Faculty of Medicine
Doctoral Programme in Population Health
University of Helsinki
Finland

FAMILY BACKGROUND DIFFERENCES IN CHILDHOOD MEAL PATTERNS AND OVERWEIGHT— FINNISH CHILD HEALTH STUDY 2007—2013

Suvi Parikka

DOCTORAL DISSERTATION

To be presented for public discussion with the permission of the Faculty of Medicine of the University of Helsinki, in Hall 1, Haartman Institute, on the 26th of May, 2023 at 13 o'clock.

Helsinki 2023

Research location:
Department of Public Health and Welfare,
Population Health Unit,
Finnish Institute for Health and Welfare,
Finland

Dissertationes Scholae Doctoralis Ad Sanitatem Investigandam
Universitatis Helsinkiensis

ISSN 2342-3161 (print)
ISSN 2342-317X (online)
ISBN 978-951-51-9160-1 (pbk.)
ISBN 978-951-51-9161-8 (PDF)

Unigrafia

Helsinki 2023

Supervisors Professor Tiina Laatikainen, MD, PhD
Institute of Public Health and Clinical Nutrition
University of Eastern Finland, Kuopio, Finland
and
Department of Public Health and Welfare
Finnish Institute for Health and Welfare, Helsinki, Finland

Tuija Martelin, PhD
Department of Public Health and Welfare
Finnish Institute for Health and Welfare, Helsinki, Finland

Reviewers Adjunct Professor Leena Koivusilta
Department of Social Research
University of Turku, Finland

Adjunct Professor Hanna Lagström
Department of Clinical Medicine
University of Turku, Finland

Opponent Adjunct Professor Sirpa Sarlio
Clinicum, Department of Public Health
University of Helsinki, Finland

The Faculty of Medicine uses the Urkund system (plagiarism recognition) to examine all doctoral dissertations.

CONTENTS

ABSTRACT

Abundant evidence over decades has shown childhood obesity to be a considerable public health problem. Overweight and obesity are known to extend into adulthood and therefore may be related to increased risk of premature mortality and adult morbidity, especially cardio-metabolic morbidity. This suggests there is an urgent need for public health action for overweight prevention in childhood.

Health behaviour of children and their parents are closely related to childhood overweight. Meal patterns in children such as breakfast consumption, high meal frequency and frequent family dinners, are suggested as favourable for maintaining a normal weight status in children and adolescents. Further, parental BMI and eating behaviour have an association with children's overweight. Overweight and meal patterns in early life are unevenly distributed across child population groups. Differences in overweight by socioeconomic position (SEP) of the family means that overweight is more common among children from families with a lower parental SEP compared with those from families with a higher parental SEP. With regard to family types, there is also some evidence that the separation of parents and single parenthood are risk factors for overweight and skipping breakfast in early life. Still, socioeconomic and family type differences regarding meal frequency are largely unknown.

Following this, the current study aimed to identify the family background factors contributing to the socioeconomic and family type differences among children (ca 3-11 years) and adolescents (ca 14-16 years) in Finland with population-based, child health survey data collected in 2007-2009 and 2013-2014. The aims were to especially shed light on the direct and indirect pathways between parental BMI, family SEP factors, family structure and overweight and meal patterns in childhood. The study also examined family background factors predicting the recommended meal frequency (4 to 6 meals a day) in later childhood in a follow-up study setting. The main statistical methods in the study included univariate and multivariate logistic regression analyses. Structural equation modeling using a path analysis was performed to identify direct and indirect pathways between family factors (i.e. parental overweight, SEP, family type) and childhood overweight (including obesity) and meal patterns.

The results showed that there were meal pattern related differences in overweight. Overweight was associated with skipping breakfast and eating less than 4 meals a day or more than 6 meals a day among children and adolescent. The associations remained statistically significant even when socioeconomic background factors of the family were taken into account. Instead, family dinner

frequency was not associated with weight status of a child. Parental BMI and education were the strongest determinants of childhood overweight. Children having parents who are overweight had significantly increased risk of being overweight compared with children who did not have overweight parents. Low SEP, as measured by parental education, was associated with higher childhood overweight. Family type and perceived family income sufficiency were the strongest determinants of meal patterns both in children and adolescents. Lastly, early childhood family background predicts meal frequency behaviour in children. Low SEP, as measured by mother's education, and a decrease in income sufficiency, increased the risk of not eating the recommended number of meals (four to six meals a day) in childhood. Children who lived in intact families were more likely to eat the recommended number of meals a day compared with those who lived in other family types throughout the follow-up period. This difference was partly explained by change in income.

Finnish national health policy aims at promoting well-being and health equity for children. The results from this study indicate that national policies and public interventions have not been able to eliminate the socioeconomic and family type differences in overweight and meal patterns in childhood. Thus, to prevent overweight and to reduce observed inequalities, children and families who need special support should be identified as early as possible. National actions to promote healthy eating behaviour, such as "health-related tax", and nutrition counselling and meals provided in early childhood education and schools could reduce health inequalities. Multi-stakeholder cooperation and effective community-based interventions relating to physical and food environment should be implemented as these reach all children from different family backgrounds. Finally, protection of income security in changing life situations is needed.

TIIVISTELMÄ

Viimeisten vuosikymmenien aikana kertynyt näyttö osoittaa lapsuuden ylipainon ja lihavuuden olevan merkittävä kansanterveysongelma. Ylipaino jatkuu usein aikuisikään, joten se lisää monien sairauksien, kuten tyypin 2 diabeteksen, kohonneen verenpaineen ja valtimotautien sekä ennenaikaisen kuolleisuuden vaaraa. Tämä osoittaa selkeän tarpeen lasten ylipainoa ehkäiseville toimenpiteille.

Lasten lihavuus liittyy vahvasti koko perheen elintapoihin. Aamupalan syömisen, säännöllisen ateriarytmin ja perheen yhteisten aterioiden tiedetään olevan hyödyllisiä lasten ja nuorten painon hallinnassa. Myös vanhempien ylipaino ja terveystottumukset vaikuttavat lasten ylipainoon ja ruokailutottumuksiin. Lapsuuden ylipaino on jakautunut epätasaisesti väestössä. Ylipainossa havaittavat sosioekonomisen aseman mukaiset erot osoittavat, että matalammassa sosiaalisessa asemassa olevien perheiden lapset ovat yleisemmin ylipainoisia kuin korkeammassa asemassa olevien perheiden lapset. On myös näyttöä siitä, että vanhempien ero ja yksinhuoltajuus ovat lapsuuden ylipainon ja aamupalan syömättä jättämisen riskitekijöitä. Säännöllisen ateriarytmin sosioekonomiset ja perhetyypin mukaiset erot ovat suurelta osin tuntemattomia.

Tämän väitöskirjatutkimuksen tavoitteena oli tunnistaa 3-11 -vuotiaiden lasten ja 14-16 -vuotiaiden nuorten ylipainon ja ruokarytmin keskeiset perhetaustaan liittyvät riskitekijät. Erityisesti tutkimuksessa tarkasteltiin sosioekonomisen taustan ja perhetyypin mukaisia eroja lapsuudessa. Lisäksi selvitettiin sitä, ennustavatko perhetaustatekijät suositellun säännöllisen ateriarytmin (4-6 ateriaa päivässä) toteutumista myöhemmin lapsuudessa. Näiden teemojen tutkimiseksi käytettiin kansallista lasten terveyskyselyn aineistoa, joka kerättiin vuosina 2007-2009 ja 2013-2014. Tutkimuksessa hyödynnettiin kvantitatiivisia analyysejä, kuten erilaisia regressiomalleja huomioiden lukuisat eri taustamuuttujat. Lisäksi polkumallien avulla analysoitiin vanhempien ylipainon, perheen sosioekonomisen aseman, perhetyypin ja lasten ylipainon sekä ateriarytmin suoria ja epäsuoria yhteyksiä.

Tulokset osoittivat, että aamupalan syöminen ja ateriarytmi vaikuttavat lapsuuden ylipainoon. Ylipaino oli yhteydessä aamupalan syömättä jättämiseen sekä epäsäännölliseen ateriarytmiin sekä lapsilla että nuorilla. Yhteys säilyi, vaikka perheen sosioekonomista asemaa kuvaavat tekijät huomioitiin. Sen sijaan perheen yhteisten aterioiden ja lapsen painon välillä ei havaittu yhteyttä. Vanhempien lihavuudella ja koulutuksella oli vahvin yhteys lapsen ylipainoon. Lapsilla, joilla molemmat vanhemmat olivat ylipainoisia, oli selvästi kohonnut ylipainon riski verrattuna lapsiin, joiden vanhemmat eivät olleet ylipainoisia.

Matalammin koulutettujen vanhempien lapset olivat ylipainoisempia kuin korkeasti koulutettujen vanhempien lapset.

Perhetyyppi ja perheen tulot olivat vahvimmin yhteydessä lasten ja nuorten ruoka- ja ateriarytmiin. Suositellun säännöllisen ateriarytmin (4-6 ateriaa päivässä) puutteellista toteutumista ennustivat äidin matala koulutus ja tulojen heikentyminen seurannan aikana. Lisäksi ydinperheiden lapsilla säännöllisen ateriarytmin toteutuminen oli todennäköisempää kuin koko seurannan ajan muissa perhetyypeissä asuvilla lapsilla. Tämä ero selittyi osin perheen tulojen muutoksella.

Suomen terveyspolitiikka tähtää lasten hyvinvoinnin ja terveyden tasa-arvoisuuden edistämiseen. Yhteiskunnalliset toimet eivät kuitenkaan ole onnistuneet poistamaan lapsuuden ylipainossa ja ruoka- ja ateriarytmissä havaittuja perhetaustasta johtuvia eroja. Lasten ja nuorten ylipainon ehkäisemiseksi ja havaittujen erojen kaventamiseksi on tärkeää tunnistaa varhain lapset ja perheet, jotka tarvitsevat erityistä tukea. Terveellistä syömistä ja ateriointia edistävät kansalliset toimet, kuten terveysperusteinen vero, sekä toimet varhaiskasvatuksessa ja kouluissa voivat tasoittaa perhetaustasta johtuvia eroja. Tarvitaan myös laaja-alaista eri toimijoiden välistä yhteistyötä sekä paikallisia toimia, jotka tähtäävät siihen, että arjen elinympäristö kannustaa eri perhetaustoista tulevia lapsia liikkumaan ja syömään terveellisesti. Lisäksi tulee huolehtia toimeentulon turvaamisesta eri elämänvaiheissa.

LIST OF ORIGINAL PUBLICATIONS

I Parikka S, Mäki P, Levälahti E, Lehtinen-Jacks S, Martelin T, Laatikainen T. Associations between parental BMI, socioeconomic factors, family structure and overweight in Finnish children: a path model approach. *BMC Public Health* 2015; 15(271).

II Parikka S, Levälahti E, Martelin T, Laatikainen T. Single-parenthood and perceived income insufficiency as challenges for children's healthy meal patterns. *Appetite* 2018;127:10-20.

III Parikka S, Martelin T, Karvonen S, Levälahti E, Kestilä L, Laatikainen T. Early childhood family background predicts meal frequency behaviour in children: Five-year follow-up study. *Scand J Public Health* 2022; 50(8):1199-1207. Epub 2021 Dec 14.

The publications are referred to in the text by their roman numerals. The original publications are reprinted with permission of the copyright holders.

ABBREVIATIONS

BMI	body mass index
CI	confidence interval
IOTF	International Obesity Task Force
LATE	Child Health Monitoring Development Study
OR	odds ratio
SEP	socioeconomic position
THL	Finnish Institute for Health and Welfare
VRN	National Nutrition Council
WHO	World Health Organization

USED TERMINOLOGY

BMI Z-SCORE body mass index measure of relative weight adjusted for child age and sex

FAMILY TYPE or FAMILY STRUCTURE refers to the combination of relatives that comprise a family

INTACT FAMILY a two-parent family

JOINT PHYSICAL CUSTODY FAMILY a family with children living for an equal-time with their mother and father in two separate homes

MEAL PATTERN a child's eating behaviour at the level of a 'meal' referring to breakfast consumption, number of meals eaten a day and family dinner frequency

RECOMMENDED NUMBER OF MEALS four to six meals a day

RECONSTITUTED FAMILY a family with a step-parent involved

SINGLE-PARENT FAMILY a single-mother or single-father family

1 INTRODUCTION

Childhood overweight is a considerable public health problem worldwide (e.g. Garrido-Miguel et al. 2019). According to estimations by the World Health Organization (WHO), overweight (including obesity) prevalence in children and adolescents aged 5–19 years, has risen from 4 percent in 1975 to over 18 percent in 2016 (WHO 2021). In Finland, the prevalence of overweight (including obesity) among children aged 2–16 years was 29 percent in boys and 18 percent in girls in 2020 (Jääskeläinen et al. 2021). These rates are even more alarming in the view of the immediate and long-term health risks. Among obese children, elevated cardiovascular risk factors are found already in early life (Dalla Valle et al. 2018). Further, it is well known that overweight and obesity extends into adulthood and therefore may be related to an increased risk of premature mortality and adult morbidity, especially cardio-metabolic morbidity (Franks et al. 2010; Freedman et al. 2005; Juonala et al. 2011; Reilly and Kelly 2011).

