

The effect of adult education on health-related behaviours

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Abstract Unhealthy behaviours continue to be pervasive and lead to premature death worldwide. According to previous research, school education appears to be a good predictor of unhealthy behaviours. The influence of adult education and training (AET) on health behaviour, on the other hand, has hardly been studied. Existing studies provide only indicative evidence on AET returns in terms of health-related behaviours, with no study to date examining the German context. Longitudinal data from NEPS SC6 ($N=7089$) are used to examine whether participation in adult education affects changes in health-related behaviour positively, i.e., whether participants smoke or drink less and are more frequently active in sports. Hybrid regression models with interaction terms are estimated to test specific theoretical mechanisms. While participation in AET does not show any positive behavioural change in sports activity or alcohol consumption, participants in AET are more likely to smoke following AET participation within the last 12 or between the last 24 and 36 months. Implications are discussed and linked to the existing state of research.

Keywords Adult- and further education · Health-related behaviour · Hybrid regression models · NEPS · Nonpecuniary returns

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Der Einfluss von Erwachsenen- und Weiterbildung auf gesundheitsbezogenes Verhalten

Zusammenfassung Ungesunde Verhaltensweisen sind nach wie vor weit verbreitet und führen weltweit zu einem vorzeitigen Tod. Dem bisherigen Forschungsstand zufolge, scheint die Schulbildung ein guter Prädiktor für ungesunde Verhaltensweisen zu sein. Der Einfluss der Erwachsenen- und Weiterbildung auf das Gesundheitsverhalten ist dagegen kaum untersucht worden. Bestehende Studien liefern nur indikative Hinweise zu Weiterbildungserträgen in Bezug auf gesundheitsbezogenes Verhalten, wobei bisher keine Studie den deutschen Kontext untersucht hat. Mit längsschnittlichen Daten der NEPS SC6 ($N=7089$) wird untersucht, ob sich die Teilnahme an Erwachsenen- und Weiterbildung positiv auf das Gesundheitsverhalten auswirkt, also ob die Teilnehmenden weniger rauchen oder trinken und häufiger Sport treiben. Hybride Regressionsmodelle mit Interaktionstermen werden geschätzt, um spezifische theoretische Wirkmechanismen zu überprüfen. Während die Teilnahme an Erwachsenen- und Weiterbildung zu keinen positiven Verhaltensänderungen in Bezug auf die sportliche Aktivität und den Alkoholkonsum führt, rauchen Teilnehmende im Anschluss an eine Weiterbildungsmaßnahme innerhalb der letzten 12 Monate oder zwischen den letzten 24 und 36 Monaten mit höherer Wahrscheinlichkeit. Mögliche Implikationen werden diskutiert und an den bestehenden Forschungsstand angegliedert.

Schlüsselwörter Erwachsenen- und Weiterbildung · Gesundheitsbezogenes Verhalten · Hybride Regressionsmodelle · NEPS · Nicht-monetäre Erträge

1 Introduction

Unhealthy lifestyles are still common in the European Union (EU) and OECD member states and a main preventable reason for chronic health conditions and premature death: About one-fifth (EU-27: 21%, OECD-36: 18%) of adults smoke daily, 4% of OECD-36 adults are alcohol dependent, 17% of EU-27 adults are obese and only 66% of adults across 23 OECD countries met the recommended guidelines for moderate weekly physical activity (OECD 2019; OECD and European Union 2020). In explaining health inequalities and unhealthy behaviours, research has so far mainly focused on educational gradients (mostly captured through years of schooling or highest educational attainment). A higher level of education is associated with more health-conscious behaviours and thus better physical and mental health (e.g. Brunello et al. 2016; Eide and Showalter 2011; Heckman et al. 2018). However, regarding learning in adulthood as the longest period of learning through the course

¹ Here and in the following, the terms adult education and training (AET) and adult education are used interchangeably. Other terms that are often used synonymously are further education or continuing education or continuing education and training (CET). Unless otherwise described, adult education here refers to adults' participation in non-formal courses and seminars, irrespective of content or context. Informal learning is not included.

of life, adult education and training (AET)¹ has received considerably less attention. School education may be argued to be a stronger predictor to explain health inequalities than adult education². Adult education as part of individuals' life-long learning can, however, start at precisely this point and make an important social and individual contribution in changing health-related behaviours of adults (Field 2011). Healthier behaviours can then affect general well-being, health status, mortality but also labour market productivity.

In this study, we ask whether participation in AET leads to changing health-related behaviours. We are testing if participation in AET has an overarching effect on health-related behaviours, i.e. whether AET leads to a change in smoking or drinking behaviour or physical activity regardless of the content or motivation to participate. With its underlying question, this study contributes to the research on returns on adult education. In this emerging field of adult education research, a distinction is commonly made between monetary and non-monetary returns. While income effects and labour market returns of AET or informal learning activities have often been studied (e.g. Büchel and Pannenberg 2004; Ebner and Ehlert 2018; Rüber and Bol 2017; Schwerdt et al. 2012), research on non-monetary returns has received less attention. Regarding non-monetary returns, it is assumed that adult learning can improve one's health, wellbeing, life satisfaction, social and political participation as well as literacy and numeracy skills (Schrader et al. 2020). Several studies have so far examined the benefits of adult education in terms of mental and physical health, life satisfaction and overall well-being³ (Dolan et al. 2012; Hatch et al. 2007; Matrix Knowledge Group 2009; Ruhose et al. 2020; Wang et al. 2020), partially with restriction to certain subgroups (women, low-skilled, older people or migrants) (Granderath et al. 2021; Hoffmann et al. 2020; Iñiguez-Berrozpe et al. 2020; Jenkins 2011; Jenkins and Mostafa 2015; Narushima et al. 2013, 2018). The state of research on health-related behaviours is characterized by less evidence, although specific health-related behaviours come into focus, especially when it comes to the practical question of how AET can help improve adult health. Three studies have so far examined the effect of AET participation on health-related behaviours. Fujiwara (2012) used data of the British Household Panel Survey (BHPS) and estimated health returns through participation in part-time courses with pooled-OLS regression models. The study shows that people who participate in part-time courses are, next to health-satisfaction increases, less likely to report an alcohol or drug abuse problem (Fujiwara 2012, p. 12). However, no conclusion can be made about the robustness of the results, because, among other things, concrete information about the different regression models and their outcome variables is not properly reported. Feinstein and Hammond (2004) used data on the National Child Development Study and studied whether participation in adult education between the ages of 33 and 42 has an impact on various health dimensions. They report an increased level of undertaking exercise

² Adult education is less time-consuming, less formalised and more selective than school education. In addition, adults already possess much more strongly developed characters traits, attitudes and (health-related) behaviours, that are more difficult to influence through learning processes than adolescents.

