily or occasionally. Compared to respondents without minor children in the household, distributions are very similar; however, we observe differences in reporting have never smoked, had quit smoking and daily smoking. Regression analyses based on linear probability regression models underline these differences and suggest that respondents with minor children in the household are less likely to report being smokers and more likely to report never having smoked or had quit smoking (see Table A-11 of the Appendix). Besides these differences in reported smoking status, we observe no differences in smoked cigarettes between respondents with and without minor children in the household (see Table 54 and Table A-12 of the Appendix). Finally, for both items, we observe only a very small number of missing values (n=5 and n=29), which serves as additional evidence that respondents in both groups are highly willing to answer the questions, and that the burden of rating the number of cigarettes seems to be very low.

Table 53: *Differences in Smoking Between Respondents With and Without Minor Children in the Household (SC6)*

	With minor children in the household	Without minor children in the household
Yes, daily	13.7	20.4
Yes, occasionally	7.1	8.2
No, not anymore	26.8	24.2
Have never smoked	52.4	47.2

Source: NEPS-Network (2020e). National Educational Panel Study, Scientific Use File of Starting Cohort Adults. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. *https://doi.org/10.5157/NEPS:SC6:11.1.0*, only respondents observed in wave 10 without missing values (2017/2018), N=3,777.

Table 54: *Differences in the Number of Cigarettes Consumed Between Respondents with and without Minor Children in the Household (SC6)*

	With minor children in the household	Without minor children in the household
Mean	14.0	15.2
Median	15.0	15.0
Std. Dev.	6.8	7.8
N	296	982

Source: NEPS-Network (2020e). National Educational Panel Study, Scientific Use File of Starting Cohort Adults. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC6:11.1.0, only respondents observed in wave 10 without missing values (2017/2018), and reported smoking, N=627.

Table 55 and Table A-13 of the Appendix show the results for parental alcohol consumption levels. About 11 percent of the respondents living with a minor child stated that they never drink alcohol, while about 28 percent claimed that they drink alcohol once a month or less frequently. Although about 40 percent report that they drink alcohol less frequently, about 21 and 22 percent, respectively, stated that they drink alcohol twice or three times a month or once a week on average. In addition, about 17 percent report drinking alcohol several times a week. Compared to respondents without minor children in the household, descriptive results reveal only very small differences, as respondents with minor children reported levels that are similar to the comparison group. Ordered logit regression models underline these similarities and show no significant differences between both groups (see Table A-13 of the Appendix). In addition, the very small number of missing values (n=4) indicates that neither group had difficulties in answering the question.

Table 55: *Levels of Alcohol Consumption between Respondents with and without Minor Children in the Household (SC6)*

	With minor children in the household	Without minor children in the household
Never	10.5	9.4
Once a month or less frequently	28.1	30.0
Twice or three times a month	21.1	28.8
Once a week	22.0	22.5
Several times a week	16.6	16.6
Daily	1.6	2.7
N	1,944	1,833

Source: NEPS-Network (2020e). National Educational Panel Study, Scientific Use File of Starting Cohort Adults. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC6:11.1.0, only respondents observed in wave 10 without missing values (2017/2018).

To sum up, measuring health and health-related behavior in respondents with and without minor children in the household highlights similar response patterns between both groups. Although we observe some differences in reports of physical activity levels and smoking

status, distribution in the variables are very similar. Therefore, we conclude that all measurements operate equally in both groups.

7. Discussion and outlook

This paper describes and validates the measurements of health-related indicators in NEPS. Following the general conceptual and theoretical framework of the NEPS working unit "Returns to Education Across the Life Course" as described in Bela et al. (2018), complementing the overview of adult measurements provided by Lettau et al. (2020), this paper provides deeper insights into the measurements for children and adolescents. We concentrate on measurements referring to our consolidated program established in 2017 and provide the theoretical background as well as the instruments for starting cohorts, targeting children and adolescents. In comparison to the previous papers, we add age-related aspects of individual understandings of health, which should be considered in surveying health inequalities by education in a large-scale panel study. In addition, we complete the one-sided view of health as the result of one's education highlighted in Lettau et al. (2020) by expanding it to include the influence of parental education and the impact of parental health and health-related behavior.