Childhood overweight is a complex problem with various factors involved. The health behaviour of the whole family is closely related to overweight. Overweight is a result of a positive energy balance, which usually derives from unfavourable eating behaviour (e.g. skipping breakfast, family dinners) and physical activity habits, but sleep and sedentary behaviour also play a role (Fatima et al. 2015; Verduci et al. 2021). The term 'meal patterns' is used to describe a child's eating patterns at the level of a meal such as breakfast or dinner. Small children need food frequently because they cannot eat large quantities at a time. Long intervals between meals can result in uncontrolled eating and unnecessary snacking, and thus cause overweight. The recommendation is that both children and adults should eat every 3–4 hours, which translates into ca. 4–6 meals a day (National nutrition council 2016). Moreover, in the national recommendation meals should be shared in order to promote the health of the whole family. Breakfast consumption is often seen as favourable for maintaining a normal weight status in children and adolescents (Haug et al. 2009; Monzani et al. 2019; van Lippevelde et al. 2013). It is suggested to play a critical role in energy balance and dietary regulation (Rampersaud et al. 2005) and is associated with a favourable nutrient intake (Larson et al. 2013) and improved food choices (Sjöberg et al. 2003). A high meal frequency is suggested to have an inverse association with childhood obesity (Jääskeläinen et al. 2013; Toschke et al. 2005; Toschke et al. 2009). However, the beneficial number of meals for healthy body weight varies in different studies (Jääskeläinen et al. 2013; Toschke et al. 2005; Vik et al.

2010). Furthermore, the evidence on family dinner frequency and overweight association is inconsistent.

In childhood, the family, and growth environment play an important role in shaping children's health behaviour and the possible development of obesity. Growth environment includes many levels and their interactions, such as local settings (e.g. home, school and peers), services, local practices and the physical environment (Ristikari et al. 2018). Childhood overweight is unevenly distributed among the child population so that overweight is more common among children from families with a lower parental SEP compared with those from families with a higher parental SEP (Buoncristiano et al. 2021; Kautiainen et al. 2009; Knai et al. 2012). Alarmingly the social inequalities in children's overweight seem to emerge already in early childhood (McCrory et al. 2019; Mekonnen et al. 2021). Considerable evidence of socioeconomic inequalities in overweight in early life suggests that inequality is more likely to increase rather than to decrease (e.g. Chung et al. 2016; Knai et al. 2012). This development anticipates widening health inequalities and increases in health costs due to obesity in the future. In addition to overweight, differences in eating patterns according to the parental SEP also exist. Children and adolescents from families with a lower parental SEP are more likely to skip breakfast and have fewer family dinners than children from higher SEP families (Kaikkonen et al. 2012; Neumark-Sztainer et al. 2013; van Ansem et al. 2014; Wijtzes et al. 2015). To my knowledge, no prior studies on the association between the family SEP and the number of daily meals among children have been published.

The effect of the parental SEP on children's overweight and meal patterns may be mediated through many family-related risk factors. One important risk factor for childhood obesity is having parents who are themselves overweight or obese (Laitinen et al. 2001). Weight gain is significantly greater among children with overweight or obese mothers (Demment et al. 2014). Additionally, parental breakfast consumption is a strong predictor of children's breakfast consumption, and it has been suggested to mediate the association between the parental SEP (especially education) and children's breakfast consumption (Gebremariam et al. 2017; Keski-Rahkonen et al. 2003). Thus, the effect of the parental SEP may be partly mediated by parental overweight and health behaviour, but the direct and indirect pathways between family factors (i.e. SEP, parental overweight) and childhood overweight/obesity and meal patterns are understudied.

In addition to the parental SEP, the family structure is another important aspect of the family context that influences children's health. Parental separation and/or living in a single-parent family are often considered to increase the risk of overweight (Duriancik and Goff 2019; Schmeer 2012) and unfavourable meal pattern behaviour, especially skipping breakfast (Jorgensen et al. 2011;

Vereecken et al. 2009). The reason for growing interest in studying the effect of the family structure on children's health is that over the past decades, family diversity has increased as the proportion of traditional intact families has declined. Single parenthood has become more common in Finland, and today already almost one-fourth of families with children are single parent families, compared to, for example, 1992, when the share was 15 percent (Official Statistics of Finland 2020). Moreover, children are increasingly likely to live in reconstituted families: in 2020, 9 percent of families with children aged 0–17 were reconstituted families.

Only a few studies have included other family types such as reconstituted families [i.e. the child lives with one parent and his/her new partner and/or new sibling(s)] as a measure of family type. These studies show mixed results regarding the association between other non-traditional family types than single parenthood and overweight in early life (Formisano et al. 2014; Kristiansen et al. 2020). Further, whereas evidence of association between skipping breakfast and living in single-parent families is fairly consistent, the impact of living in reconstituted families on meal patterns is inconclusive (Jorgensen et al. 2011; Levin et al. 2012; Vereecken et al. 2009; Yelick 2017). To my knowledge, no prior studies on the association between the family type and number of daily meals among children have been conducted. One study investigating family dinner frequency and family type suggested that having a regular family dinner seemed to be more prevalent among adolescents from two-parent families compared to adolescents living either in single-parent families or reconstituted families (Levin et al. 2012). Nevertheless, that study had limitations as children do not always remain in one family type throughout their childhood. The transition from one family form to another (e.g. from having married parents to having a single-parent) rather than the family type as such may negatively affect children's health through concomitant factors such as parental conflict, loss of parental contact and reduced family income following separation (Reiter et al. 2013). Empirical evidence on the association between family transitions and childhood overweight and meal patterns is scarce.

Promoting well-being and health equity for children is a central aim of the Finnish national health policy. Implementation of this policy is based on universal healthcare institutions, such as maternity and child health clinics and school healthcare services, that are available to children and their families across the socioeconomic spectrum. Early childhood education, pre-primary education and schools teach children health education relating to eating, physical activity and sleeping (Finnish National Agency for Education 2014). Health education is also given during the school day in different situations related, for example, to eating together. Further, each child and young person

attending pre-primary, basic and upper secondary education can enjoy a free school meal. Nevertheless, the socioeconomic inequalities in overweight are unambiguous also among Finnish children aged 5 to 14 years old (Kaikkonen et al. 2012) and adolescents (Mäki et al. 2019) implying that tackling these inequalities requires that the mechanisms behind them are well understood.

Even though large differences have been detected in childhood overweight and overweight-related meal patterns between socioeconomic groups, the picture remains incoherent, particularly regarding family type differences. The aim of this study is to identify the family background factors contributing to the socioeconomic and family type differences among children (ca 3-11 years) and adolescents (ca 14-16 years) in Finland using population-based, child health survey data. Further, the study elucidates the direct and indirect pathways between parental BMI, family SEP, family structure and overweight and meal patterns in childhood. The study also focuses on the effect of family type transitions and changes in the family SEP in childhood in a follow-up setting. The study is anticipated to help target and implement relevant health policies aiming to prevent overweight and inequalities in it and to promote healthy eating behaviour in early life.

2 CONCEPTUAL FRAMEWORK

2.1 HEALTH INEQUALITIES IN THE LIFE COURSE

In the life course approach, childhood and adolescence are seen as critical life periods as persistent health behaviours begin during these phases (Kjonniksen et al. 2008; Mikkilä et al. 2005) and thus create lifelong implications for individuals' health and wellbeing (see Kuh et al. 2003). Childhood is a time of rapid biological, psychological, and social development and children's health behaviour is largely shaped by the material and time resources of the parents and their parenting styles. Adolescence is a second sensitive developmental period in which puberty and rapid brain maturation lead to new sets of behaviours (relating to substance misuse, sex, diet and exercise) (Viner et al. 2012). Although the influence of peers and media increases, family still retains an important role in the adolescent's life (Aaltonen and Karvonen 2016). In recognition of the importance of childhood and adolescence, the Commission on Social Determinants of Health's "Closing the Gap in a Generation" report suggests that "equity from the start" should be an essential component of any attempt to improve health outcomes overall and, in particular, to address health inequalities (Commission on Social Determinants of Health 2008).

Research questions relating to socioeconomic health inequalities are common in social epidemiology, which focuses particularly on what effect social factors have on individual and population health. The traditional explanation for health inequalities is based on two main mechanisms: *social causation* and *health selection* (Townsend and Davidson 1982). Social causation suggests that the SEP has an effect on health, i.e. children from lower SEP families are likely to become less healthy adults. Health selection suggests, instead, that health in early life influences the SEP later in life, i.e. illness during childhood and adolescence may influence the attainment of adult SEP. Later, it has been argued that causation and selection are not sufficient to explain health inequalities. There are also other exposures, risk factors and mechanisms that influence the development of health inequalities over the life course. For example, Mackenbach (2019) lists the following factors: childhood growth environment, material living conditions in adulthood, physical working conditions, psychosocial factors and stress, health behaviour and health services. Moreover, inequalities in adult-disease risk factors do not emerge exclusively in mid-life but accumulate over decades (Power and Matthews 1997). Subsequently, socioeconomic health inequalities have been reported to emerge already in childhood. For example, Mekonnen et al. (2021) reported

that maternal and paternal educational differences in children's weight and BMI trajectories emerged during infancy, continuing to later childhood.

The life course approach to health and health inequalities emphasises that both biological and social beginnings of life have important implications for adult health. Life-course theorists have identified three ways by which early circumstances may be linked to adult health: *direct, indirect through social pathways or through accumulation of disadvantages*. Kuh et al. (2003) also point out that these life-course models are not mutually exclusive, but rather might operate simultaneously.

First, in a study by David Barker (1998), different environmental factors were assumed to "programme" particular body systems during infancy and early life and to affect *directly* to adult health. He suggested that in biological programming, undernutrition during pregnancy, low birth size and poor growth in infancy affect the individual's adult risk of disease (Barker 1998). Subsequently, numerous studies have shown inverse associations between body size at birth and CHD and type 2 diabetes in adult life (Eriksson et al. 1999; Eriksson et al. 2000; Eriksson et al. 2003a; Eriksson et al. 2003b). The highest incidence of diabetes in adult life is seen among individuals who had the highest BMI in childhood but who had been small at birth (Eriksson et al. 2003b).

Second, early life exposures can affect adult health and mortality *indirectly through social pathways*. Childhood social circumstances may be important because they can be mediated by social pathways, such as education and employment to the adult SEP. This, in turn may influence adult health and disease. (Kestilä 2008.) Moreover, social pathways often interact with biological pathways and link exposures during the life course to later life health (Kestilä and Rahkonen 2011).

Third, the importance of the *accumulation of disadvantage* during the life course refers to processes, where previous disadvantages affect subsequent disadvantages. Mortality can be seen as an extreme end point of the accumulation of disadvantage (e.g. Berg 2017). For example, poor family relationships in adolescence play a role in chains of disadvantages such as economic adversity in midlife and these pathways are shaped by low education and poor mental health in early adulthood (Berg 2017). The accumulation of disadvantage seems evident also concerning overweight. A low SEP in childhood seems to be associated with adult morbidity risk: the prevalence of overweight is especially high among children in lower social groups (Buoncristiano et al. 2021), overweight tends to extend into adolescence and adulthood (Freedman et al. 2005), among obese children cardiovascular risk factors have found to be present already in early life (Dalla Valle et al. 2018) and childhood overweight may increase chronic disease risk in later life including type 2 diabetes, hypertension and cardiovascular disease (Juonala et al. 2011; Sahoo et al. 2015).

2.2 DETERMINANTS OF CHILDHOOD OVERWEIGHT AND MEAL PATTERNS

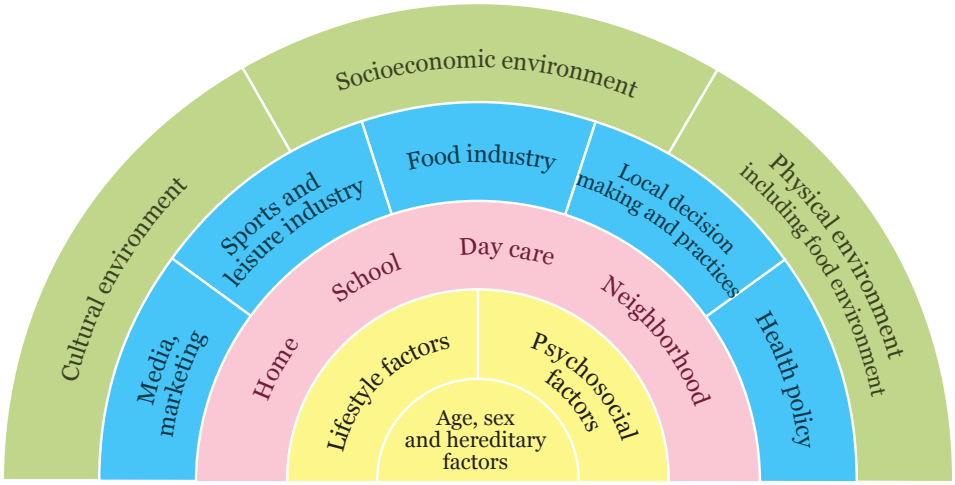
The global problem of childhood overweight has created a vast body of research investigating its causes and consequences. In this research, taking account of the characteristics of social contexts that child grows up in, lives and learns are important. The adoption of health behaviour is directly or indirectly influenced by the complex web of family, peer, community, social and cultural influences, and the impacts of these, are, in turn, moderated by child-related individual factors such as age and gender. Behavioural risk factors for obesity include dietary intake, physical activity, and sedentary behaviour (Verduci et al. 2021). Subsequently, a short sleep duration has been revealed as a potential risk for overweight/obesity in early in life (Fatima et al. 2015). In young children, however, most daily health behaviours are probably routines in which children have given little thought. Yet, health behaviour in early in life and adolescence are important for later health as these have been shown to extend into adulthood (Kjonniksen et al. 2008; Mikkilä et al. 2005).