³ Life satisfaction and well-being are broader concepts that are influenced by and correlated with health status or health-behaviours.

due to participation overall and specifically in leisure courses as well as a higher probability of giving up smoking for participation in at least three up to 10 courses across a period of nine years. Since the study cannot rule out reverse causality, it is only indicative of health-related behaviour changes through adult education. As part of the Europe-wide project “Benefits of Lifelong Learning” (BeLL), 8646 persons in 10 countries were asked what returns they had gained from participating in liberal adult education courses. Descriptive analysis shows that participants more often report a positive than a negative change in behaviour (i.e. drinking or smoking less). Nevertheless, some participants also report that their health-related behaviour has worsened concerning smoking or drinking (Manninen et al. 2014, p. 24 ff.). The study deals with several limitations. Due to the use of a cross-sectional convenience sample in each country, the results cannot be generalized. Also, one-time surveyed retrospective self-reported changes in health-related behaviour can be very erroneous. The findings are complemented by many qualitative interviews and case studies (e.g. Preston and Hammond 2003; Schuller et al. 2004). While the existing studies are in favour of a correlation, there is no (causal) evidence whether participation in AET does indeed lead to less drinking or smoking or increased physical activity (Hammond 2005). Since returns from adult education can vary greatly for individuals, it is also unknown whether certain subgroups benefit particularly from adult education in terms of change in their health-related behaviour.

Our analysis uses longitudinal data on adults for wave 4 and 7 from the National Educational Panel Study (NEPS SC6, Version 10.0.0; Blossfeld et al. 2011)⁴. For the analyses, we use hybrid models. To the author’s knowledge, for the German context, this study is the first to investigate whether participation in adult education influences individual smoking or drinking behaviour or physical activity.⁵

2 Conceptual framework

To explain changes in smoking or drinking behaviour or physical activity through participation in adult education, no specific theory has been proposed so far. Therefore, one needs to fall back on more general theories that explain the relationship between education and health or health-related behaviour changes. The “Self-in-Context” model, which is based on assumptions by Bronfenbrenner (1979), has already been referred to several times in explaining individual health (e.g. Desjardins and Schuller 2006). It states that—in very simplified terms—health and health-related behaviours can be explained by individual actions and the contexts in which each individual stands. Both, one’s actions and the contexts in which individuals find themselves, are strongly influenced by the level of education. Therefore, individuals

⁴ From 2008 to 2013, NEPS data was collected as part of the Framework Program for the Promotion of Empirical Educational Research funded by the German Federal Ministry of Education and Research (BMBF). As of 2014, NEPS has been carried out by the Leibniz Institute for Educational Trajectories (LIfBi) in cooperation with a nationwide network.

⁵ The impact of AET on healthy nutrition—as another important factor of individual health behaviour—cannot be examined because NEPS Starting Cohort (SC) 6 is not surveyed on this topic.

have a certain degree of (bounded) agency to choose between positive or harmful health-related behaviours (Desjardins and Schuller 2006, p. 180f.). Since this model only provides a very general indication of a link between education and health and the empirical evidence is, as already shown, weak, many different theoretical explanations and mechanisms have been proposed in explaining health benefits through learning across the life-course, so far. Most explanations stem from research on the wider benefits of learning (Schuller 2002; Schuller et al. 2004) and the social outcomes of learning (Desjardins and Schuller 2006; OECD 2007) which partly refer to classic capital theories (e.g. human or social capital). By linking this literature to research that deals with explaining health-related behaviour or health-related behaviour changes (e.g. Strecher et al. 1986; Umberson et al. 2010a), one can assume four reasons for AET induced health-related behaviour changes: (1) social network effects, (2) through the development of skills and abilities, (3) economic effects and (4) content-related effects. Underlying all mechanisms is the assumption of the “Self-in-Context” model, that (adult) education can affect health by empowering healthy choice (Desjardins and Schuller 2006, p. 180).

2.1 Social network effects

Referring to Putnam, we assume that “socially isolated people are more likely to smoke, drink, overeat, and engage in other health-damaging behaviours” (Putnam 2000, p. 355). Adult education can start here, as it is a social activity that can expand social networks (Rüber and Janmaat 2021, p. 58). Through participation in AET or due to a job change or career advancement following participation in AET, one might meet new people or new work colleagues and build new networks. Several quantitative as well as qualitative studies have reported that participation in AET has remarkable positive effects on social participation, social bonding and social networks: Ruhose et al. (2019) show significant positive effects of participation in work-related training on social capital in terms of civic or political and cultural participation (e.g. volunteering, attending classic or modern activities, being active in musical activities). All these activities can foster social bonding and extend one’s social network. A recent study by Rüber and Janmaat (2021) shows that participation in adult education increases volunteering, irrespective of volume, content and obtained qualifications. The authors argue that the effect may be driven by the social interactions and self-perceptions gained through participation in AET. Fujiwara (2012) reports a significant increase in the frequency with which people meet others after participating in part-time courses. Manninen et al. (2014) report that liberal adult education helps participants to uptake new contacts. For the case of community-based adult learning, McIntyre (2012) argue that participation can support the development of social capital for at least some learners and Pearce (2017) reports that participation in creative arts adult education classes provides a sense of belonging and strengthens relationships. The state of research is indicative that AET can improve social networks, irrespective of the course content or motivation to participate; job-related courses as well as leisure courses can increase the social networks of participants. These social networks and social ties can then influence health-related behaviours directly as well as indirectly through social and personal

control and social support (Umberson et al. 2010a). Social support can help individuals to change health behaviours by increasing psychological well-being and decreasing psychological arousal through emotional support (Feinstein and Hammond 2004; Uchino 2004; Thoits 2011). Adult education usually takes place in (learning) groups that provide a sense of belonging, from which especially socially isolated or lonely people can benefit. Moreover, healthy norms in the form of less smoking or drinking or more physical activity may be (more or less) actively reinforced by (new) peers or colleagues. One assumption is that participants in a new environment will inevitably have to rethink their values and attitudes when they are in an open and positive exchange with others (Feinstein et al. 2003). This may also include reflection of health-damaging behaviours or unhealthy lifestyles. Another assumption is that social control can have a positive effect on changes in health behaviour as well as social comparison even without peer reinforcement (Thoits 2011). To a certain extent, individuals adapt their behaviour to that of the reference group (Thoits 2011, p. 147). Social integration and the feeling of belonging to a community through participation in adult education may also reduce chronic levels of stress and therefore promote healthier lifestyles (Braveman et al. 2011). Social participation has been shown to be associated with smoking cessation whereas a lack of active social participation may increase the probability of smoking initiation (Giordano and Lindström 2011). On a social level, individual health-related behaviour is influenced in particular by peers, a marital relationship or community ties (Umberson et al. 2010a, p. 142). Community ties can be strengthened, as has been shown for the case of civic or cultural participation, through participation in AET (Rüber and Janmaat 2021; Ruhose et al. 2019). Although the literature suggests that increasing social networks have a positive effect on health behaviour, there are also conditions under which contact with other people can have negative effects on one's health behaviour. This has been reported occasionally so far, mostly in qualitative or cross-sectional studies: In the BeLL study, for example, few people reported negative changes in health behaviour through participation in liberal adult education, i.e., they smoked or drank more alcohol than before (Manninen et al. 2014, p. 26). Regarding the assumptions about social support and social control, it can be assumed that this depends on whether healthy behaviours and positive health beliefs prevail in the reference group and whether the support received is effective in stopping harmful behaviours (Thoits 2011, p. 147f.). The aforementioned studies contribute to the formulation of our hypotheses, specifically for our formulation of hypothesis H2.