Based on different theoretical approaches, we argue that education causally affects individual health even in childhood and adolescence. Drawing on sociological, economic, and psychological theories, we assume that both the child's and the parents' education are prerequisites for the good health of the target child via higher productive and allocative efficiency, higher levels of social capital, and positive skill-related feedback. Thus, measuring health and health-related behavior in NEPS corresponds to an important return to education. However, since the primary focus of the NEPS is on educational processes, we face some restrictions which limit the survey time available for health-related instruments. We therefore focus on subjective health assessments and primarily ask children for their overall, physical, and mental health status as well as their body height and weight. In addition, we add short comprehensive measurements for health-related behavior, such as physical activity, smoking behavior, and alcohol consumption levels. As supplementary information, we ask parents about the most important health characteristics of their children, survey the health of early childhood, and ask the parents themselves about essential health aspects in order to consider all of these factors as possible mechanisms and control variables.

Empirical results suggest validity and reliability in most of the measurements provided. For measuring children's birth-related health outcomes, measurements of gestational age, birth height and weight, and breastfeeding show reliable and valid results in the respective starting cohorts. Regarding children's and adolescents' health status, self-rated health provides a valid indicator for children's overall health status. Although the parents surveyed made slightly more positive health assessments about their child than the targets themselves, the response patterns of self-rated health were largely consistent. In addition, the subjective evaluation of children's physical and mental health based on subscales of the Kid-KINDL is expected to provide valid and reliable indicators of the two health domains. Assessing children's and adolescents' body weight and height, furthermore, shows valid results in the four starting cohorts, although there are some limitations for young children in particular. Compared to external data, NEPS data yield similar results in parents' reports and only slightly different patterns for children and adolescents. Although children tend to report higher values in body height and show lower values in body mass index, these differences should not limit the

potential for analysis since they do not affect the variation or range of values. Thus, even though the children report different values compared to official data reports, education's effect on health should be still observable. Finally, children's and parents' reports about physical activity levels, smoking behavior, and alcohol consumption do not indicate deficiencies in data quality. Consequently, children's and parents' answers to these questions demonstrate rough indicators for their health-related behavior. As a result of these measurements, NEPS provides valuable information on children's and parents' health and health related behavior.

For some of the measurements, however, several limitations must be considered. Firstly, for the measurements focusing on early health limitations and hospitalization after birth, only those in SC2, SC3, and SC4 are comparable. The item included in SC1 seems to cover a diverging group of children identified. Secondly, the items referring to children's health impairments and developmental delays provided in SC1 show an inconsistent categorization of children's health problems over panel waves. The reports provided by these questions should thus be treated with caution. Thirdly, asking about physical activity levels based solely on monthly or weekly frequency strongly limits the analysis potential for physical activity, since this measurement only represents a very rough measure of physical activity levels and provides no information on different levels of intensity. Similarly, only focusing on the number of cigarettes smoked limits the analysis of variation in prevalence levels of other types of smokers. A further limitation in the analysis of educational differences in drinking patterns may be caused by concentrating on the frequency of alcohol consumption since research provides evidence that while education increases the frequency of drinking, it prevents heavy drinking (Bloomfield et al., 2000; Grittner et al., 2012).

Despite the limitations mentioned above, NEPS provides valuable information on different aspects of individual health and health-related behavior. With a special focus on children and adolescents, we consider age-related differences for measuring health and health-related behavior and implement additional information on parents to allow for deeper causal analyses on education's effect on health. In particular, the longitudinal design and the consideration of important confounding factors, such as parental health and health-related behavior, offers more opportunities for causal inferences when compared to cross-sectional designs or surveys only concentrating on children's characteristics.

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Appendix

Table A-1: *Missing Values Due to Item-Nonresponse in Parents Reports on Health Impairments After Birth*

SC	Wave	Don't know	Refused	N
1	2012	0.10	0.00	3,481
2	2011	2.26	0.00	2,340
	2013	2.80	0.02	5,364
3	2010	3.78	0.05	4,154
	2012	3.83	0.00	1,226
4	2012	6.73	0.03	3,597

Source: NEPS-Network (2020b). National Educational Panel Study, Scientific Use File of Starting Cohort Kindergarten. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC2:8.0.1; NEPS-Network (2019a). National Educational Panel Study, Scientific Use File of Starting Cohort Grade 5. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC3:9.0.0; NEPS-Network (2019b). National Educational Panel Study, Scientific Use File of Starting Cohort Grade 9. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC4:10.0.0.