As overweight in childhood embodies interacting factors from multiple contexts, various theoretical or conceptual frameworks have been used to describe this complexity. Socioecological models, for example, point out the influences of intrapersonal, interpersonal, organizational, community, and policy levels as well as their interaction (Sallis and Owen 2015). The "full obesity system map", in turn, illustrates the complexity of obesity risk by mapping the clusters of factors related to individual and social psychology, individual activity, activity environment, food consumption, food production, social influences, individual physiology, and physiology that influence an individual's energy balance (Vandenbroeck et al. 2007).

In relation to those mentioned above, the concept of "obesogenic environments", defined as "the sum of the influences that the surroundings, opportunities or conditions of life have on promoting obesity", points out the importance of environmental factors on childhood overweight (Swinburn et al. 1999). Individuals interact with multiple microenvironments or local settings such as schools, homes, neighbourhoods and supermarkets that involve food, physical activity or both. Obesogenic microenvironments can contribute to overweight and obesity by encouraging unhealthy diets in terms of increased consumption of energy-dense, nutrient-poor food and beverages as well as inadequate leisure-time exercise. These, in turn, are influenced by broader macro environments and actors such as the media, the food industry, health systems, and government policies, which are often beyond the control of individuals. (Swinburn et al. 1999.) However, despite the ubiquity of the "obesogenic" environment, individuals have not uniformly developed obesity.

Genetic variation is offered to explain why some are susceptible, and others resistant to the modern obesogenic world (Llewellyn 2018).

Figure 1 depicts the main determinants of childhood overweight based on the models presented above and especially on the concept of "obesogenic environments". I will next shortly review the three dimensions identified by these approaches and their relevance relating to this study: *hereditary factors, physical and food environments,* and the *socioeconomic environment*. As the main objective of this study was to investigate the family background factors, I will concentrate more closely on its two main constructs, which are the *socioeconomic position of the family* and the *family type*.



Source: Adapted from Dahlgren and Whitehead 2006, and Swinburn, Egger and Raza 1999.

Figure 1. The main determinants of childhood overweight.

Gene-environment interplay is well studied in the context of obesity. The heritability of BMI is well established and some studies suggest a significant influence of genes on an individual's predisposition to developing obesity, accounting for up to 70% of heritability estimates for BMI (Lipek et al. 2015). The heritability estimates are documented to be the lowest in mid-childhood but they then increase in adolescence (Anderson and Butcher 2006). Instead, monogenic reasons for obesity are rare. In the search for responsible gene loci, the identified common variants have only explained a small proportion of the risk for obesity (Manco and Dallapiccola 2012). Moreover, genetic susceptibility often needs to be coupled with contributing environmental and behavioural factors to affect weight (Rokholm et al. 2011; Silventoinen et al. 2009). Prior research has also focused on the gene-environment interplay

in the context of the intergenerational transmission of social inequalities. The questions arise on to what extent differences in education, occupational standing, and income are attributable to genes, and whether genetic influences differ according to the parents' socioeconomic standing? Erola et al. (2021) reported that in childhood genetic influences are strongest in education and weakest in income, and always strongest among those with the most advantaged socioeconomic background. For instance, more educated parents may both have high educational expectations and sufficient economic resources to provide a learning-stimulating home environment that helps children to fulfil their genetic potential (Erola et al. 2021).

Regarding the *physical environment, including the food environment,* Feng et al. (2010) summarized three domains that may influence obesity: 1) facilities for physical activity (i.e. parks, playgrounds, sports clubs that promote active play and sports), 2) land use and transportation (i.e. mixed land use, walkability, access to public transport or walking/cycling paths that facilitate active commuting to school/work), and 3) the foodscape (availability of healthy or unhealthy food) (Feng et al. 2010). For example, children living closer to parks and recreational spaces are less likely to experience weight gain (Wolch et al. 2011). Regarding the foodscape, changes in the obesogenic food environment have been suggested to explain most of the obesity epidemic (Swinburn et al. 2009). Over the past 30 to 40 years, increases in energy dense foods, increased consumption of sugar-sweetened beverages, large portion sizes, large packages, increased variety, increased visibility of foods, and marketing food to children have taken place. All these changes are known to augment eating and energy intake (Mustajoki 2015).

The development of health behaviour among children is shaped by *social influences*. As children grow, school and peers join families as major determinants of health behaviour development (Mollborn and Lawrence 2018). First, schools serve as an institution that shape children's health behaviour. In Finland, for example, all school-aged and preschool-aged children are served a free lunch at school and in day care. The nutritional quality of the school lunch is good and having a school lunch is important for children's regular meal frequency and vegetable intake (Hoppu et al. 2010). Moreover, eating a balanced school lunch has been associated with overall healthier eating patterns outside school (Tilles-Tirkkonen et al. 2011). According to the national recommendations (National nutrition council 2016), mealtimes at school and day care are part of the early childhood education of children, and healthy, nutritious and appropriately organized and supervised meals must be provided to children. Second, schools serve as arenas for peer interaction. Like parents, peers may function as social models and set social norms in mid-childhood and adolescence. Prior studies have found that peers shape adolescents' sexual

behaviour (Mollborn et al. 2014), smoking (Flay et al. 1994), physical activity (de la Haye et al. 2011) and healthy eating (Fitzgerald et al. 2013).

The impact of the family background on children's health behaviour is mediated by many factors, such as parental health behaviour, the SEP of the family and the family type. Children may adopt the behaviour of their parent(s) through parental practices and attitudes (Baranowski and Nader 1986); for example, family eating environments include the parents' own eating behaviour and child-feeding practices. Parents who are overweight, who have problems controlling their own food intake, or who are concerned about their children's risk of being overweight may adopt controlling child-feeding practices in attempts to prevent overweight in their children (Davison and Birch 2001). Prior studies have reported that parental control in child feeding has a negative impact on child weight, particularly for young girls (Carper et al. 2000). Prior research has also reported that the parental body mass index (BMI) is one of the most important factors influencing variation in the BMI of children (Laitinen et al. 2001) due to both genetic and environmental components (Lajunen et al. 2012).

In this study, childhood meal patterns and overweight, and inequalities in them are viewed from the perspectives of social epidemiology and life course epidemiology. Regarding the traditional explanation for health inequalities, the study represents the social causation model. To extend the framework to the child's growth environment, the health behaviour of the child and the parents, in addition to family background factors including both the family SEP and family type are taken into account.

2.3 THE SOCIOECONOMIC POSITION (SEP) OF THE FAMILY

In social epidemiology, various domains of the social determinants of health are studied. Among these, SEP is one of the most important, if not the most important, social factor in determining population health (Lahelma and Rahkonen 2011; Lynch and Kaplan 2000).

The key measures of an individual's SEP are education, occupation and income. Temporally, education is the first individual measure of SEP (Lahelma and Rahkonen 2011). The educational level may reflect knowledge and skills, and a higher level is presumed to be related to greater awareness of and ability to follow healthy lifestyle recommendations. Education enables occupational opportunities and higher incomes, and it is often regarded as a key socioeconomic indicator in health behaviour research. Lahelma et al. (2004) studied self-rated health and limiting longstanding illness among adults. For

example, most of inequalities in limiting longstanding illness by education were mediated through occupational class and household income. Inequalities by occupational class were largely explained by education. Inequalities by income were to a great degree explained by education and occupation. As a conclusion, parts of the effects of each socioeconomic indicator on health were either explained by or mediated through other socioeconomic indicators. (Lahelma et al. 2004.)

Among children and adolescents, these key measures of individual SEP are not suitable as they have not yet materialised, for example, the level of education is not yet determined. Thus, other measures of SEP have been proposed, such as parental or family SEP, school performance, the amount of pocket money and subjective social status of the family (Karvonen and Rahkonen 2011). Furthermore, the family SEP is usually assessed in terms of the parental education, employment or parental/household income level. For example, higher educated parents more often may have working conditions with flexible working hours which, in turn, might be beneficial for family life. Paid work and income provides families with purchasing power and contributes to the material resources needed to maintain good health (Lahelma et al. 2004).

Educational level, occupation as well as income level have been shown to be associated with adults' obesity-related health outcomes in many European adult populations (Giskes et al. 2010; Wikström et al. 2011). Among children, those exposed to a low SEP are reported to face an increased risk of various health problems and chronic conditions (Sares-Jäske et al. 2022). The negative effects of a low parental SEP on children's health can be identified before a child has reached school age, and these effects persist, and frequently worsen, as children grow older (Currie and Stabile 2003). Giskes et al. (2010) suggest that dietary behaviour may be an important contributing factor to socioeconomic inequalities in overweight/obesity: those who are socioeconomically disadvantaged consume less fibre, fruit and vegetables than individuals with a higher SEP, and these dietary inequalities are consistent by gender (Giskes et al. 2010). The role of other proposed obesogenic dietary behaviour, such as meal patterns, has not be ascertained as it has been relatively understudied in Europe.

2.4 FAMILY TYPE

In addition to the family SEP, the family structure is another important aspect of the family context which influences children's development. Parental divorce and/or living in a single-parent family is considered a potential risk factor for adverse health consequences throughout the life-course, that is, in childhood (Barrett and Turner 2005; Bramlett and Blumberg 2007) and in adulthood (Kestilä 2008; Merikukka 2020). Recently, researchers have recognized the need to study families as dynamic systems (Osborne et al. 2012). It has been suggested that the family structure per se does not necessarily lead to negative child outcomes, but it is the number of family transitions that may be more strongly associated with poorer child outcomes (Fomby and Cherlin 2007; Kiernan et al. 2011).

Over the past decades, family diversity has increased as the proportion of traditional two-parent families has declined. In Finland, children are increasingly likely to experience living with only one parent or living in a reconstituted family. In 2020, over half of families with children aged 0-17 years were families of married couples (Official Statistics of Finland 2020). One-fifth of the families with children were families of cohabiting couples. Same-sex married couples were parents in 667 families with children and registered couples in 219 families with children. Nine percent of families with children aged 0–17 were reconstituted families. Slightly over one-half, 54 percent, of the parents of reconstituted families were cohabiting and close on one-half, 46 percent, were married. The share of single-parent families formed by a mother and children was 20 percent among families with children. Even though the number of families formed by a father and children has grown, their number is still very low, and stands at approximately four percent (Official Statistics of Finland 2020).

Along with parental separation and re-partnering, there has been an increase in joint physical custody and a related shift away from sole motherly custody. Around 110,000 children reside in both parents' homes and every third of them share their time equally between two custodial parents' homes after parental separation (Hanifi and Nieminen 2022). According to previous research, joint physical custody seems to be most common among children aged 3–12 years, but also younger and older children have these arrangements. Joint physical custody is more common among highly educated parents or parents with higher incomes (Miettinen et al. 2020). In these families, parents may be better able to afford two large enough houses, and can continue to live in the same neighbourhood after separation or to arrange the transport of the child between two homes in a convenient way (Hanifi and Nieminen 2022).

Two primary mechanisms that might account for differences between families are time and money. In general, children living with both biological parents are more affluent than children in other family structures (Bramlett and Blumberg 2007). Furthermore, Thomson et al. have suggested that children may receive less parental time and attention in single-parent and reconstituted families (Thomson et al. 1994; Thomson and McLanahan 2012). Time constraints may limit the single parents' ability to monitor or participate in their children's health-related behaviour (Quarmby et al. 2011). In reconstituted, or in joint custody families, children often live with a stepparent, a stepsibling(s) or a half sibling(s), which adds to the complexity of the family and might lead to poorer parental cooperation. Family transitions may result in conflict and tension between parents and that can be stressful to children (see Carlson and Corcoran 2001). Dissolution of an existing relationship or entering into a new relationship can also create parental stress (Meadows et al. 2008; Osborne and McLanahan 2007), although entering new relationships may also bring positive effects (Osborne et al. 2012). A recent study found that parental happiness was associated with healthy behaviour of preschool-aged children. Parents who were happier were more likely to have a child who engaged in multiple healthy behaviours such as meeting physical activity and screen time guidelines, a higher consumption of vegetables, fruit and berries, and a lower consumption of sugary foods, treats and drinks (Engberg et al. 2022).

2.5 THE HYPOTHESIZED PATHWAYS BETWEEN PARENTAL SEP, FAMILY TYPE, OVERWEIGHT AND MEAL PATTERNS

In this study, the gene-environment interplay is not investigated as the aim is not to study the variation in body mass index (BMI) and other measures of body fatness (e.g. Silventoinen et al. 2009). Neither school, day care and peer influences, nor physical and food environment influences are studied although their importance is recognized (e.g. Swinburn et al. 1999). In this study, parental lifestyle is explored via the parental BMI as that was the only nutrition-related variable for parents available in the data. Parental practices and attitudes were not available in the data.