2.2 Development of skills and abilities

Numerous mainly qualitative studies have examined the effect of AET on cognitive and psychosocial skills and abilities. Both skills and abilities are crucial for individual health behaviour change (Feinstein and Hammond 2004). Feinstein and Hammond (2004) assume that adult education can foster generic cognitive development and hereby critical thinking and problem-solving skills, which can then be used to reflect and adopt healthy behaviours. People, who can reflect appropriately in certain situations may be able to develop other coping mechanisms than relying

on health-damaging behaviours, for example when being in stressful conditions. To the author's knowledge only one quantitative study investigated the effect of adult education on cognitive ability. By comparing measures of cognitive ability at age 53 between adults with different levels of education and different levels of participation in adult education over the life course, Hatch et al. (2007) show that participation in adult education can improve verbal memory and verbal skills, regardless of the qualification acquired through participation in adult education. However, the causal interpretability of this study is limited to a certain extent.

It can also be assumed that adult education influences health literacy both directly (through participation in health literacy courses; see *Content-related effects*) and indirectly through the promotion of literacy and numeracy as well as communication and social skills. According to a recent systematic review by Liu et al. (2020), which synthesizes various existing definitions, health literacy may be understood as the ability to acquire and translate knowledge and information to improve health behaviours and health. Health-literate persons, through a wide range of cognitive and social skills, are able to process and use information to take health-promoting actions and maintain healthy behaviour (Liu et al. 2020). A widely cited and adapted definition by Nutbeam (2000) states that health literacy has a hierarchical three-level structure of functions (functional, communicative, and critical literacy)⁶. Basic skills in reading and writing, advanced cognitive and literacy skills as well as social skills are important sequential prerequisites for these three different functions of health literacy. Each of these skills can be strengthened or gained through participation in AET. Hammond (2004) interviewed 145 adult learners and reported for some learners that their improved communication and writing skills through adult learning had a positive impact on their understanding of health information and health-related systems (Hammond 2004, p. 564). Literacy can help people to make better-informed health-related decisions (Braveman et al. 2011, p. 386).

Furthermore, adult education may foster personal development by improving resilience, self-esteem and self-efficacy which can then enhance the ability to change unhealthy behaviours (Feinstein and Hammond 2004, p. 202; Strecher et al. 1986). The underlying assumption is that participants in adult education experience perceptions of achievement or can do more challenging tasks at work which will then result in increased self-efficacy (Hammond and Feinstein 2005, p. 277). These skills and abilities can be used to modify traits and behaviour patterns. Hammond's above cited study reported increased self-esteem and self-efficacy as one central outcome of the learning experiences regardless of the content or type of adult education. The increased self-esteem and self-efficacy are often associated with adult learners being better able to cope with difficult or stressful situations (Hammond 2004, p. 556). Self-efficacy can be seen as one prerequisite for successful health behaviour change (Strecher et al. 1986). The aforementioned studies contribute to the formulation of our hypotheses, specifically for our formulation of hypothesis H3.

⁶ See Nutbeam (2000, p. 263f.) and Liu et al. (2020, p. 4) for a detailed description of the different functions of health-literacy.

2.3 Economic reasons

As Cutler and Lleras-Muney (2010) report, income and other economic factors (e.g. health insurance, job status) play an important role in explaining the education health-behaviour gradient. For our underlying question, however, there are limitations with respect to AET. In contrast to schooling education, the general economic effect of AET is rather ambiguous and elusive, especially for the German context (for recent studies see Ebner and Ehlert 2018; Rüber and Bol 2017; Schwerdt et al. 2012). Few studies report income effects from participation in AET or CVT, and for the most part the effects are very small. To the authors' knowledge, no study has investigated the actual effect of AET on health-behaviours through an increase of economic resources. Even though individual groups of people may benefit economically from adult education, we do not consider this mechanism as one main explanatory factor. Therefore, we do not resort to this mechanism to formulate our hypotheses.

2.4 Content-related effects

Content-wise, participation in certain adult education courses can improve health literacy, which is considered to influence healthy actions for example quitting smoking or drinking cessation (Wagner et al. 2009). Many evaluation studies have looked at the effect of participation in health literacy courses on improving adult health literacy (e.g. Chervin et al. 2012; Muscat et al. 2017; Soto Mas et al. 2015). Improving health literacy is crucial as it partially mediates the relationship between educational attainment and health behaviour. Especially for physical inactivity, unhealthy diet and obesity, health literacy explains a substantial part of the effect of educational attainment on health behaviours (Friis et al. 2016, p. 56). Suka et al. (2015) have shown, with Japanese cross-sectional data, that people with high health literacy report less smoking, drinking or physical inactivity. Health literacy courses have been shown to promote the development of verbal skills at both the functional, communicative, and critical health literacy levels (Muscat et al. 2017). Some learners have reported that they used the knowledge and skills they have acquired to change their health behaviour (Chervin et al. 2012, p. 741). Learners also showed higher self-efficacy after being taught about health literacy (Chervin et al. 2012, p. 741), an important skill to be able to change health-related behaviours.

A rather obvious content-wise effect may be participation in AET courses with specific physical health-related content (e.g. leisure courses involving physical activity like dancing or sports) which will then result in a higher physical activity on its own. Participation in such courses may also spill over into personal life, as the acquired sports-related knowledge may have led to healthier behaviours and more regular exercise while decreasing smoking or drinking. We consider these course-related effects to formulate our hypothesis H1 and discuss our findings in the following sections, but we cannot test them specifically.

3 Hypotheses

Based on the assumptions and the indicative state of research, various hypotheses were formulated to test whether participation in AET affects health-related behaviour change. First, we expect that adult education has an overall impact on the change of health-related behaviours since it can extend social networks, foster generic cognitive and personal development as well as self-efficacy and health-literacy and improve labour market perspective:

H1: People who participate in AET are more likely to change their health-related behaviours in a positive sense (i.e. less drinking or smoking and more physical activity).