Table A-2: *Further Measurement of Medical Diagnosed Health Impairments in SC1: Developmental Delays, Developmental Disorders and Behavioral Disorders*

SUF-File	Variable	German text	English text
pParent	p524800	Kinder entwickeln sich sehr unterschiedlich. Bei manchen Kindern in diesem Alter werden Verzögerungen oder Störungen in der Entwicklung und im Verhalten beobachtet. Ist bei <Name des Zielkindes> jemals eine Entwicklungsverzögerung, Entwicklungsstörung oder Verhaltensstörung durch eine Ärztin bzw. einen Arzt oder eine Therapeutin bzw. einen Therapeuten !!festgestellt!! worden? 1 - ja 2 - nein -97 - Verweigert -98 - weiß nicht	Children progress very differently. Some children in this age have delays or disorders in their development and behavior. Has <name of the target child> been !!diagnosed!! with any developmental delay, developmental disorder or behavioral disorder by a doctor or a therapist? 1 - yes 2 - no -97 - Refused -98 - Don't know
	p524801	Welche Arten von Entwicklungsverzögerung, Entwicklungs- oder Verhaltensstörung sind bei <Name des Zielkindes> durch eine Ärztin bzw. einen Arzt oder eine Therapeutin bzw. einen Therapeuten !!festgestellt!! worden? OFFEN: _____ -97 - Verweigert -98 - Weiß nicht	What kind of developmental delay, developmental disorder or behavioral disorder was <name of the target child> !!diagnosed!! with by a doctor or a therapist? OPEN TEXT: _____ -97 - Refused -98 - Don't know
	p524802	Erhält <Name des Zielkindes> !!zurzeit!! aufgrund der angegebenen Entwicklungsverzögerung, Entwicklungs- oder Verhaltensstörung eine Behandlung durch eine Ärztin bzw. einen Arzt oder eine Therapeutin bzw. einen Therapeuten? 1 - ja 2 - nein -97 - Verweigert -98 - weiß nicht	Does <name of the target child> !!currently!! receive any treatment due to this developmental delay, developmental disorder or behavioral disorder by a doctor or a therapist? 1 - yes 2 - no -97 - Refused -98 - Don't know?

Table A-3*: Further Measurement of Medical Diagnosed Health Impairments in SC1: Impairments, Developmental and Behavioral Disorders*

SUF-File	Variable	German text	English text
pParent		Neben sprachlichen Verzögerungen werden bei Kindern in diesem Alter manchmal auch andere Verzögerungen oder Störungen in der Entwicklung und im Verhalten sowie gesundheitliche Einschränkungen beobachtet. Ist bei <Name des Zielkindes> eine der genannten Einschränkungen, Entwicklungs- oder Verhaltensstörungen durch eine Ärztin bzw. einen Arzt oder eine Therapeutin bzw. einen Therapeuten !!festgestellt!! worden?	In addition to linguistic delays, other delays or disturbances in development and behavior as well as health restrictions are sometimes observed with children of this age. Has any of the above-mentioned restrictions, developmental or behavioral disorders !!been diagnosed!! by a doctor or therapist in case of <name of the target child?
	p524431	Seheinschränkungen	Visual impairments
		0 - nicht genannt 1 - genannt -97 - Verweigert -98 - weiß nicht	0 - not specified 1 - specified -97 - Refused -98 - Don't know
	p524432	Höreinschränkungen	hearing impairments
	p524433	motorische Einschränkungen oder motorische Entwicklungsstörung	motoric impairments or motoric developmental delays
	p524436	Aufmerksamkeitsdefizit mit oder ohne Hyperaktivität	attention deficit with or without hyperactivity
	p524437	Autismus oder Autismus-Spektrum Störung	autism or autism spectrum disorder
	p524434	Chronische Krankheiten, wie Asthma oder Neurodermitis	chronic diseases, such as asthma or neurodermatitis
	p524438	Sonstige körperliche, geistige oder emotionale Einschränkungen, Entwicklungs- oder Verhaltensstörungen	other physical, mental or emotional impairments, developmental or behavioral disorders
	p524439	Nichts davon	none of the above