The family SEP and family structure may lead to childhood overweight and poor meal patterns via different pathways. In overweight research education is strongly associated with overweight throughout the life-course: a lower educational level and increased overweight risk is observed in both childhood and adulthood (McLaren 2007; Shrewsbury and Wardle 2008). Both key

SEP measures, education and income, have been shown to pose independent associations with childhood overweight (Mekonnen et al. 2021). The effect of parental education can be mediated, however, by different pathways to childhood overweight and meal patterns. It may be partly mediated by parental overweight-related health behaviour. On the other hand, the effect of parental education may be mediated through labour market position and household income, as suggested by Lahelma and colleagues (2004). Moreover, part of the association between parental education and childhood overweight or meal patterns might be mediated by the family structure.

The effect of income on health inequalities is suggested to be a great degree explained by education and occupation (Lahelma et al. 2004). The effect of family income on child health may also be explained by the family structure as in many cases a direct consequence of parental separation is a lower household income, especially for single-parent families (McLanahan and Percheski 2008). The association between family structure and overweight or poor meal patterns may be attenuated or explained by family income or parental education. Figure 2 depicts a simplification of the possible interrelationships (not necessarily direct causal associations) between family SEP measures, family structure and meal patterns and overweight in childhood.

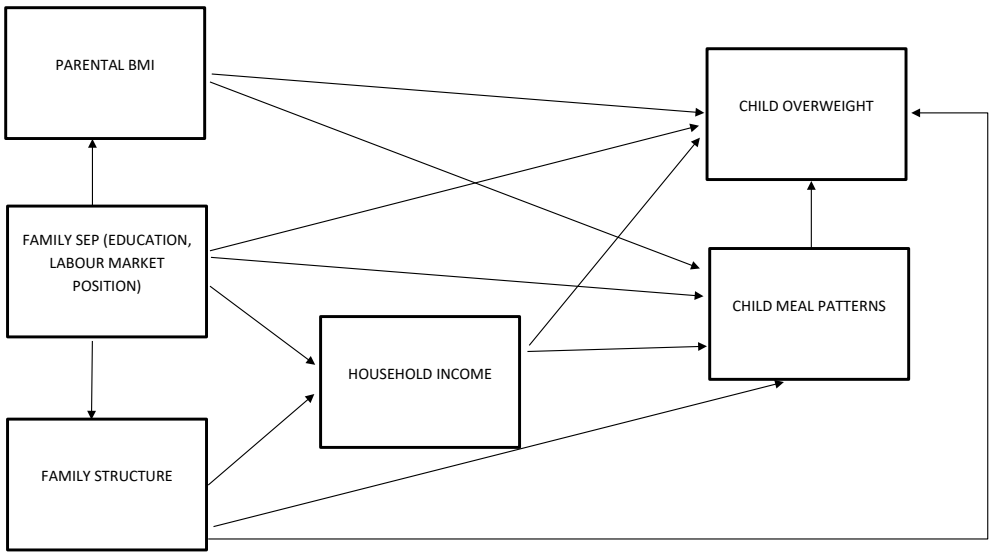


Figure 2. Possible direct and indirect pathways between indicators of parental socioeconomic position, family type and their association with meal patterns and overweight in childhood.

3 REVIEW OF THE LITERATURE

The review focuses primarily on population-based studies from Europe and the United States as childhood overweight and the impact of the family background has been an area of interest especially in Western countries. In section 3.1, evidence on the association between childhood overweight and meal behaviour is examined. Section 3.2 examines the association between the family socioeconomic position (SEP), its changes and childhood overweight and meal pattern. Section 3.3 includes earlier studies on the association between family type, its transitions and childhood overweight and meal pattern. Finally, section 3.4 identifies the gaps in the current literature.

3.1. ASSOCIATIONS BETWEEN OVERWEIGHT AND MEAL PATTERNS IN CHILDHOOD

The associations between childhood overweight and meal pattern variables for children and adolescents have been studied in different settings. However, no uniform categorisation of age has been applied in the studies. To illustrate both the differences in prior studies and the current evidence base, systematic reviews, cross-sectional and longitudinal studies are summarised in Appendix 1. Of 22 studies, 11 investigated the association between skipping breakfast and overweight, 8 concentrated on the association between family meals and overweight and 3 on the association between the number of meals and overweight.

The association between overweight in childhood and meal frequency is rather strong and widely reported. In particular, breakfast has suggested to play a critical role in energy balance and dietary regulation (Rampersaud et al. 2005) and is associated with favourable nutrient intake (Larson et al. 2013) and better food choices (Sjöberg et al. 2003). Regular breakfast consumption among children and adolescents is inversely associated with body mass index (BMI) and overweight in both cross-sectional (Haug et al. 2009; Keski-Rahkonen et al. 2003; Monzani et al. 2019; Ober et al. 2021; Rampersaud et al. 2005; Szajewska and Ruszczyński 2010; Van Lippevelde et al. 2013; Wadolowska et al. 2019) and longitudinal studies (Niemeier et al. 2006; Timlin et al. 2008).

Two studies have compared the association between childhood overweight and breakfast consumption in European and North American children and adolescents. Haug et al. (2009) investigated overweight in school-aged children (aged 11-, 13-, and 15 years) and its relationship with demographic and lifestyle

factors. The data consisted of nationally representative samples in 41 countries participating in the WHO Collaborative HBSC survey in 2005-2006. The results revealed that overweight was consistently and negatively associated with breakfast consumption and moderate to vigorous physical activity when the age of the child and socioeconomic factors of the family were taken into account. Daily fruit, vegetable or soft drink consumption were generally not associated with overweight. Van Lippevelde et al. (2013) conducted a cross-sectional survey among 10–12-year-old children and their parents in eight European countries. They found that parental practices regarding permissiveness linked to skipping breakfast, negotiating about breakfast, and family breakfast frequency were associated with children's BMI. Finally, A Finnish study by Mäki et al. (2021) investigated the impact of lifestyle factors on overweight among adolescents aged 14-to 17 years with cross-sectional survey data. They found that overweight was associated with skipping breakfast along with moderate or poor self-rated health and low physical activity. Moreover, the association between adolescents' overweight and skipping breakfast remained statistically significant when socioeconomic background factors of the family were adjusted for.

Only a handful of studies have examined the associations between family meal frequency and overweight or obesity and most of the studies have been conducted in cross-sectional study settings. Research investigating child populations in the United States and other non-European countries indicate that more frequent family meals are associated with a lower obesity risk (Gillman et al. 2000; Fulkerson et al. 2008; Larson et al. 2013), although findings have not been consistent (Valdes et al. 2013; Berge et al. 2015). In these studies, different family meal variables were used: family breakfast (Larson et al. 2013; Berge et al. 2015), family lunch (Berge et al. 2015), family dinner (Gillman et al. 2000; Taveras et al. 2005; Berge et al. 2015) and the number of family meals during a week (Fulkerson et al. 2008). Having family meals has been associated with a healthier and more varied eating habits such as lower soda consumption, lower frequency of skipped breakfasts and higher intake of fruit and vegetables (Gillman et al. 2000; Larson et al. 2013; Berge et al. 2015).

One comparative study conducted on European child populations was identified. Roos et al. (2014) investigated the associations of family meals and the habit of having the TV on during dinner with 11-year-old children's overweight in nine European countries. The researchers suggest that in Northern Europe, children having a family breakfast or dinner less than once weekly were more likely to be overweight, while there was no association between family breakfast or dinner and overweight status in the Southern and Eastern European countries. In their models, age, gender, parental educational level and country were adjusted for (Roos et al. 2014).

In a longitudinal study, Fulkerson et al. (2008) described associations between the frequency of family meals and overweight status over a 5-year period in a large and ethnically diverse population of adolescents. The researchers presented findings with adjustments of demographic characteristics (e.g. family SEP and ethnicity) and of physical activity level and energy intake. The results revealed significant inverse associations between family meal frequency and overweight status for early adolescent girls in all cross-sectional models, but no significant longitudinal associations were observed. Neither cross-sectional nor longitudinal associations were significant for boys and older girls in any models. Subsequently, in a systematic review of 11 cross-sectional and 4 longitudinal studies, Valdes et al. (2013) reported inconsistent and weak evidence of an inverse association between family meal frequency and the risk of childhood overweight. However, great variability in family meal variables in the reviewed studies was pointed out by Valdes et al.

Some previous studies have suggested an inverse association between an increase in the number of daily meals and the prevalence of overweight and obesity in childhood and adolescence. However, the beneficial number of meals varies from four meals a day (Vik et al. 2010) to five meals a day (Jääskeläinen A et al. 2013) to five or more meals a day (Toschke et al. 2005). Moreover, high meal frequency is an essential element in health-promoting eating behaviour as it has been found to be associated with higher diet quality (Pedersen et al. 2012) and a lower risk of metabolic syndrome traits such as abdominal obesity and hypertriglyceridemia (Jääskeläinen et al. 2013). Moreover, Toschke et al. (2005) have suggested that the impact of frequent daily meals on childhood obesity is independent of breakfast eating and the effect might be mediated through modulation of insulin response.

In a study by Jääskeläinen et al. (2013), the aim was to examine whether the importance of breakfast on overweight could be outweighed by that of regular daily meal frequency. They examined associations of three meal patterns on weekdays—five meals including breakfast, a maximum of four meals including breakfast and a maximum of four meals without breakfast—with overweight/obesity and components of metabolic syndrome. In their study of 16-year-old Finnish adolescents, several factors related to health outcomes such as tobacco use, sleep duration, physical activity, sedentary time, pubertal stage and parental education level were adjusted for in the models. After adjustments, the regular five-meal-a-day pattern including breakfast remained significantly associated with a decreased risk of overweight/obesity for both genders and abdominal obesity in boys compared with the breakfast skipping pattern, i.e. four meals or less per day without breakfast. Thus, the Finnish study did not find evidence of the high meal frequency outweighing the importance of breakfast on overweight.

Koletzko and Toschke (2010) reviewed observational studies addressing meal frequency and obesity risk for children and adolescents. These studies, published between 2004 and 2009, reviewed data on a total of 13 998 children and adolescents from the United States, Germany, and Portugal. Three of the five studies found a significant reduction in the obesity risk with an increasing number of meals, which persisted after adjustment for confounders, while the two other studies found a non-significant trend in the same direction (Koletzko and Toschke 2010).

In summary, there is considerable and consistent evidence of an association between breakfast consumption and healthy body weight in childhood and inconsistent evidence on the association between family meal frequency and overweight. Additionally, the association between the number of daily meals and the prevalence of overweight and obesity in childhood is ambiguous.

3.2 SOCIOECONOMIC DIFFERENCES IN CHILDHOOD OVERWEIGHT AND MEAL PATTERNS

We examined the research findings on the association between the family SEP and overweight among the children and adolescents, Nordic and European cross-sectional studies as well longitudinal studies with several years of follow-up. Additionally, the associations between family SEP and meal pattern variables are reviewed.

3.2.1 The association between family SEP and childhood overweight

From cross-sectional and longitudinal investigations in Europe and other developed countries, there is considerable evidence that the prevalence of overweight is especially high among children in lower socio-economic groups (Buoncristiano et al. 2021; Knai et al. 2012; Akkoyun-Farinez et al. 2018). A study using data from three European countries and four different infant and child cohorts suggest that socioeconomic differences seem to emerge as early as at age of three in Ireland, Portugal and the United Kingdom (McCrory et al. 2019). A recent study of Norwegian children even suggests that social differences in children's weight and BMI trajectories emerge already during infancy (Mekonnen et al. 2021). Moreover, there is evidence of a widening social gradient in child and adolescent overweight and obesity in Western countries (Chung et al. 2016; Knai et al. 2012). Knai et al. (2012) have suggested that it is likely that the changes in lifestyles and dietary habits involved in the increase

in the prevalence of overweight have had a more unfavourable impact on low socio-economic status groups than on the rest of the population.

Parental educational attainment seems to be the strongest predictor of childhood obesity in Western countries (Shrewsbury and Wardle 2008) and in European countries (McCrory et a. 2019). Lange et al. (2010) studied the child population in Germany and reported lower parental educational level, a lower degree of professional education, low income, nationality (German vs. non-German), limited living space per person, and single parenthood as the most relevant predictors of a child being overweight or obese (Lange et al. 2010). Akkoyun-Farinez et al. (2018) studied French adolescents (13- to 18-year-old) and found that a low parental education, low family income level and low social status (measured with parental occupational class and maternal employment status) increased the risk of being overweight in adolescence. Moreover, inconsistency was observed among genders so that some studies found a SEP-overweight association for both boys and girls and others for one gender only (De Spiegelaere et al. 1998; Morgen et al. 2010).

The association between the parental level of education and childhood BMI has been shown also in Finland. Mäki et al. (2019) examined socioeconomic differences in a Finnish adolescent population in 2017 in a nationwide cross-sectional questionnaire survey of 8th and 9th graders (15- to 16-year-old). Low maternal education and low family income levels were associated with overweight (including obesity) among both boys and girls (Mäki et al. 2019). Furthermore, consistent results on the relationship between low maternal education and increased risk of overweight was reported among Finnish children aged 5 to 14 years old (Kaikkonen et al. 2012).