In the first hypothesis, the effect of AET participation on health-related behaviours is still operationalized as a black box. However, it is possible to approximate the mechanisms at work in this process. As several studies have shown, AET is a social practice that improves social networks, social bonding, and social participation (Ruhose et al. 2019) which can then help individuals to change their health-related behaviours through social support or social control (Thoits 2011). One would expect that either socially isolated people or people who have competing work-related time events in their lives, and are thus less socially active, may derive higher health-related benefits from participation in AET. Vice versa, people with extensive social networks may not profit from the social returns of AET, as there might be a marginal utility of AET. Literature indicates that certain family constellations can increase stress and loneliness, decrease social participation and well-being, and may also reinforce harmful health-related behaviours, for example single parenthood (Umberson et al. 2010b), specific constellations of parenthood on minor children (Arimoto and Tadaka 2021; Umberson et al. 2010b) as well as parenthood on children with disabilities (Currie and Szabo 2020). All constellations have high childcare costs in common. We try to approximate different family constellations with a childcare key to test whether parents with a high amount of care needs benefit particularly from AET, as through participation in AET, they can meet new people, expand their social networks, and may receive social support and social control. We do not assume that parents with increasing numbers of children are fundamentally socially isolated, but that increasing care needs compete with other social activities that may positively affect health behaviours. Therefore, we suppose, that:

H2: For parents with a high level of childcare, participation in AET has a stronger effect on health-related behaviour change than for parents with a lower level of childcare or for childless adults.

It is also possible to formulate specific hypotheses about the possible effect of adult education on health-related behaviour via cognitive mechanisms and the development of psychosocial skills. From a human capital perspective, it can be assumed that cognitive and non-cognitive skills are closely related to labour market returns. Accordingly, the labour market returns to educational investments in skills decline the later in the life course these investments take place (Heckman 1999, 2006). Thus, if AET affects health-related behaviour through the same cognitive mecha-

nisms, this return should decline the later in the life course AET takes place. It can also be assumed that the marginal return of adult education in terms of health behaviour change decreases the later in life participation in AET occurs, as traits and (addictive) behaviours become more persistent and stable (Burgard et al. 2020) and may be more difficult to address through an increase in critical thinking, self-efficacy, or health-literacy. In addition, cognitive abilities generally decline with age (e.g. reasoning, Salthouse 2012, p. 9), which can make changes in health-related behaviours less likely as generic cognitive abilities seem to be crucial for health-related behaviours (Cutler and Lleras-Muney 2010; Tomljenovic and Bubic 2021).

H3: For older people, participation in AET has a weaker effect on health-related behaviour change than for younger people.

4 Data and methods

To test our hypotheses, we use the starting cohort (SC) 6 (adults) of the NEPS (Version 10.0.0; Blossfeld et al. 2011). The NEPS is a German national panel study that follows educational biographies from early childhood through kindergarten, elementary school, lower secondary school, higher education, and further education in adulthood in a multi-cohort sequence design. The NEPS SC6 provides a good data basis for the underlying question, as it collects educational biographies in the form of event data in addition to sociodemographic information and employment biographies in a national representative survey of birth cohorts 1956 to 1986. Since participants are asked retrospectively about their education and learning activities, information on participation in non-formal courses and seminars is available for each survey wave. Information on health status and health-related behaviours (e.g., sports activity, smoking, alcohol consumption) is only collected in individual waves, but repeatedly, as a central dimension of the SC6 is the identification of educational returns over the life course.

We operationalize health-related behaviours across three variables: smoking status, physical activity, and alcohol consumption. These variables are available in the NEPS in the fourth (survey period: 2011/2012) and seventh survey waves (survey period: 2014/2015). Accordingly, there are more than 3 years between the survey waves. The variables represent health-related behaviours at different scale levels. Smoking status is binary, sports activities are continuous, and alcohol consumption is ordinally scaled. A visualization of the data structure can be found as Supplement.

Our main independent variable is continuing AET participation. This variable is available in the NEPS for the entire period in the form of event data. We have operationalized continuing AET participation based on the number of courses attended within one year. Any reported participation in adult, continuing, further, or vocational education is included, regardless of the content, duration, or motivation for participation (professional or private). Both job-related and non-job-related, voluntary as well as mandatory courses are included in the sample, as we want to investigate whether participation in AET has a general effect on health behaviours. Since it can be assumed that the effect of adult education on health-related behaviour

takes time, we used the continuing participation in AET with different time lags at the time of the observed health-related behaviour (36 to 24; 24 to 12; and 12 months before)⁷.

We control for several variables. We select the variables according to the literature that investigates the determinants of AET participation and health-related behaviours to minimize confounding effects. For example, participation in further training has been shown to be dependent on age, gender, employment and job status and years of schooling (Büchel and Pannenberg 2004; Grund and Martin 2012). Childcare responsibilities may encourage non-participation (Büchel and Pannen-

Table 1 Overview of variables and descriptive statistics

		M/%	SD	Min/Max
<i>Health-related behaviour</i>				
Smoking Status	0=No, 1=Yes	22%	0.42	0/1
Sports Activity (weekly)	1=up to 1 h, 2=between 1 and 2 h, 3=between 2 and 4 h, 4=more than 4 h	2.57	1.01	1/4
Alcohol consumption	0=never, 1=once per month or less, 2=2–4 times a month, 2–3 times a week, 4=more than 4 times a week	2.17	1.13	0/4
<i>Participation in AET</i>				
AET 12 months	Number of attended courses within 12 months before the observed health-related behaviour	1.98	2.48	0/20
AET 24 months	Number of attended courses between 12 and 24 months before the observed health-related behaviour	1.98	2.41	0/21
AET 36 months	Number of attended courses between 24 and 36 months before the observed health-related behaviour	1.57	2.07	0/23
<i>Demographic characteristics</i>				
Age	Age in years	49.54	10.85	24/70
Sex	0= male, 1= female	53%	0.50	0/1
Childcare key	Number of Childs under age 14 divided by number of Adults aged 18 years or older in the household	0,20	0.40	0/4
Years of Education	Schooling years (derived from CASMIN classification)	14.36	3.39	0/18
Household income	Net household income (€)	3704.29	3798.08	0/200,000
Employment	Employment status within the last 12 months, 0=unemployed, 1=employed	87%	0.34	0/1
Unemployment duration	Months unemployed within the last 36 months	1.64	6.19	0/36
Managerial position	Holding a managerial position, 0=No, 1=Yes	31%	0.46	0/1

N= 10,659. Source: NEPS SC6, wave 4 and 7, own calculations
AET adult education and training

⁷ The respective time periods are restricted by the data structure, as month-by-month information is not available for all reported courses.

berg 2004, p. 93). Health-related behaviours have also been shown to vary across these sociodemographic and socioeconomic characteristics (Heckman et al. 2018; Pampel et al. 2010; Ross and Wu 1995). Some of these variables vary between subjects and within subjects, others vary only between subjects. Gender and years of education vary only between subjects. Employment status, disposable household income, duration of unemployment in the last three years, age, childcare key and holding a managerial position vary between and within subjects. Especially employment status, disposable household income and unemployment duration can be expected to confound the relationship between participation in AET and health-related behaviour as all factors affect the probability of participation and health-related behaviours (BMBF 2021; Pampel et al. 2010). Since we are unable to verify the actual childcare effort required for children in the household, we have calculated a childcare key. For this, we calculated the quotient of the number of children under age 14 in the household divided by the number of adults over age 18 (including parents) in the household⁸. We assume that with an increasing number of children under age 14 in the household, there is a higher care effort and responsibility per adult. However, this does not allow us to cover specific individual cases in which child disabilities or illnesses are associated with a particularly high level of care required. An overview of the variables used is given in Table 1.