Table A-4: *Data Descriptions for Analyses of Self-Rated Health* – SC2

	Wave 1 2011	**Wave 2 2012**	**Wave 3 2013**	**Wave 4 2014**	**Wave 5 2015**	**Wave 6 2016**	**Wave 7 2017**	**Wave 8 2018**	**Wave 9 2019**	**Wave 10 2020**
Corresponding data files	pParent	pParent	pParent	pParent	pParent pTarget	pParent pTarget	pParent pTarget	pParent pTarget	pParent pTarget	pParent pTarget
Target	Child	Child	Child	Child	Child	Child	Child	Child	Child	Child
Age	4	5	6	7	8	9	10	11	12	13
Grade			1	2	3	4	5	6	7	8
Mode of collection - Parents	CATI	CATI	CATI	CATI	CATI	CATI	CATI	-	CATI	-
Mode of collection - Target					PAPI	PAPI	PAPI/CAWI	PAPI/CAWI	PAPI/CAWI	PAPI/CAWI
Sample Size (complete cases)	2,340	2,111	6,925	6,198	3,901	4,498	3,247	-	-	-

Table A-5: *Data Descriptions for Analyses of Self-Rated Health* - SC3

	Wave 1 2010	**Wave 2 2011**	**Wave 3 2012**	**Wave 4 2013**	**Wave 5 2014**	**Wave 6 2015**	**Wave 7 2016**	**Wave 8 2017**	**Wave 9 2018**	**Wave 10 2019**	**Wave 11 2020**
Corresponding data files	pTarget	pParent pTarget	pParent pTarget	pTarget	pParent pTarget	pParent pTarget	pTarget	pTarget	pTarget	pTarget	pTarget
Target	Child	Child	Child	Child	Child	Child	Child	Child	Child	Child	Child
Age (approximately)	10	11	12	13	14	15	16	17	18	19	20
Grade	5	6	7	8	9	10	11	12	13	-	-
Mode of collection - Parents		CATI	CATI		CATI	CATI					
Mode of collection - Target	PAPI	PAPI	PAPI	PAPI	PAPI	PAPI/CATI	PAPI/CATI	PAPI/CATI	PAPI/CATI	CATI	CATI
Sample Size (complete cases)	5,187	3,382	4,269	6,614	3,724	2,758	5,488	5,263	-	-	-

Table A-6: *Outside Activities Referring to Physical Activity Available in NEPS SC1 and SC2*

SC	Wave	SUF-File	Variable	German text	English text
1	2018-2020	pParent	p26260b	Nimmt <Name des Zielkindes> regelmäßig an sportlichen Aktivitäten teil, z. B. Kinderturnen oder -schwimmen, Training im Sportverein, Reitstunden oder Ähnliches? Tanzen ist hier nicht gemeint.	And does <name of the target child> regularly participate in sports activities, e.g. children's gymnastics or swimming, training in a sports club, riding lessons or similar? This does not include dancing.
2	2012, 2013/ 2014	pParent	p262601	1 - ja 2 - nein -97 - Verweigert -98 - Weiß nicht	1 - yes 2 - no -97 - Refused -98 - Don't know
1	2021	pParent	p281384	Nun geht es um Dinge, die Sie oder jemand anderes zusammen mit <Name des Zielkindes> außerhalb von Ihrem zu Hause unternehmen. Mich interessiert dabei, wie oft Sie solche Dinge gemeinsam unternehmen. Sie oder jemand anderes machen mit <Name des Zielkindes> zusammen Sport oder spielen Spiele, bei denen man körperlich aktiv ist. 1 - mehrmals täglich 2 - einmal täglich 3 - mehrmals in der Woche 4 - einmal im Monat 5 - mehrmals im Monat 6 - einmal im Monat 7 - seltener 8 - nie	Now we would like to look at things which you, or someone else, do outside your home with <name of target child>. I am interested in how often you do things like this together. You, or someone else, do sport or play games with <name of target child> at home where the participants are physically active. 1 - several times a day 2 - once a day 3 - several times a week 4 - once a week 5 - several times a month 6 - once a month 7 - less frequently 8 - never