Shrewsbury and Wardle (2008) also suggested that while parental education seems to be the strongest predictor of childhood obesity, the results are more inconsistent regarding other SEP indicators, such as parental labour market status and family income. Subsequently however, longitudinal studies conducted in Nordic countries report a rather consistent association, especially, regarding family income. Morgen et al. (2010) investigated the possible association between the parental SEP, weight change and the risk of developing overweight in Danish children. They found that the parental socioeconomic position (measured by parental occupational status) was associated with an overall rise in BMI from the age of 15 to 21 among girls only. Compared to girls with the highest level of parental occupation, girls from families with lower parental occupational levels had a significantly higher risk of developing overweight over the six-year study period. Another Danish study examined how the SEP during early (0–8 years) and late childhood (9–14 years) related to overweight at ages 15, 18 and 21 (Poulsen et al. 2018). A lower parental educational level, lower household income, low labour market participation

and poor family functioning (i.e. families may be characterised by poor communication, poor problem solving, poorly defined or rigid roles) during childhood were found to be associated with an increased risk of overweight and obesity in both adolescence and early adulthood and for both genders.

Finally, Mekonnen and colleagues (2021) investigated parental income- and education- related inequalities in children's weight, height, and body mass index among Norwegian children from 1 month to 8 years using large cohort data. Maternal and paternal educational differences in children's weight and BMI trajectories emerged during infancy, continuing to the age of 8 years. Parental income-related inequalities in children's BMI were observed from 18 months to 8 years for maternal income, and from 9 months to 8 years for paternal income. To conclude, the results of these Nordic studies suggest that social inequalities in children's BMI emerge early in infancy and continue into later childhood and adolescence. The inequalities were observed according to various indicators of SEP (education, occupation, income).

Prior studies have examined the mediators between the parental SEP and childhood overweight. In a systematic review of 28 studies, Gebremariam et al. (2017) evaluated the mediators of the association between SEP and obesity among European and North American children and adolescents. The most consistent mediators were as follows: consumption of sugar-sweetened beverages, television viewing, computer use, parental body mass index, breastfeeding duration, breakfast consumption, maternal smoking during pregnancy and infant feeding practices. Among the reviewed studies, the most used indicator of SEP was parental education (n = 12) followed by combined SEP scores (n = 6), family income or poverty (n = 6), neighbourhood/school SEP (n = 5) and parental occupation (n = 4). Parental education has been found to be associated with children's weight-related health behaviour, such as children's sedentary behaviour measured by screen time (Tandon et al. 2012), fruit and vegetable intake (Pearson et al. 2009) and physical activity (Kantomaa et al. 2007). It has also been shown that an association between parental education and childhood overweight may be partly mediated by breakfast consumption, sports participation and screen time (Fernandez-Alvira et al. 2013). Thus, prior research quite consistently shows that childhood overweight reflects the health behaviour of the whole family.

A few longitudinal studies suggest that the trajectory of a family's SEP affects children's overweight and obesity more profoundly than the SEP measured at a single time point. A systematic review by Levesque et al. (2021) found that distinct geographical patterns emerged in the results of the studies examining the relationship between changes in the family SEP and childhood overweight. For example, in three studies conducted in Quebec there was no evidence that household income changes had a unique effect on child/adolescent

BMI. In comparison, two studies in the United Kingdom and three Brazilian studies showed mixed evidence, with only one study in each country displaying a unique effect of changing income on child/adolescent BMI (Levesque et al. 2021). Three studies of child populations in the United States showed the most consistent relationships between the changes in family income and overweight in children.

Demment et al. (2014) examined the associations between the changes in family income status, early-life risk factors for overweight or obesity trajectories for a child, and body mass index (BMI) z-score trajectory from ages 2 to 15 years among children living in a rural region of New York State. The five early-life risk factors studied were maternal overweight/obesity, maternal gestational weight gain, maternal smoking during pregnancy, breastfeeding duration, and early-life weight gain trajectory. According to their results, children who remained in a low-income family throughout childhood were more likely to maintain overweight and children whose families shifted to a low-income during their childhood were more likely to be obese compared to children who were never in a low-income family. Additionally, maternal overweight/obesity was significantly associated with a child becoming obese, overweight, or staying overweight (Demment et al. 2014).

Another study from the United States examined children aged from 5 to 16 years and studied the differences in their BMI trajectories, weight-related health behaviour and risk of overweight in association with household poverty dynamics during the follow-up (classified as no experience of poverty, experienced once, recurrently poor (more than 2 times), and persistently poor) (Min et al. 2018). They suggested that the recurrently poor children had the fastest BMI trajectories, highest overweight/obesity prevalence from 5 to 16 years old and the highest proportion of excessive soda/fast food consumption and irregular exercise in the 8th grade than did the others. Children in the recurrently poor group had a 1.5 times higher risk of overweight than those having never experienced poverty during the follow-up. The persistently poor were the lowest in terms of their BMI growth trajectory but became the second highest in childhood obesity through a steady increase in their BMI over time. Min et al. (2018) concluded that the recurrently and persistently poor groups were characterized by being primarily African American and Hispanic, having less-educated parents, and having more single parents than the other groups. Finally, Oddo and Jones-Smith (2015) assessed whether gains in family income were associated with changes in BMI z-scores among children aged 2 to 6 years. They found that an increase in family income over a 4-year period was associated with a significant decrease in BMI z-scores in girls but not in boys (Oddo and Jones-Smith 2015).

Moreover, three studies were identified which evaluated the impact of changes in parental employment on childhood BMI. Two studies found that increasing maternal working hours or employment between infancy and childhood/adolescence were associated with increases in child/adolescent BMI (Ettinger et al. 2018; Jones 2018), and one of the two also found paternal employment was associated with decreases in a child's BMI trajectory (Jones 2018). Of the three studies, one suggested that changes in maternal employment were not associated with overweight/obesity, although this study was restricted to adolescents (Martin et al. 2018). All three studies were conducted in the U.S and they revealed no consistent relationship between changes in parental employment and overweight in children.

To summarise, studies on the association between the family SEP and overweight in children show that the overweight is more common among children in lower social groups. Socioeconomic differences in overweight seem to emerge already in early childhood. The SEP differences in child and adolescent overweight and obesity have more likely widened than narrowed. The previous studies show mixed evidence on the association between changes in the family SEP (mostly measured by income) and childhood overweight.

3.2.2 The association between family SEP and meal patterns in childhood

To my knowledge, only cross-sectional investigations have been conducted to study the association between the family SEP and meal patterns in childhood and adolescence. Most research has focused on the association between the family SEP and skipping breakfast (Gebremariam et al. 2017; Haug et al. 2009; Kaikkonen et al. 2021; Keski-Rahkonen et al. 2003; Lazzeri et al. 2016; Pedersen et al. 2016; van Ansem et al- 2014; Vereecnken et al. 2009; Wijtzes et al. 2015), while some have examined the association between the family SEP and family dinner frequency (Larson et al. 2013; Neumark-Sztainer et al. 2003; Neumark-Sztainer et al. 2013) and a few have studied the association between the family SEP and skipping breakfast and other meals (dinner, lunch) (Vik et al. 2013; Wadolowska et al. 2019; Wijtzes et al. 2015). In Finland and other European countries, skipping breakfast and having fewer family dinners seems to be especially high among children and adolescents in the lower social groups (Kaikkonen et al. 2021; Neumark-Sztainer et al. 2003; van Ansem et al. 2014; Wijtzes et al. 2015).

Skipping breakfast has been more frequently reported in girls, older school-aged children, those with a lower family SEP, low family functioning and single-parent families (Lazzeri et al. 2016; Monzani et al. 2019). According to previous European studies, being a child or adolescent in a low SEP family

has been associated with irregular breakfast habits. This relationship exists for a range of different SEP indicators, such as parental education (Gebremariam et al. 2017; Pedersen et al. 2016; van Ansem et al. 2014; Wijtzes et al. 2015), parental occupation (Haug et al. 2009) and family income (Vereecken et al. 2009). The association between a low level of parental education and skipping breakfast in childhood has been reported also in Finnish cross-sectional studies. A low level of maternal educational attainment and a low level of family income have been associated with skipping breakfast among adolescents aged 14 to 16 in both boys and girls (Mäki et al. 2021) and among primary school aged children (Kaikkonen et al. 2012).

Studies investigating the association between family SEP factors and family meals are scarce. Separate studies in North American child populations conducted by Neumark-Sztainer and Larson et al. consistently found that children with unemployed mothers and children from high SEP families had family meals more frequently, compared with those from families with other socioeconomic characteristics (Larson et al., 2013; Neumark-Sztainer et al. 2003; Neumark-Sztainer et al. 2013). In the Health Behaviour in School-Aged Children (HBSC) cross-national study of 11-, 13- and 15-year-old European and North American boys and girls, it was shown that daily family meals with parents tended to be more common among young people from high-affluence families (WHO 2016). In Finland, the socioeconomic position (measured by maternal education) was not associated with family meals for children aged 14 to 15 years (Kaikkonen et al. 2012).

Wijtzes et al. (2015) utilised data from ethnically diverse children at the age of 6 years, who participated in a population-based prospective cohort study in Rotterdam, the Netherlands. Skipping breakfast, lunch and dinner was more prevalent among low SEP children (measured by parental education and household income) and ethnic minority children. Regarding ethnic minority children, adjustment for family SEP attenuated the results considerably for all meal skipping behaviour. Similar socioeconomic inequalities were found earlier for skipping dinner but not for skipping lunch in a European-wide study among 10- to 12-year-old children (Vik et al. 2013). According to Vik et al. (2013), children of highly educated parents were more likely to have breakfast and dinner compared to children of lower educated parents.

Wadolowska et al. (2019) examined Polish children aged 11 to 13 years and studied socioeconomic differences (measured by family affluence) in skipping breakfast and/or a meal at school. Predictors for skipping breakfast and/or a meal at school included female gender, age over 12 years, urban residence, lower family affluence, lower nutrition knowledge, higher screen time, and lower physical activity. The results indicated that urban residence was associated with skipping both meals or skipping a meal at school alone but not associated

with skipping breakfast, while being in a family with a lower SEP and female gender were associated with skipping breakfast but not with skipping a meal at school alone.

Some studies have examined the mediators between parental SEP and childhood breakfast consumption. An association between the parental educational level and children's breakfast consumption has been shown to be mediated by parental breakfast consumption (Keski-Rahkonen et al. 2003; van Ansem et al. 2014). Gebremariam et al. (2017) proposed in their study of Norwegian adolescents (mean age 13.6 years) that the availability of breakfast foods and parental modelling mediate the association between the family SEP and breakfast consumption. Higher parental modelling (i.e. parents eat breakfast regularly), eating breakfast regularly with parents and a higher availability of breakfast foods (e.g. bread, cereals, milk) at home were associated with higher odds of being a daily breakfast consumer. Thus, the importance of parental lifestyle and the family SEP regarding breakfast consumption in childhood seems evident.

To my knowledge, the first systematic review on the relationship between changes in household or parental SEP and subsequent child and adolescent health outcomes was conducted by Levesque et al. in 2021. Of the eighty articles included in their review, nine studied health behaviour outcomes such as smoking, alcohol or drug use, diet, and exercise for children and adolescents aged 18 years or younger. Three of the nine studies assessed the effect of changes in household income over time on children's nutritional behaviour. The results did not show an effect of upward or downward income mobility on child/adolescent nutrition in two of these articles: one in the United Kingdom, in which nutrition was measured by consumption of vegetables, fruit, crisps, sweets, and soft drinks (Skafida and Treanor 2014), and one in Quebec, Canada in which nutrition was measured by consumption of milk, cheese, fruit, vegetables, sweets and sugar-sweetened beverages (Kakinami et al. 2014). By comparison, Min et al. (2018) found that children in the U.S who were recurrently poor between 5 years of age and eighth grade had distinctively worse eating habits than children who were transiently poor or persistently poor. Together, these three studies revealed no generalizable relationship between changes in household income and changes in children's dietary behaviour. (Levesque et al. 2021.)

All in all, there is quite strong evidence on socioeconomic differences in skipping breakfast in childhood and a few investigations on social inequality linked to family meals. Little is known, however, on socioeconomic differences linked to skipping breakfast and skipping other meals among young school-aged children. To my knowledge, no prior investigations on the association between family SEP and the number of daily meals among preschool or school-

aged children have been published. Respectively, no studies on the association between changes in family SEP factors and the number of meals in childhood were identified.

3.3 FAMILY TYPE DIFFERENCES IN CHILDHOOD OVERWEIGHT AND MEAL PATTERNS

In this section, I will first present the earlier findings on the association between family type, its transitions and overweight among the children and adolescents. Prior Nordic studies as well as international systematic reviews are given priority. Then, the association between family type and meal pattern variables are reviewed.