In our analytic sample, we nested $N = 10,659$ observations into $n = 7089$ subjects. Therefore, the panel is not balanced. Only individuals with valid responses to each variable are included. Our sample consists of individuals who are between 24 and 70 years old with a mean-age of 49.5 years. There are slightly more women in the data set (53%) and about one in ten persons (13%) was unemployed in the last 12 months. Compared with the data for the EU-27 member states cited in the introduction, the proportion of smokers is similarly high (22%).

We use hybrid models to analyse the data. The advantage of these models is that all the information available in the data can be used to test our hypotheses. Hybrid models allow to estimate effects of both variables that vary over time and time-constant variables (Wooldridge 2010). Thus, hybrid models combine the advantages of fixed-effects and random effects models. In hybrid models, both between and within effects are estimated simultaneously. The comparison of between and within effects of a variable gives an indication of unobserved heterogeneity (Schunck 2013). Hybrid models also allow the estimation of cross-level interaction effects between variables that vary only between subjects and variables that vary within subjects (Schunck 2013). All analyses were performed with Stata using the XTHYBRID module (Perales and Schunck 2021). Scripts can be found as Supplement.

In the first model, we examine the extent to which participation in AET has an effect on health-related behaviours. For the dependent variable smoking status, we use a probit hybrid model (first equation). For sports activities (hours per week) we

⁸ The household includes all persons with whom the respondent lives and runs the household.

use a linear hybrid model (second equation) and for alcohol consumption an ordinal logit hybrid model (third equation).

$$Pr(y_{ij} = 1|x_{ij}) = \Phi(\beta_0 + \sum_{z=1}^{z=3}(\beta_{FEz}(x_{ijz} - \bar{x}_{iz})) + (\beta_{BWz}\bar{x}_{iz}) + \sum_{z=4}^{z=9}(\beta_{FEz}(x_{ijz} - \bar{x}_{iz})) + (\beta_{BWz}\bar{x}_{iz}) + u_i + \epsilon_{ij}) \quad (1)$$

$$y_{ij} = \beta_0 + \sum_{z=1}^{z=3}(\beta_{FEz}(x_{ijz} - \bar{x}_{iz})) + (\beta_{BWz}\bar{x}_{iz}) + \sum_{z=10}^{z=11}(\beta_{BWz}\bar{x}_{iz}) + u_i + \epsilon_{ij} + \sum_{z=4}^{z=9}(\beta_{FEz}(x_{ijz} - \bar{x}_{iz})) + (\beta_{BWz}\bar{x}_{iz}) + \sum_{z=10}^{z=11}(\beta_{BWz}\bar{x}_{iz}) + u_i + \epsilon_{ij} \quad (2)$$

$$\begin{aligned} \text{logit}(y_{ij} > s|x_{ij}) = & \beta_0 + \sum_{z=1}^{z=3}(\beta_{FEz}(x_{ijz} - \bar{x}_{iz})) \\ & + (\beta_{BWz}\bar{x}_{iz}) + \sum_{z=4}^{z=9}(\beta_{FEz}(x_{ijz} - \bar{x}_{iz})) + (\beta_{BWz}\bar{x}_{iz}) \\ & + \sum_{z=10}^{z=11}(\beta_{BWz}\bar{x}_{iz}) + u_i + \epsilon_{ij} \end{aligned} \quad (3)$$

In the hybrid models, between-subject effects as well as within-subject effects are estimated simultaneously. The within-subject effects are operationalized by mean-centering and are described in all models by the term $\beta_{FEz}(x_{ijz} - \bar{x}_{iz})$. These effects are estimated for those independent variables that vary over time. Between-subject effects are estimated for all variables using the mean: $\beta_{BWz}\bar{x}_{iz}$.

$x_{ij1}-x_{ij3}$ represents the adult education participation (number of courses per year) of a subject i at time j 3 years ago (x_{ij3}) two years ago (x_{ij2}) and in the last 12 months (x_{ij1}). $x_{ij4}-x_{ij9}$ are variables that vary between and within subjects (age, employment status, duration of unemployment, managerial positions, and childcare). The variables $x_{ij10}-x_{ij11}$, on the other hand, vary only between the subjects (gender, years of education). To test hypotheses 2 and 3, interaction effects between participation in adult education and childcare key and age are included in the models described above. Also, for the interaction effects, between-subject effects and within-subject effects are estimated. The three interactions between participation in continuing education at the three observation times and the childcare ratio can be described as follows: $\sum \beta_{FE}(x_{ij1...3}x_{ij9} - \bar{x}_{i1...3}\bar{x}_{i9}) + \beta_{BW}(\bar{x}_{i1...3}\bar{x}_{i9})$. Accordingly, the interactions between participation in continuing education and age can be depicted as follows: $\sum \beta_{FE}(x_{ij1...3}x_{ij4} - \bar{x}_{i1...3}\bar{x}_{i4}) + \beta_{BW}(\bar{x}_{i1...3}\bar{x}_{i4})$. For reasons of comprehensibility and manageability, these 18 additional terms are not included in the description of the basic models above.

As a result of these estimations, we obtain three models for each outcome (smoking, sports, alcohol consumption). One model (model 1) without interaction effects