Table A-7: *Domestic Activities Referring to Physical Activity Available in NEPS SC1 and SC2*

SC	Wave	SUF-File	Variable	German text	English text
2	2011	pParent	p281377	Nun geht es um Dinge, die Sie oder jemand anderes zusammen mit <Name des Zielkindes> zuhause unternehmen. Mich interessiert dabei, wie oft Sie solche Dinge gemeinsam unternehmen. Sie oder jemand anderes machen zuhause mit <Name des Zielkindes> Sport oder spielen Spiele, bei denen man körperlich aktiv ist. 1 - mehrmals täglich 2 - einmal täglich 3 - mehrmals in der Woche 4 - einmal im Monat 5 - mehrmals im Monat 6 - einmal im Monat 7 - seltener 8 - nie -97 - Verweigert -98 - Weiß nicht	Now we would like to look at things which you, or someone else, do at home with <name of target child>. I am interested in how often you do things like this together. You, or someone else, do sport or play games with <name of target child> at home where the participants are physically active. 1 - several times a day 2 - once a day 3 - several times a week 4 - once a week 5 - several times a month 6 - once a month 7 - less frequently 8 - never -97 - Refused -98 - Don't know

Table A-8: *Alternative Measurements of Alcohol Consumption Patterns in SC4*

SUF-File	Variable	German text	English text
pTarget	t525200	Wie häufig pro Woche trinken Sie normalerweise Alkohol?	How often per week do you normally drink alcohol
		1 - nie	1 - never
		2 - seltener als einmal pro Woche	2 - less than once per week
		3 - einmal pro Woche	3 - once per week
		4 - an zwei bis vier Tagen pro Woche	4 - on two to four days per week
		5 - an fünf bis sechs Tagen pro Woche	5 - on five to six days per week
		6 - täglich	6 - everyday
		-90 - keine Angabe	-90 - unspecific missing
pTarget	t525201	Haben Sie schon einmal so viel Alkohol getrunken, dass Sie betrunken waren?	Have you ever drunk so much alcohol that you became drunk?
		1 - nein, nie	1 - no, never
		2 - ja, einmal	2 - yes, once
		3 - ja, zwei- bis dreimal	3 - yes, two to three times
		4 - ja, vier- bis zehnmal	4 - yes, four to ten times
		5 - ja, öfter als zehnmal	5 - yes, more often than ten times
		-90 - keine Angabe	-90 - unspecific missing

Table A-8: *Alternative Measurements of Alcohol Consumption Patterns in SC4 (continued)*

SUF-File	Variable	German text	English text
pTarget	t525210	In welchem Alter haben Sie zum ersten Mal Alkohol getrunken?	How old were you when you drank alcohol for the first time?
		Ich war …	I was…
		_ _ Jahre alt Ich habe noch nie Alkohol getrunken.	_ _ years old I have never drunk alcohol.
		-90 - keine Angabe	-90 - unspecific missing

Table A-9: *Differences in Self-Rated Health between Respondents with and Without Minor Children in the Household*

	Model 1	**Model 2**
Minor children in household		
(Ref.: Without minor children in household)		
Minor children in household	0.011	-0.057
	(0.0363)	(0.0364)
Sex		
(Ref.: Male)		
Female		0.277***
		(0.0611)
Age		0.060***
		(0.0044)
Highest educational level		
(Ref.: Intermediate level of education)		
Low level of education		0.530***
		(0.0978)
High level of education		-0.446***
		(0.0831)
Migration background		
(Ref.: Without migration background)		
With migration background		0.089
		(0.0772)
Observations	47,177	47,177

*Note: * p < 0.05, ** p < 0.01, *** p < 0.001; ordered logistic panel regression models with random effects, robust standard errors in parentheses.*

Source: NEPS-Network (2019c). National Educational Panel Study, Scientific Use File of Starting Cohort Adults. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC6:10.0.0, N=8,194.