3.3.1 The association between family type, its transitions and overweight in childhood

In addition to the family SEP, the family type is another important aspect of the family context that influences children's overweight (Schmeer 2012). The association between the family type and childhood overweight has been less explored than the association between the family SEP and overweight. However, prior literature on public health suggests that a family break-up is one of the stressors included in adverse childhood events (ACEs) and is associated with childhood overweight (Arkes 2012; Elsenburg et al. 2017). Overweight is consistently reported to be more prevalent among single-parent families and among children of divorced parents than among children in two-parent families (Duriancik and Goff 2019; Formisano et al. 2014; Schmeer 2012; Yannakoulia et al. 2008).

Of the family type measures, singe-parenthood is widely used in cross-sectional and longitudinal childhood overweight research. In their systematic review, Duriancik and Goff (2019) evaluated whether children living in single-parent households had a higher risk of obesity. Of the 10 original studies evaluated, one was conducted in an Australian child population, one in European child populations and eight in the United States. The age range of the children varied from preschool children (Augustine and Kimbro 2015; Schmeer 2012) to school-aged children (Byrne et al. 2011; Formisano et al. 2014) and adolescents (Sisson et al. 2014; Yelick 2017). Overall, the studies found higher BMIs and obesogenic behaviours in children of single parent households. These associations were the strongest among girls and black children (Duriancik and Goff 2019).

Only a few studies have included other family types such as reconstituted families (i.e. a child lives with one parent and his/her new partner and/or new sibling[s]) as a family type measure. Moreover, the findings in these cross-sectional and longitudinal studies are not consistent. In a cross-sectional study of European primary school aged children, Formisano et al. (2014) reported that children who lived with their grandparents had significantly greater BMI z-scores than either children living with both parents or those living in reconstituted families. They also reported that children living in reconstituted families showed the lowest BMI z-scores. Kristiansen et al. (2020) investigated the effect of sociodemographic factors and family structure on the baseline BMI z-score and increase in BMI z-score after one year in Norwegian children aged 6-15 years. The family structure was categorised into three groups: reconstituted families, defined by the presence of a step-parent and/or half-sibling(s), single-parent families and intact families. A low parental education, high maternal BMI and a living in a reconstituted family were associated with a higher BMI z-score after one year than at baseline. Instead, only maternal BMI was associated with a higher baseline BMI z-score (Kristiansen et al. 2020).

Formisano et al. (2014) carried out a longitudinal analysis on changes in children's BMI by family type. Children living with a single parent tended to gain more weight than children living within other family types. Additionally, children living in reconstituted families tended to gain less weight over time than those living in the other family types examined. The reason for this finding was not clear and the researchers discussed that it is possible that children living in new contexts, with rules and habits differing from the previous ones, may experience a stressful situation that may influence their eating habits. It was also concluded that further studies more specifically designed to answer these questions are needed.

In a Finnish study of primary school aged children, Häkkänen et al. (2020) explored overweight transition rates across weight categories in a longitudinal cohort of children who at some point were overweight. They found that children developed overweight more probably than returned from overweight to normal weight over the ages of 6 to 14. During primary school, when compared with girls from intact families, girls of divorced or single parents transitioned at higher rates from overweight to obesity. Experiences of crises, such as contacting child protection services or parental mental health problems and being bullied were associated with transitions to obesity among boys (Häkkänen et al. 2020).

The connection between the family structure and childhood overweight could be mediated through both socioeconomic and lifestyle factors. The explanation as to why children in single-parent households are possibly at a higher risk of obesity is most often linked to material disadvantages and

lack of time—although the evidence is still rather controversial. Single parents may, for example, have fewer financial resources to procure fresh foods and provide access to safe outdoor playgrounds and have less time to prepare healthy meals and accompany their children to play outdoors, leading to higher rates of watching television and other sedentary activities (e.g. Duriancik and Goff 2019). A cohort study of UK children focused on the mediating role of income between family structure and children's BMI. Burkill et al. (2021) reported that at ages 3 and 5, there was no direct or indirect effect of family structure mediated by income on BMI. Between the ages of 7 and 11, the overall proportion of the association mediated by income vastly increased. Thus, an increasing proportion of the association between family structure and BMI was mediated by income as the children grew older (Burkill et al. 2021). Another study including children aged 5 to 7 in Germany found that boys living with their single mothers were more often overweight compared with boys in couple families (Scharte et al. 2012). After adjusting the results for maternal education and household income, the difference lost significance.

Regarding lifestyle factors, children who have experienced parental break-up have been found to spend more time with screens (Stahlmann et al. 2020), drink more sugar-sweetened drinks (Mauskopf et al. 2015) and have more unhealthy eating habits, including the eating food for comfort (Yannakoulia et al. 2008). Researchers have also suggested that the reason for girls being heavier than boys in single-parent households may be related to girls not being as active due to the mother's perception of an unsafe neighbourhood. Thus, girls were less likely to exercise (Byrne et al. 2011). Another comparative study suggested that girls may have had different coping mechanisms when undergoing family-related stress compared to boys (Augustine and Kimbro 2015). Further, a reduction of homemade meals, shared family meals, and physical activity can occur in single-parent families (Sisson et al. 2014).

Regarding family meals, which are associated with higher fruit and vegetable intake, children in single-parent households are at a higher risk of having a reduced intake of these food groups which may increase their obesity risk (Gillman et al. 2000; Sisson et al. 2014). A cross-sectional study of obesogenic behaviours in European children reported that children from single-parent families were less likely to have family rules regarding screen time and higher reported hours of screen time per week compared to two-parent biological families (Stahlmann et al. 2020). Instead, sleep duration, bedtime routines and the availability of sugar-sweetened beverages during meals did not differ between children from these family structures. Moreover, parental education did not modify any of these associations.

Most studies investigate the impact of the family structure measured at one time point on the children's health behaviour-related outcomes. However,

children do not always remain in one family type throughout their childhood. In their study, Reiter et al. (2013) reported that the transition from one family form to another (for example, from having married parents to becoming a single-parent family) rather than the family type as such may negatively affect children's health through concomitant factors such as parental conflict, loss of parental contact and reduced family income following separation. Studies on family transitions and childhood overweight and obesity have utilized data of the child population approximately five years and under (at the baseline) in the United States. First, Bzostek and Beck (2011) examined the relationship between family structure at birth, the change in family structure during the 5-year follow-up and three measures of child health (asthma, obesity and overall health) for a sample of five-year-old children. The change in family structure was measured by parental living arrangements, categorized into six groups: stable married, unstable married, stable cohabiting, unstable cohabiting, stable single and unstable single. They found that instability in family living arrangements among children living with both biological parents at birth (but not among children born to single mothers) was associated with worse health outcomes at age five (Bzostek and Beck 2011). Second, Augustine and Kimbro (2015) reported that preschool-aged children in married parent families, i.e. stable intact and stable reconstituted families, had the lowest rates of obesity. Furthermore, children in stably single-parent families were no more likely to be obese than children living in married parent families. The researchers suggested that those children in single-parent families, who had once been in a short-term cohabiting or married family (i.e. had experienced a family structure change), were more likely to be obese compared with other children.

As the only European study identified for this review of the literature on family transition and childhood overweight, Goisis et al. (2019) used longitudinal cohort data in the United Kingdom which was representative of children 9 months old at the baseline. Five subsequent survey waves were collected when the children were approximately ages 3, 5, 7, 11, and 14. Compared to children in intact families, children who experienced a parental separation between the ages of 9 months and 11 years had larger increases in BMI and higher risks of overweight and obesity. The effects seemed to become stronger with the length of time since separation (Goisis et al. 2019).

To summarise, the literature suggests that living in a single-parent family increase the risk of overweight and weight gain in childhood. Findings on the association between living in a reconstituted family and childhood overweight are not consistent. Regarding the findings of family transition and a childhood overweight association, it seems that the effect of parental separation is stronger than that of any family type.

3.3.2 The association between family type, its transitions and meal patterns in childhood

A few studies have analysed associations between the family type and children's meal patterns. A large body of literature has concentrated on food consumption, socioeconomic patterns and family structure relationships and suggested, for example, that Norwegian adolescents aged 11 to 16 years living in reconstituted families (with mother and stepfather) reported a lower intake of fruit and vegetables, compared to their counterparts living with both parents (Fismen et al. 2022).

There are numerous studies on the associations between the family type and skipping breakfast in childhood, suggesting a consistent association between living in single-parent families, especially with single-parent fathers, and skipping breakfast (Vereecken et al. 2009; Pearson et al. 2009, Jorgensen et al. 2011; Levin et al. 2012). The findings regarding children living in reconstituted families have been mixed, suggesting an increased risk of skipping breakfast in girls (Jorgensen et al. 2011), an increased risk of skipping breakfast in boys and girls (Levin et al. 2012) and no significant association (Vereecken et al. 2009). A North American follow-up study reported that adolescents in non-traditional families (single parent, reconstituted family, no parent) were more likely to display unhealthy eating habits such as skipping breakfast and lunch, eating fewer vegetables, consuming more fast food, and having less parental monitoring of meals (Stewart and Menning 2009).

Yelick (2017) studied the effects of family formation on eating and exercise behaviours among adolescents in the United States. Family structure was a significant factor related to an eating behaviour that included eating breakfast regularly, eating fruit regularly, eating vegetables regularly, not consuming soda or soft drinks regularly, and not eating fast food regularly. Children from single parent families, reconstituted families and multi-generational families had less healthy consumption patterns than children from intact families. The researcher discussed, however, that as income data was not easily accessible or interpretable in this dataset, these differences may be mediated or confounded by income.

Lazzeri et al. (2016) examined if gender and family background correlated with daily breakfast consumption and compared 31 cross-sectional surveys including nationally representative samples of 11–15-year-olds in European countries and in North America during 2002, 2006 and 2010. The distribution of daily breakfast consumption by family structure showed that in all countries, adolescents in two-parent families were more likely to report a daily breakfast consumption compared with those from single parent families. In most countries, the proportion of adolescents consuming breakfast daily were generally higher among boys than in girls. Further, daily breakfast consumption

was also associated with family affluence. Numerous reasons for skipping breakfast were discussed, including the lack of time to eat or prepare breakfast and the unavailability of foods for breakfast (Lazzeri et al. 2016).

There is limited literature on the associations between family types and meal patterns in childhood from studies conducted on population-based child or adolescent samples. No such study was identified on the interrelationship between the number of meals a day in childhood and family type. One European study was identified on the interrelationship between family meals in adolescence and the family type. Levin et al. (2012) investigated the impact of family meal frequency on the relationship between the family structure and risk behaviour of 11–15-year-old boys and girls in Scotland. Having a regular family dinner seemed to be more prevalent among adolescents from two-parent families compared to adolescents living either in single-parent families or reconstituted families (Levin et al. 2012).

Berge et al. (2013) conducted a qualitative study of 59 North American parents to examine the parents' perspective on how to deal with the challenges they face in having regular family meals and how their perspectives differ depending on the family structure (i.e. single- vs. two-parent households). They reported that both single- and two-parent households identified having a "picky eater" as a barrier to having family meals. Additionally, parents in single-headed households included cost, and the burden of being solely responsible for planning family meals. Parents from two-parent households identified time constraints, being tired and running out of ideas as barriers to having family meals (Berge et al. 2013). Other prior studies have provided similar explanations as to why children in single-parent households were possibly at a higher risk of less favourable food habits. Lack of time to make healthy homemade meals and limited financial resources were suggested as explanations (Yelick 2017; Formisano et al. 2014).

In their cross-sectional study of Norwegian adolescents Fismen et al. (2022) discussed why national dietary recommendations may be more easily achieved in some family types than others. One possible explanation for the less favourable food habits among adolescents living in single-mother families could be that the family structure is a proxy for SEP. According to Fismen et al., single mothers are shown to be lower educated and more likely to face material deprivation than mothers in two-parent households in Norway. However, adjustments for SEP were included in their analysis but no significant interaction effects were identified between family structure and SEP. Thus, the authors summarised that family structure differences were driven by other underlying mechanisms than the one represented by the material dimension of SEP (Fismen et al. 2022).

To conclude, the literature suggests a consistent association between skipping breakfast and living in single-parent families. Little is known on the associations between family type and family meal, and family type and meal frequency in childhood.

3.4 IDENTIFIED GAPS IN THE PREVIOUS RESEARCH

First, there is considerable and consistent evidence of an association between breakfast consumption and healthy body weight in childhood but inconsistent evidence on the association between family meal frequency and overweight. Prior investigations on the association between frequent daily meals and the prevalence of overweight and obesity in childhood and adolescence are also inconclusive.

Second, social inequalities in the prevalence of childhood overweight and obesity are well-established in the Nordic countries as well as in other European and Western countries. Social inequalities in childhood overweight are observed for a range of different SEP indicators (education, occupation, income). Due to considerable evidence on the social gradient in overweight, recent studies have focused on the age at which the social gradient first emerges and how it evolves across childhood and adolescence. Additionally, the association between the health behaviour of the whole family and childhood overweight has been reported. Regarding the family type, the literature suggests that living in a single-parent family increases the risk of overweight and weight gain in childhood.

Prior research reports inconsistent results between genders in the SEP-overweight association. Moreover, only a few studies have been able to investigate the pathways between parental BMI, family SEP, family type and childhood overweight in the same model and none of them have explored direct and indirect associations between these factors. Another gap in research is the underrepresentation of other non-traditional families than single-parent households. The extent to which reconstituted families play a role in family type differences has so far not been extensively examined in the Nordic countries.