Table 2 Smoking Status and AET participation

		Model 1	Model 2	Model 3
Dependent variable: Smoking status				
AET 12 months	Between	-0.033 (0.049)	-0.060 (0.055)	-0.129 (0.258)
	Within	0.142** (0.051)	0.176** (0.058)	0.165 (0.245)
AET 24 months	Between	-0.007 (0.060)	0.029 (0.066)	-0.166 (0.307)
	Within	-0.045 (0.054)	-0.048 (0.059)	0.179 (0.281)
AET 36 months	Between	0.002 (0.057)	0.004 (0.064)	0.082 (0.283)
	Within	0.232*** (0.064)	0.217** (0.069)	0.095 (0.354)
AET 12 months * Childcare key	Between	–	0.008 (0.127)	–
	Within	–	-0.125 (0.109)	–
AET 24 months * Childcare key	Between	–	-0.118 (0.158)	–
	Within	–	-0.001 (0.135)	–
AET 36 months * Childcare key	Between	–	0.086 (0.132)	–
	Within	–	0.075 (0.152)	–
AET 12 months * Age	Between	–	–	0.001 (0.005)
	Within	–	–	-0.001 (0.005)
AET 24 months * Age	Between	–	–	0.004 (0.006)
	Within	–	–	-0.005 (0.006)
AET 36 month * Age	Between	–	–	-0.002 (0.006)
	Within	–	–	0.003 (0.007)
Age	Between	-0.018* (0.007)	-0.015* (0.007)	-0.019* (0.009)
	Within	-0.177*** (0.039)	-0.170*** (0.039)	-0.166*** (0.039)
Sex (Ref. = Male) Childcare key	Between	-0.123 (0.136)	-0.088 (0.137)	-0.110 (0.137)
	Within	-0.223 (0.189)	-0.100 (0.258)	-0.212 (0.197)
Years of Education	Between	-0.065* (0.289)	-0.069* (0.028)	-0.055 (0.028)
	Within	-0.000* (0.000)	-0.000* (0.000)	-0.000* (0.000)
Employment (Ref. = Unemployed)	Between	0.274 (0.240)	0.220 (0.239)	0.313 (0.256)
	Within	0.471 (0.410)	0.468 (0.411)	0.444 (0.414)
Unemployment duration	Between	0.026** (0.009)	0.019 (0.011)	0.013 (0.012)
	Within	0.011 (0.024)	-0.011 (0.025)	-0.010 (0.025)
Managerial position (Ref. = No)	Between	0.117 (0.159)	0.153 (0.159)	0.216 (0.157)
	Within	-0.118 (0.284)	-0.118 (0.283)	-0.122 (0.281)
Cons.	–	-18.819*** (1.047)	-17.612*** (1.044)	-17.658*** (1.088)
Var (Cons.)	–	588.847 (50.563)	513.952 (47.200)	514.162 (46.682)
N	–	10,659	10,659	10,659

The table shows logistic hybrid regression models with unstandardized coefficients. Standard errors in Parentheses. Source: NEPS SC6, wave 4 and 7, own calculations

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*significant ($p \leq 0.05$); **significant ($p \leq 0.01$); ***significant ($p \leq 0.001$)

Table 3 Sports activity and AET participation

		Model 1	Model 2	Model 3
Dependent variable: Sports activity				
AET 12 months	Between	0.022** (0.008)	0.012 (0.009)	0.026 (0.039)
	Within	−0.001 (0.009)	0.000 (0.009)	−0.022 (0.040)
AET 24 months	Between	0.010 (0.010)	0.018 (0.011)	−0.03 (0.048)
	Within	0.007 (0.009)	0.004 (0.010)	−0.004 (0.047)
AET 36 months	Between	−0.003 (0.009)	−0.003 (0.010)	0.004 (0.044)
	Within	−0.015 (0.011)	−0.016 (0.012)	−0.070 (0.055)
AET 12 months * Childcare key	Between	—	0.047* (0.019)	—
	Within	—	−0.007 (0.018)	—
AET 24 months * Childcare key	Between	—	−0.038 (0.024)	—
	Within	—	0.015 (0.023)	—
AET 36 months * Childcare key	Between	—	0.005 (0.022)	—
	Within	—	0.000 (0.025)	—
AET 12 months * Age	Between	—	—	−0.000 (0.001)
	Within	—	—	0.000 (0.001)
AET 24 months * Age	Between	—	—	0.001 (0.001)
	Within	—	—	0.000 (0.001)
AET 36 months * Age	Between	—	—	−0.000 (0.001)
	Within	—	—	0.001 (0.001)
Age	Between	−0.001 (0.001)	−0.001 (0.001)	−0.002 (0.001)
	Within	0.017* (0.007)	0.017* (0.007)	0.016** (0.007)
Sex (Ref. = Male)	Between	−0.227*** (0.023)	−0.225*** (0.023)	−0.227*** (0.023)
	Within	−0.253*** (0.030)	−0.283*** (0.043)	−0.252*** (0.030)
Childcare key	Between	−0.182** (0.068)	−0.194* (0.083)	−0.182** (0.068)
	Within	—	—	—
Years of Education	Between	0.001 (0.004)	0.000 (0.004)	0.000 (0.005)
	Within	—	—	—
Household income	Between	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
	Within	−0.000 (0.000)	−0.000 (0.000)	−0.000 (0.000)
Employment (Ref. = Unemployed)	Between	−0.244*** (0.038)	−0.243*** (0.038)	−0.249*** (0.038)
	Within	−0.084 (0.071)	−0.084 (0.071)	−0.086 (0.071)
Unemployment duration	Between	0.001 (0.002)	0.001 (0.002)	0.000 (0.002)
	Within	−0.001 (0.004)	−0.001 (0.004)	−0.001 (0.004)
Managerial position (Ref. = No)	Between	−0.025 (0.026)	−0.025 (0.026)	−0.025 (0.026)
	Within	−0.020 (0.054)	−0.021 (0.054)	−0.018 (0.054)
Cons.	—	2.903*** (0.104)	2.917*** (0.104)	2.966*** (0.117)
Var (Cons.)	—	0.430 (0.017)	0.429 (0.017)	0.430 (0.017)
Var (Sport activity)	—	0.571 (0.013)	0.571 (0.013)	0.571 (0.013)
N	—	10,659	10,659	10,659

The table shows linear hybrid regression models with unstandardized coefficients. Standard errors in Parentheses. Source: NEPS SC6, wave 4 and 7, own calculations

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*significant ($p \leq 0.05$); **significant ($p \leq 0.01$); ***significant ($p \leq 0.001$)

to test hypothesis 1, one model (model 2) with interaction effects between AET and the childcare key to test hypothesis 2 and one model (model 3) with interaction effects between AET and age to test hypothesis 3. We present the unstandardized coefficients.

5 Results

In total, nine hybrid regression models were estimated. Table 2 presents the results of three probit hybrid regression models estimating the change in smoking behaviour as a function of the change in AET participation. Model 1 shows the regression coefficients for the total effect of AET participation on smoking status (H1). When participating in AET within the last 12 or between the last 24 and 36 months before observation, people are highly significant more likely to report smoking ($b_{\text{AET } 12} = 0.142$ and $b_{\text{AET } 36} = 0.232$, within coefficients). The calculation of one-sided p -values based on the z -statistic further supports this result ($p_{\text{AET } 12} = 0.003$, $p_{\text{AET } 36} = 0.000$; see Supplement for all one-sided p -values of the within coefficients). Based on the pseudo R^2 , we find a Cohen f^2 of 0.006 for the overall effect of AET after 36 months. The model shows no significant effect of AET at any time before the observation of smoking status (between coefficients). Our hypothesis that adult education improves health-related behaviour cannot be confirmed with regard to smoking. We also find a significant effect for childcare. Caring for children significantly reduces the chance of smoking ($b = -0.957$). Adding interaction terms for the childcare key in Model 2 (H2) keeps the AET coefficients significant and stable. Nonetheless, we do not find positive effects for those with a high level of childcare participating in AET. Moreover, the significant negative effect of childcare key in model 1 becomes insignificant. By adding interaction terms with age in Model 3 (H3), the effect of AET participation on smoking status diminishes and becomes insignificant. Also, those being older do not benefit from AET participation in particular. Regarding these results, all formulated hypotheses about the impact of AET on smoking status must be rejected.