Table A-10: *Differences in Physical Activity Levels between Respondents With and Without Minor Children in the Household*

	Model 1	**Model 2**
Minor children in household		
(Ref.: Without minor children in household)		
Minor children in household	-0.207***	-0.225***
	(0.0585)	(0.0591)
Sex		
(Ref.: Male)		
Female		0.060
		(0.0591)
Age		0.011*
		(0.0043)
Highest educational level		
(Ref.: Intermediate level of education)		
Low level of education		-0.420***
		(0.1013)
High level of education		0.427***
		(0.0664)
Migration background		
(Ref.: Without migration background)		
With migration background		-0.039
		(0.0797)
Observations	3,776	3,776

*Note: * p < 0.05, ** p < 0.01, *** p < 0.001; robust standard errors in parentheses.*

Source: NEPS-Network (2019c). National Educational Panel Study, Scientific Use File of Starting Cohort Adults. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC6:10.0.0, only respondents observed in wave 10 without missing values (2017/2018), N=3,776.

Table A-11: *Logistic Regression Results for Probabilities of Being a Smoker, Quitted Smoking and Never Smoking by Respondents With and Without Minor Children in the Household*

	Smoker		Quit smoking		Never smoking	
	Model 1	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
Minor children in household						
(Ref.: Without minor children in household)						
Minor children in household	-0.078***	-0.071***	0.026	0.032*	0.052**	0.038*
	(0.0140)	(0.0138)	(0.0142)	(0.0143)	(0.0163)	(0.0161)
Sex						
(Ref.: Male)						
Female		-0.051***		-0.010		0.061***
		(0.0138)		(0.0143)		(0.0161)
Age		-0.003**		0.002		0.001
		(0.0010)		(0.0011)		(0.0012)
Highest educational level						
(Ref.: Intermediate level of education)						
Low level of education		0.141***		-0.009		-0.132***
		(0.0229)		(0.0238)		(0.0267)
High level of education		-0.102***		-0.037*		0.139***
		(0.0155)		(0.0161)		(0.0181)
Migration background						
(Ref.: Without migration background)						
With Migration background		-0.004		-0.006		0.010
		(0.0186)		(0.0192)		(0.0216)
Observations	3,777	3,777	3,777	3,777	3,777	3,777

*Note: * p < 0.05, ** p < 0.01, *** p < 0.001; robust standard errors in parentheses.*

Source: NEPS-Network (2019c). National Educational Panel Study, Scientific Use File of Starting Cohort Adults. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC6:10.0.0, only respondents observed in wave 10 without missing values (2017/2018), N=3,777.

Table A-12: *Differences in Number of cigarettes smoked between Respondents With and Without Minor Children in the Household*

	Model 1	**Model 2**
Minor children in household		
(Ref.: Without minor children in household)		
Minor children in household	-1.625**	-1.048
	(0.6099)	(0.5850)
Sex		
(Ref.: Male)		
Female		-3.462***
		(0.5712)
Age		0.125**
		(0.0420)
Highest educational level		
(Ref.: Intermediate level of education)		
Low level of education		3.200***
		(0.7290)
High level of education		-1.027
		(0.6638)
Migration background		
(Ref.: Without migration background)		
With migration background		-0.219
		(0.7943)
Observations	627	627

*Note: * p < 0.05, ** p < 0.01, *** p < 0.001; robust standard errors in parentheses.*

Source: NEPS-Network (2019c). National Educational Panel Study, Scientific Use File of Starting Cohort Adults. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC6:10.0.0, N=627.

Table A-13: *Differences in Alcohol consumption levels between Respondents With and Without Minor Children in the Household*

	Model 1	**Model 2**
Minor children in household		
(Ref.: Without minor children in household)		
Minor children in household	-0.040	0.023
	(0.0578)	(0.0587)
Sex		
(Ref.: Male)		
Female		-0.940***
		(0.0603)
Age		0.045***
		(0.0043)
Highest educational level		
(Ref.: Intermediate level of education)		
Low level of education		-0.433***
		(0.1005)
High level of education		0.479***
		(0.0663)
Migration background		
(Ref.: Without migration background)		
With migration background		-0.374***
		(0.0797)
Observations	3,777	3,777

*Note: * p < 0.05, ** p < 0.01, *** p < 0.001; robust standard errors in parentheses.*

Source: NEPS-Network (2019c). National Educational Panel Study, Scientific Use File of Starting Cohort Adults. Leibniz Institute for Educational Trajectories (LIfBi), Bamberg. https://doi.org/10.5157/NEPS:SC6:10.0.0, only respondents observed in wave 10 without missing values (2017/2018), N=3,777.