Third, studies examining differences in meal consumption and the family SEP mostly show an association which is parallel to that with overweight: children and adolescents in lower social groups are more likely to skip breakfast and other meals than their counterparts. Regarding skipping breakfast, this relationship exists for a range of different SEP indicators, such as parental education, occupation and income. Moreover, prior studies have examined the mediators between parental SEP and childhood meal consumption, concluding that the parental lifestyle and parenting practices play an important role in

the explanation of socioeconomic disparities. The literature also suggests a consistent association between skipping breakfast and living in a single-parent family. The evidence from the few conducted studies on the association between other family types, such as reconstituted families, and meal frequency is highly mixed.

Fourth, little is known on the socioeconomic differences associated with skipping breakfast and other meals among young children. To my knowledge, no prior investigations on the association between family SEP and number of daily meals, or between a change in family SEP and the number of daily meals among preschool or school-aged children have been published. Moreover, studies on the relationships between family SEP factors and family meals are scarce, and few of these come from Europe including the Nordic countries. The association between changes in the family SEP and meal frequency has rarely been the main objective of the investigations and none of the Finnish or Nordic studies have examined this with a population-based sample of children. Similarly, no prior studies on the association between family transition and meal frequency in childhood have been identified.

Finally, there are no studies investigating the interrelationships between family SEP factors and the role of the family type as predictors of meal patterns in school-aged children. No child population study was identified for this review taking advantage of pathway analysis between parental SEP factors, family type and meal patterns in childhood.

4 AIMS OF THE STUDY

The main objective of this study is to identify the most important family background factors that determine overweight and meal patterns among children (aged 3-16 years) in Finland. In addition, the aim is to explore the direct and indirect pathways between parental BMI, family SEP factors, family structure and overweight and meal patterns in childhood. In particular, the study focuses on the effect of family type transitions and changes in the family SEP in childhood in a follow-up study setting. The sub studies utilise population-based child health survey data with both a cross-sectional and a 5-year follow-up setting.

The specific objectives of the study are to:

1. study the association between overweight and meal patterns on weekdays (skipping breakfast, meal frequency, family dinner) in children (ca 7-11 years) and adolescents (ca 14-16 years) (supplementary analysis, findings reported in 6.1);

2. examine the interrelationships between parental BMI, family SEP (education, labour market position, income), family structure and overweight in younger (ca 3-8 years) and older (ca 11-16 years) children, and to study the pathways between these factors (Sub study I);

3. examine the interrelationships between parental BMI, family SEP (education, labour market status, income) and family structure and meal patterns on weekdays (skipping breakfast, meal frequency, family dinner) among children (ca 7-11 years) and adolescents (ca 14-16 years), and to study the pathways between these factors (Sub study II);

4. examine the association of meal frequency with family SEP (education, labour market status, income) and family structure at the baseline as well as the changes in them over a five-year follow-up period of a cohort aged 5-10 years (Sub study III).

5 MATERIALS AND METHODS

5.1 STUDY DESIGN AND PARTICIPANTS

This study relies on survey data from children and parents participating in the Child Health Monitoring Study (LATE) in 2007-2008 and in 2013-2014. The LATE study was carried out by the Finnish Institute for Health and Welfare (THL). Both the baseline and the follow-up study consisted of a self-administered questionnaire for parents. The baseline study also included a standardized physical examination of children carried out by a trained nurse. The survey data includes two datasets: a pilot study and two sub studies. The baseline LATE-study was carried out in child healthcare clinics and school healthcare units in 10 health centers around Finland (pilot study) and in Kainuu and Turku regions (sub studies) from March 2007 to January 2009. In the follow-up-study from November 2013 to March 2014, all the children and families who participated in the baseline study were called for to the follow-up.

In the baseline LATE-study, the target age-groups were half-, one-, three-, and five-year-olds, and first (ca. 6–8 years), fifth (ca. 11–12 years) and eighth or ninth (ca. 14–16 years) grade students. All the children who attended the routine child healthcare or school healthcare examination during the period of the LATE-study were invited to participate in the study. In the pilot study, each age group sample contained ten boys and ten girls except in the capital area where double the number were selected. The target sample size in the pilot study was 1,540 children with 880 children in child healthcare centres and 660 in school health centres. In Kainuu and Turku region sub studies, the whole target sample size was 6,000 children: 3,000 children in Kainuu and 3,000 children in Turku region (see Figure 3). The target sample size was 430 children in each age group in both Kainuu and Turku region. As a sampling design, a power analysis was used to find the optimal sample size for health inequality monitoring in child population. In both the pilot study and sub studies, data collection was continued until the target sample size was obtained. Although the study sample is not a national random sample, it covers different geographical areas and socioeconomic groups in Finland, making it reasonably representative of the Finnish child population. (Kaikkonen et al. 2012; Mäki et al. 2010.)

In total, 6,509 children aged 0.5-16 years participated in the baseline study. The overall participation rate was 83% in the child health clinics and

77% in the school healthcare units. In the follow-up study, 3,132 children aged 5-21 years participated and the overall participation rate was 48 % (Figure 3).

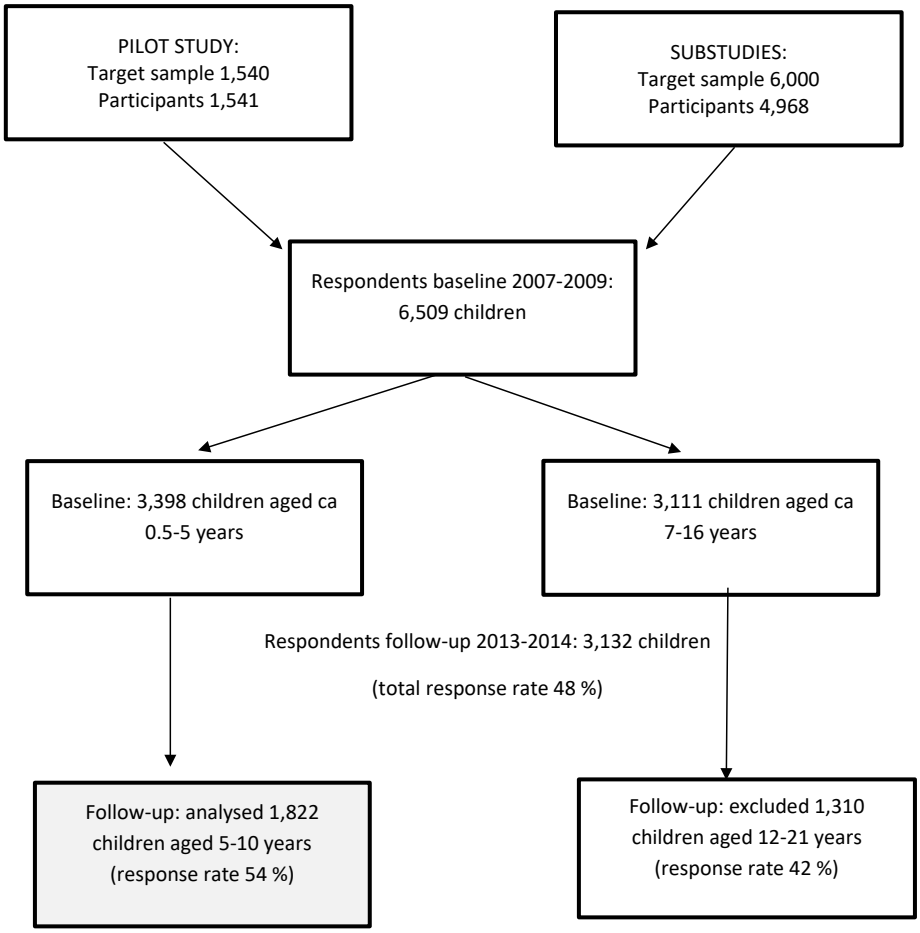


Figure 3. Diagram of study participants.

[Modified from Parikka et al. 2021 (sub study III)]

In this study, the studied samples varied in all sub studies. The characteristics of the samples are described in Table 1. In the supplementary analysis and in sub studies I and II cross-sectional survey data was used. In sub study III, both baseline data (2007–2009) and follow-up data (2013–2014) were used.

In the dataset used in sub study III (Figure 3, left box in the bottom line), follow-up data was more often missing for children with single-parents ($\chi 2 = 19$, $p < 0.001$), children whose mothers had a low educational level ($\chi 2$

= 54, p < 0.001), children whose fathers had a low educational level ($\chi 2 = 31$, p < 0.001), children from families experiencing income hardship ($\chi 2 = 32$, p < 0.001) and children with an unemployed father ($\chi 2 = 9$, p = 0.009). Non-responses did not differ according to the mother's labour market position at baseline (p > 0.05).

Table 1. Characteristics of the samples and variables used in the study.

Study	Age group	Sample size	Outcome variables	Explanatory variables		Study design
			Child	Child	Parent	
Suppl	ca 7-16 years[1]	2864	overweight	daily breakfast consumption, meal frequency, family dinner frequency		cross-sectional
I	ca 3-16 years[1]	4409	overweight		BMI, education, labour market position, self-perceived family income, family type	cross-sectional
II	ca 7-16 years[1]	2864	daily breakfast consumption, meal frequency, family dinner frequency		BMI, education, labour market position, self-perceived family income, family type	cross-sectional
III	ca 5-10 years[2]	1822	meal frequency		education, labour market position, self-perceived family income and family type in baseline, change in family type, unemployment and income sufficiency during follow-up period	longitudinal

[1] age at the time of the baseline study
[2] age at the time of the follow-up study

5.2 QUESTIONNAIRES AND MEASUREMENTS

The baseline study included a self-administered questionnaire for parents and a standardised physical examination of the children carried out by trained public health nurses. The parents were also asked if the person who completed the questionnaire was the mother and/or the father or someone else. Adolescents aged 14 to 16 answered the questionnaire by themselves and parents filled in the questionnaire of family-related issues. The questionnaire was completed at home and returned later in the child's physical examination. It included questions about the living arrangements and housing, sociodemographic factors of the family, health behaviour of the child and other family members (e.g. eating habits and daily meals), diseases of parents and siblings, day care arrangements, schooling, the child's health status and long-term illnesses, symptoms, medications and use of healthcare services. In the follow-up-study in 2013-2014, questionnaires were sent to all the children and families who participated in the baseline study. The follow-up study did not include a physical examination for children.

The health examination of the child in the baseline LATE-study was performed as a part of the statutory health examinations in the maternity and child health clinics and school healthcare. An extensive health check-up included, for example, examination of the height, weight, waist, and head circumference, inspecting sight, hearing and posture, and an evaluation of neurological development. When measuring the child's height and weight, nurses used standardized protocols to check and calibrate devices and to perform the measurements for height and weight.

5.3 VARIABLES

5.3.1 Outcome variables

Child's overweight was an outcome variable in the supplementary analysis and in sub study I. The child's overweight was based on the measured height and weight. The BMI of each child was calculated as the weight in kilograms divided by the square of height in meters (kg/m2). Children were classified as overweight (including obesity) according to the international age- and gender-specific BMI cut-off points of the IOTF criteria (Cole et al. 2000). In the study by Cole et al. (2000) six nationally representative cross sectional growth studies from Brazil, Great Britain, Hong Kong, the Netherlands, Singapore, and the United States were analyzed. For each of the surveys, centile curves were drawn that at age 18 years the widely used cut off points of 25 and 30 kg/m^2 for adult

overweight and obesity were reached. The resulting curves were averaged to provide cut off points for the body mass index for overweight and obesity by sex between 2 and 18 years. In this study, children were 3-16 years old resulting, in general, to 336 different gender-specific cut-off values by month.

Meal patterns were outcome variables in sub studies II and III. In sub study II, meal patterns were measured by three outcome variables (daily breakfast consumption, meal frequency, family dinner frequency). In sub study III, only the meal frequency variable was used. To assess the daily breakfast consumption the parents of 7–11-year-old children were asked how often during the last week (5 days, excluding weekends) their child ate breakfast. Those eating breakfast every weekday were classified as eating daily breakfast and others as skipping breakfast.

The meal frequency was assessed using the question "How often during the last week (5 days, excluding weekends) has your child eaten the following meals: breakfast, mid-morning snack, lunch, mid-afternoon snack, dinner, evening snack, evening meal, other snacks?" The variable was categorized as a dichotomous variable: other (less than 4 meals a day or more than 6 meals a day) and the recommended number of meals (4–6 meals a day) according to the national dietary recommendations for families with children by National nutrition council (2016).

To assess the family dinner frequency, the parents were asked to assess how often in the evening during a week (5 days, excluding weekends) their family had dinner together so that at least one parent ate together with the child. The variable was categorized into once a week or less, two to three times a week and four or five times a week. Children aged 14–16 answered the above-mentioned questions themselves. The family dinner variable was formed from a different question than skipping breakfast and the number of meals per day. However, the family dinner was presumably mentioned in the meal frequency question as one of the daily meals.