In addition to the effects to be tested, people with increasing age or level of childcare tend to stop smoking. Additionally, with a regard to the results in models 2 and 3, people with more years of education are less likely to smoke.

Table 3 presents the results of the three linear hybrid regression models estimating change in weekly sports activity as a function of the change in AET participation. Model 1 shows the regression coefficients for the total effect of AET participation on weekly sports activity (H1). People with a higher average AET participation rate (between effect) report a higher average weekly sports activity than those with lower AET participation rates within the first 12 months before observation ($b = 0.022$, between coefficient). On an individual base (within coefficient), people who participated in AET do not report more weekly sports activities. The one-sided p -values support this result (see Supplement for the different p -values). Hypothesis 1, that AET promotes health-related behaviour, must be rejected regarding sports activities. Adding interaction terms with the childcare key in Model 2 (H2), the AET between-coefficient from Model 1 becomes insignificant. Instead, those with a higher level

Table 4 Alcohol Consumption and AET participation

		Model 1	Model 2	Model 3
Dependent variable: Alcohol consumption				
AET 12 months	Between	0.020 (0.037)	0.011 (0.041)	-0.104 (0.175)
	Within	-0.011 (0.024)	-0.008 (0.027)	-0.139 (0.114)
AET 24 months	Between	0.003 (0.045)	-0.025 (0.050)	0.136 (0.217)
	Within	-0.002 (0.026)	-0.002 (0.029)	0.035 (0.133)
AET 36 months	Between	-0.043 (0.041)	0.008 (0.046)	-0.276 (0.202)
	Within	-0.000 (0.031)	-0.001 (0.033)	-0.201 (0.156)
AET 12 months * Childcare key	Between	—	0.030 (0.088)	—
	Within	—	-0.013 (0.051)	—
AET 24 months * Childcare key	Between	—	0.140 (0.110)	—
	Within	—	-0.001 (0.063)	—
AET 36 months * Childcare key	Between	—	-0.233* (0.102)	—
	Within	—	0.003 (0.070)	—
AET 12 months * Age	Between	—	—	0.003 (0.004)
	Within	—	—	0.003 (0.002)
AET 24 months * Age	Between	—	—	-0.003 (0.004)
	Within	—	—	-0.001 (0.003)
AET 36 months * Age	Between	—	—	0.005 (0.004)
	Within	—	—	0.004 (0.003)
Age	Between	0.080*** (0.006)	0.079*** (0.006)	0.073*** (0.007)
	Within	0.089*** (0.020)	0.089*** (0.020)	0.084*** (0.020)
Sex (Ref. = Male) Childcare key	Between	-1.774*** (0.109)	-1.773*** (0.110)	-1.778*** (0.109)
	Within	-0.290* (0.140)	-0.259 (0.201)	-0.284* (0.140)
Years of Education	Between	-0.417* (0.192)	-0.386 (0.236)	-0.420* (0.192)
	Within	0.258*** (0.022)	0.258*** (0.022)	0.257*** (0.022)
Household Income	Between	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
	Within	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Employment (Ref. = Unemployed)	Between	0.584** (0.176)	0.576** (0.176)	0.549** (0.178)
	Within	0.342 (0.208)	0.344 (0.208)	0.338 (0.208)
Unemployment duration	Between	-0.052*** (0.009)	-0.052*** (0.009)	-0.052*** (0.009)
	Within	0.000 (0.012)	0.000 (0.012)	-0.001 (0.012)
Managerial position (Ref. = No)	Between	-0.069 (0.122)	-0.072 (0.122)	-0.069 (0.122)
	Within	0.110 (0.154)	0.110 (0.154)	0.116 (0.154)
Cut 1	—	1.452 (0.487)	1.424 (0.488)	1.085 (0.547)
Cut 2	—	4.826 (0.493)	4.798 (0.494)	4.461 (0.551)
Cut 3	—	8.517 (0.509)	8.490 (0.510)	8.156 (0.565)
Cut 4	—	12.433 (0.535)	12.405 (0.536)	12.074 (0.588)
Var (Cons.)	—	13.760 (0.645)	13.744 (0.644)	13.773 (0.645)
N	—	10,659	10,659	10,659

The table shows ordinal probit hybrid regression models with unstandardized coefficients. Standard errors in Parentheses. Source: NEPS SC6, wave 4 and 7, own calculations

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*significant ($p \leq 0.05$); **significant ($p \leq 0.01$); ***significant ($p \leq 0.001$)

of childcare participating in AET within the last 12 months before observation report a higher weekly sports activity ($b=0.047$, between coefficient). Since we do not find any within-effect of the interaction between AET and childcare on health-related behaviours here, we must reject Hypothesis 2 with regard to sports activities. Adding interaction terms between AET and age in Model 3 did not yield significant effects. All formulated hypotheses about the impact of AET on sports activity must therefore be rejected.

In addition to the effects to be tested, people with increasing age are more frequently active in doing sports. Women and employed persons (between) report fewer weekly sports activities and people with childcare are less likely to report frequent sports activities.

Table 4 presents the results of three ordinal logit hybrid regression models estimating change in alcohol consumption as a function of the change in AET participation. In each model, we do not find any significant effects of participation in AET on the change in alcohol consumption behaviour, even after computing one-sided p -values (see Supplement). Only adults with childcare responsibilities who participated in AET between 24 and 36 months preceding the observed drinking behaviour, drink less alcohol than comparable adults with less childcare responsibilities ($b=-0.233$, between coefficient). Since we find no significant positive effect on an individual base (within), the formulated hypotheses must also be rejected with respect to alcohol consumption.

The remaining control variables show that (average) unemployed persons and women drink less alcohol. Childcare also significantly reduces alcohol consumption (between and within). People with more years of education, older people, (average) employed people and those with a higher average household income drink more alcohol.

6 Discussion

In the present study, we investigated whether participation in adult education and training leads to healthier behaviours, as has been reported many times (e.g. Feinstein and Hammond 2004; Fujiwara 2012; Manninen et al. 2014). The theoretical assumption was that educational activities generally promote cognitive and noncognitive skills and that the circumstances associated with participation in AET (e.g., social interaction and integration) have a positive effect on healthier behaviours (Feinstein and Hammond 2004). Literature indicates that AET can improve social support, social participation, resilience, self-efficacy as well as health-literacy indirectly as well as directly through participation in specific health-related courses (e.g. Hammond 2004; Hammond and Feinstein 2005; Ruhose et al. 2019) which can then be used to change health-behaviours. With reference to these mechanisms, we have also hypothesised, that adult education could be of particularly high value for parents with high childcare needs and of lower value for older people to change their health behaviour. The results could not confirm the formulated hypotheses, neither the general hypothesis nor the interaction hypotheses. For the case of alcohol consumption, neither positive nor negative effects could be observed overall.

Positive behavioural changes were evident only in three models regarding sports activity (Table 3, Model 1 & 2) and alcohol consumption for adults with childcare responsibilities who participated in AET between 24 and 36 months preceding the observed drinking behaviour (Table 4, Model 2). Since in all three models only the between coefficient was significant, it can be assumed that there are confounding factors for this finding. Therefore, we cannot assume that participation in AET has had an impact on changing sports activity or alcohol consumption. Interestingly, negative behavioural changes were evident with respect to smoking status (Table 2, Model 1 & 2). The finding is indicative that AET may also lead to unintended consequences.

Our results cannot support the general assumption that AET, as an educational resource, can promote health behaviour. Instead, the findings are indicative that certain constellations of life circumstances and participation in adult education can have a negative effect on health-related behaviours, whereby both circumstances preceding participation and circumstances occurring during participation may have decisive influence. With our statistical approach, we are not able to fully differentiate between both circumstances. The effect of adult education on smoking is particularly remarkable. The fact that adult education increases the probability of changing smoking behaviour requires explanation. First, as we have already mentioned, social networks, social support and social control can also have damaging effects on health behaviour (Thoits 2011), even though these negative outcomes were reported much less frequently than positive ones (see for example Manninen et al., 2014). Smoking is often a social practice that takes place in informal groups. In this sense, the additional social contacts through adult education can increase the probability of meeting smokers and starting or resuming smoking in an informal group. Secondly, it is possible that AET may promote career progression which in turn may lead to increased stress and an increase in smoking. Also, the learning process itself can cause stress and anxiety eroding good health practices (Jenkins 2011, p. 404). Thirdly, it may be possible that specific life circumstances preceding the participation in AET, have led to people smoking more frequently after participation (for example unemployment). To proof which of these explanations hold, the specific life circumstances preceding the participation in AET would have to be controlled more precisely in future studies.

The fact that we did not find any group-specific effects for parents with a high amount of childcare or for older people could be related to our interaction variables used. Our childcare key might not be a proper proxy to distinguish between parents with high and low childcare needs. For the case of age, it can be assumed that the relationship is not linear and therefore the marginal return changes only with very high age. Another reason, that we did not find a general positive effect of adult education on health behaviours, but also no group-specific effects, could be related to the heterogeneity of the courses being too great and suppressing positive effects. Since our aim was to investigate the overall effect of adult education on health behaviour, participation in AET was not included in a differentiated manner. We still assume that AET can have a positive impact on the individual health-behaviour. However, the association might be more complex than the state of research indicated. The results point out that for the different health-related behaviours, different

mechanisms could be at work, which must be covered with specifically formulated causal assumptions. The associations between AET and health behaviours examined here are only indirect effects that can be generalized to AET and education as a whole. The strength of AET, however, is its high degree of differentiation in terms of content and its thematic focus on very specific target groups. In order to measure the direct effect of adult education, it would be useful to investigate whether courses with health-related content change health behaviour and whether this helps risk groups in particular. Also, the course context could be important, i.e. whether the participation was voluntary, mandatory, intrinsic or extrinsic and whether it was a basic education or academic course.

A noteworthy effect beyond our research question is the influence children have on their parents' health behaviours. In particular, negative behaviours such as smoking and drinking are reduced. There may be two explanations for this. First, social contacts may be reduced to the point that there is little opportunity for smoking and drinking in social settings. This is also supported by the fact that there is no time for sports. Secondly, unhealthy behaviour is difficult to reconcile with the normative role modelling of parents. The responsibility for the children then directly reduces unhealthy behaviours.

7 Limitations

Our study dealt with several limitations. First, the proposed mechanisms could not be investigated, as the necessary information is not available in the NEPS data used. Therefore, we tried to approximate two mechanisms (social networks and cognitive development and development of skills) by estimating interaction coefficients for two selected populations (people with a high amount of childcare needs and older people) which should be harmed in their social networks or cognitive learning success. We cannot estimate how well our proxies for social networks (childcare key) and cognitive processes (age) represent underlying but not directly observable characteristics. We computed childcare as a continuous variable. It might, as well, make sense to examine different family constellations by computing dummies, as it is known that single parents are particularly exposed to stress. Second, we have been interested in the overarching effect of participation in AET as education in general should have a positive impact on health behaviour. Since adult education and training is very heterogeneous, it should be noted, that the health benefits of adult education can be expected to vary greatly depending on the content, motivation for the course or the qualification achieved through participation. The heterogeneity of courses included in our sample could therefore suppress specific effects. Third, our statistical approach is limited regarding causal interpretation. With health-related behaviours being observed only two times across a period of over 3 years, longitudinal analyses are limited. The assumption of parallel processes associated with the fixed effects model cannot be verified with only two points of observation. We cannot completely rule out reverse causality, nor proof whether specific life circumstances preceding the participation in AET led to health-related behaviour changes. Finally, we cannot

distinguish between people who participated voluntarily and those who are required to participate.

8 Conclusion

With our analyses, we contributed to the state of research on non-monetary returns of adult education and showed that AET as a general educational resource does not necessarily have a positive effect on health-related behaviour, as one could assume according to the previous state of research. With longitudinal data, we were able to show that adult education can even reinforce unintended negative health behaviours (in the case of smoking); a relationship that has so far only been described from qualitative studies or descriptively on the basis of cross-sectional data. Our study highlights the challenge to identify specific mechanisms which explain health-related returns on adult education, especially when the mechanisms cannot be directly included in the analyses.

Future research should therefore consider the segments of adult education (employer provided CET, individually job-related CET, Non-work-related adult education) in addition to mere participation in adult education. In addition, it might be valuable to examine the life circumstances that led to participation in adult education to examine further mechanisms. With certain restrictions, the NEPS could be used for this purpose. In this context, it should be examined whether adult education has positive effects on health-related behaviour in addition to negative effects, and what these effects are related to. It can be assumed that changes in occupational circumstances (e.g. job loss) may affect participation in adult education on the one hand and poor health-related behaviours on the other. With regard to the weak theoretical base, it would also be desirable to test the specific mechanisms of action empirically, i.e., whether changes in health-related behaviour are related to a change in social networks or acquired skills, abilities or literacy. For this purpose, the effect of courses with specific health-related course content could be studied. Then, more targeted conclusions about health literacy as a mechanism could be drawn. Refugees and migrants could be a valuable and interesting population group to find out to what extent health literacy and thus health behaviour is improved by teaching literacy and numeracy in integration courses.

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Conflict of interest J. Kohl and A. Martin declare that they have no competing interests.

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