5.3.2 Explanatory variables

Parental BMI was an explanatory variable in sub studies I and II. It was calculated based on self-reported weight and height. The parental BMI was categorized into normal weight (including underweight), overweight and obese according to the international cut-off-points of the World Health Organization (WHO): underweight or normal weight <25.0 kg/m2, overweight 25.0–29.9 kg/m2, obese ≥30.0 kg/m2 (WHO Consultation on Obesity 2000). The parental BMI was defined as a polytomous variable, when exploring the associations between the number of overweight parents and childhood overweight in

univariate logistic regression analysis (sub studies I and II). Otherwise, the parental BMI was analyzed as a continuous variable.

In sub studies I, II and III, the family SEP was investigated using the following categories: parental education, parental labour market position and self-perceived family income. However, children do not always remain in one SEP group throughout their childhood. To understand the interplay and causal pathways between SEP and weight-related meal pattern outcomes in the life course, it was important to account for the SEP over time and not just at one point of time. Thus, the change in family SEP (measured with labour market position, family income) was examined in sub study III.

Parental education was categorized according to the highest achieved educational level: secondary education, lower and upper academic degree. The parental labour market status was categorized as full-time employed, unemployed and other (part-time employed students, stay-at-home mother/father, military service, retirement). The self-reported income sufficiency was coded into three categories according to the parents' answers to the perceived difficulty or ease of covering the family expenditure with household income: difficult (including very difficult, difficult, quite difficult), quite easy and easy (including easy and very easy). Experiences of unemployment during the follow-up period and changes in family income sufficiency were introduced in sub study III. Unemployment in the family was coded as: no unemployment in the family, unemployment at the time of the baseline, unemployment at the time of the follow-up and unemployment during the follow-up period. Any change in the perceived income sufficiency at the time of the follow-up study compared to the baseline was coded according to the stability or change in income sufficiency into the following categories: has remained easy or quite easy, has remained hard, income sufficiency has improved, or income sufficiency has worsened. For parental education, no change variable was calculated because education is a generally stable factor among adults.

In sub studies I, II and III, the family structure was an explanatory variable. The family structure was investigated in the following family types: an intact family, which refers to a two-parent-biological family, a reconstituted family with a step-parent involved, joint physical custody family with a 50-50 schedule, and a single-parent family. Joint physical custody families include those children living for an equal time with their mother and father in two separate homes. Single-parent families included both single-mother families and single-father families. In all sub studies, they were often analysed together with reconstituted families, as the number of these families was too small to be analysed separately. The concept of family transition was introduced in sub study III. A family transition refers to the dissolution of a parental relationship or the reformation of a new parental relationship. Transitions

occur, for example, if married or cohabitating parents separate or if a single parent forms a new partnership through marriage or cohabitation. In this study, however, the number of total transitions the child experienced prior to our observation was not considered. A change in the family type noted in the follow-up study was coded into four categories: a stable intact family, a stable reconstituted family, a single-parent or joint physical custody family, a new reconstituted or joint physical custody family and a new single-parent family.

In sub study I, parental education and self-reported income sufficiency were analysed as ordinal variables, and the labour market status and family structure were analysed as polytomous variables, exploring the associations between family background factors and childhood overweight using logistic regression analysis. In sub studies II and III, all these variables were analysed as ordinal variables in a logistic regression analysis. In the path models of sub study I, the parental BMI variables were continuous, the parental education variables were ordinal, and the childhood overweight variable dichotomous. In the path models of sub study II, the family type and parents' labour market statuses were treated as dichotomous variables: family type (nuclear family, others vs. single parent family, reconstituted family in family dinner models; nuclear family, reconstituted family, others vs. single-parent family in the other models) and parental labour market status (full-time employed vs. others). Perceived income sufficiency and parental education were treated as ordinal covariates.

5.4 STATISTICAL METHODS

Spearman's rho correlation coefficients were calculated for the parental SEP factors and family type in all sub studies and for the family background change variables in sub study III. Furthermore, the multicollinearity between these variables was assessed by examining the tolerance and the Variance Inflation Factor (VIF) which showed acceptable collinearity. Using survey data on family background factors at the baseline, children with missing data at the follow-up were compared using Chi-square tests with children who participated in the follow-up. The results from the nonresponse analysis using survey data at the baseline were used in the sub study III.

5.4.1 Logistic regression analysis

For frequency tables and binary logistic regression and ordinal regression analysis, SAS version 9.2 and SPSS 25/26 statistical programme were used. All the sub studies used logistic regression, which estimated the strength of the associations with odds ratios (OR) together with 95% confidence intervals (95% CIs). A probability level of $p<0.05$ was chosen to indicate statistical significance. The sub studies included the following regression models:

In the supplementary analysis of the associations between meal patterns and overweight in childhood (see section 6.1), first, the univariate associations were performed separately for children (ca 7-11 years; N= 1920) and adolescents (ca 14-16 years; N= 944). Due to strong and statistically significant correlation between the explanatory meal-related variables, no multivariate modelling was conducted.

In sub study I, the associations between family background factors and overweight in childhood were examined so that univariate and multivariate analyses were performed separately for four groups: younger boys and girls (ca 3-8 years) (n = 2573) and older boys and girls (ca 11-16 years) (n = 1836). Those explanatory variables that had the most consistent statistically significant associations with childhood overweight in the univariate analysis were selected for further multivariate modeling and structural equation modeling using path analysis (see section 5.3.2). The multivariate logistic regression analysis was used to examine which family background factors were associated with a child's overweight by age and gender of the child as follows: paternal and maternal BMI (among all groups), paternal education (among boys), maternal education (among boys and older girls), maternal labour market status (among older boys), paternal labour market status (among younger girls), intact family vs. other family structure (among older girls), self-reported income sufficiency (among older girls).

In sub study II, the associations between family background factors and meal pattern variables were calculated using a binary logistic (skipping breakfast, meal frequency) and ordinal (family meal) regression analysis. Bivariate and multivariate regression analyses were performed separately for children (aged ca 7-11 y; N=1920) and adolescents (aged ca 14-16 y; N=944). The interactions (determinant × gender) were all statistically non-significant for skipping breakfast. For meal frequency, the interactions were statistically non-significant, except for single parenthood (among children) and maternal obesity (among adolescent). For family meals, the interactions were statistically non-significant, except for parental overweight and obesity (among adolescent). Further investigations on the magnitude of these associations suggested that stratification by gender was not necessary, and therefore the main results were presented for girls and boys together.

The association between potential explanatory factors and the outcome variables were first explored in gender-adjusted regression analyses. Those explanatory variables that had statistically significant associations with the meal pattern outcome variables in the regression analyses, were selected for further modelling with the multivariate regression analysis and path analysis.

In sub study III, a univariate model and three multivariate models were constructed to examine the association between the SEP factors, family type and changes in them and meal frequency in childhood. As no significant interactions between the gender and explanatory factors were found, all models were adjusted for both the gender and the age group (5, 6, 8 and 10 years) of the child at the time of the follow-up study. The association between the potential explanatory factors and the outcome variables were first explored in univariate analyses. Then, statistically significant explanatory variables (p-value <0.05 that had any category that differed from the reference category at this significance level) were selected for further modelling.

Models 1–3 were designed to clarify the pathways between the family background determinants. The family background factors were added to the model sequentially, starting with the family type at the baseline and changes in the family type variable, followed by other parental SEP variables occurring sequentially over time (first education, then the labour market position and the income together). In the final phase all statistically significant variables were explored in a fully-adjusted multivariate regression analysis. The final multivariable model was tested against the full model using likelihood-ratio test.

5.4.2 Path analysis

Path analyses were carried out using the Mplus (Version 5.1) software. Sub studies I and II took advantage of the structural equation modeling using path analysis. A path analysis is an extension of a regression model, which is used to examine the relationships between and among one or more dependent variables and two or more predictor or independent variables (Grapentine 2000). A regression is done for each variable in the model. The regression coefficients predicted by the model are compared with the observed correlation matrix for the variables, and a goodness-of-fit statistic is calculated. The model is usually depicted in a circle-and-arrow figure in which single-headed arrows indicate causation (see Figures 5 and 6 in chapter 6 Results).

In sub studies I and II, path analyses were performed to identify direct and indirect pathways between parental BMI, parental education and childhood overweight (sub study I), and parental SEP factors, family type and meal patterns in childhood (sub study II). In sub study I, a mean- and

variance-weighted least squares estimation method was used as the parental BMI variables were continuous, the parental education variables were ordinal, and the childhood overweight variable was dichotomous. Four alternative path models were considered; three of these were sub models of the full path model (Model 0). In Model 1 the path from paternal/maternal education to paternal/maternal BMI (b1) was fixed to 0. In Model 2 the path from paternal/maternal education to child's overweight (b3) was fixed to 0 and in Model 3 both paths (b1 and b3) were fixed to 0.

If both parents' educational variables were significant predictors for the child's overweight, more general path models were fitted. In the full model, paternal and maternal education together were assumed to measure the general family education level. This factor was called an education factor. Indirect paths from the education factor through parental BMI to child's overweight were estimated. All estimated path models were adjusted for the child's age (in years) and the person who completed the questionnaire (mother and/or father or someone else). The sub models were tested against the full model using chi-square difference tests (Asparouhov and Muthen 2006). Parameter estimates for the best fitting model were shown as b-coefficients with bias corrected bootstrap 95% confidence intervals (Mackinnon et al. 2014), which were estimated using 1,000 bootstrap draws.

In sub study II, only children (aged 7-11 y) were included in the path analysis, as SEP factors and the family type were more coherently related to meal pattern variables in children compared to adolescents. It was tested whether parental education and labour market status and family type were directly or indirectly (mediated by income sufficiency) associated with skipping breakfast, meal frequency and family dinner in childhood. Full path models were implemented separately for the mother's (Model A) and father's (Model B) education levels and labour market statuses. In the path analysis, the weighted least squares estimation method was used. B-coefficients with bias corrected bootstrap 95% confidence intervals (estimated by performing 10,000 bootstrap draws) of the direct and indirect associations of these models were calculated. All models were adjusted for gender.

5.5 ETHICAL CONSIDERATIONS

Both the baseline and the follow-up study were approved by the Coordinating Ethics Committee of Helsinki and Uusimaa Hospital District (the ethical approval for baseline study 233/E0/2006 and for follow-up study 133/13/03/00/2013). Participation was voluntary and parents and children over 12 years of age provide informed written consent before enrolment in the study.

6 RESULTS

6.1 ASSOCIATIONS BETWEEN MEAL PATTERN VARIABLES AND CHILDHOOD OVERWEIGHT

Supplementary analyses concerning the association between meal pattern variables and childhood overweight were performed to establish the study setting in sub studies I-III. The outcome measure was childhood overweight. The explanatory variables were breakfast consumption, meal frequency and family dinner frequency. Analyses were performed separately for four groups: younger boys and girls (ca 7-11 years; N=1920) and older boys and girls (ca 14-16 years; N=944).

Breakfast consumption was associated with the weight status of younger boys and older girls but not of older boys. For younger girls the association was close to being statistically significant (p=0.053, see Table 2). Overweight was more prevalent in younger boys (29 %) and in older girls (26 %) who skipped breakfast compared with those eating a daily breakfast (younger boys 19 %, older girls 17 %). The meal frequency was associated with the weight status for younger and older girls, but the association was not statistically significant for boys. Overweight was more prevalent in younger girls (27 %) and in older girls (25 %) not eating the recommended number of meals a day compared with those doing so (younger girls 18 %, older girls 16 %). The family dinner frequency was not statistically significantly associated with the weight status. (Table 2.)

The interaction between gender, three meal pattern variables and overweight in childhood was tested separately for younger children (7–11 y) and adolescents (14–16 y), but no interactions were observed.

The association between skipping breakfast, meal frequency, family dinner frequency and childhood overweight was examined using logistic regression analyses. The gender-adjusted regression analyses were performed separately for children (aged 7–11 years; N = 1920) and adolescents (aged 14–16 years; N = 944). Due to strong correlations between the explanatory meal-related variables (e.g. between skipping breakfast and meal frequency with a Spearman's rho coefficient 0.51 $p < 0.01$), no further multivariate modelling was conducted. For example, it was not studied whether an impact of one meal pattern variable on childhood overweigh was independent from another meal pattern variable.

Table 2. Weight status of children by meal pattern variables, age and gender.

	Breakfast consumption		Meal frequency		Family dinner frequency		
	eating daily breakfast N (%)	skipping breakfast N (%)	4–6 meals a day N (%)	other N (%)	at most once a week N (%)	two to three times a week N (%)	four or five times a week N (%)
Boys aged 7–11 years							
normal weight	676 (80.8)	78 (70.9)	628 (80.6)	118 (75.2)	27 (73.0)	111 (78.2)	616 (80.3)
overweight	161 (19.2)	32 (29.1)	151 (19.4)	39 (24.8)	10 (27.0)	31 (21.8)	151 (19.7)
Total N (%)	837 (100)	110 (100)	779 (100)	157 (100)	37 (100)	142 (100)	767 (100)
p[1]	0.016		0.121		0.492		
Girls aged 7–11 years							
normal weight	696 (81.0)	79 (73.1)	659 (81.8)	113 (73.4)	39 (78.0)	97 (77.0)	641 (80.8)
overweight	163 (19.0)	29 (26.9)	147 (18.2)	41 (26.6)	11 (22.0)	29 (23.0)	152 (19.2)
Total N (%)	859 (100)	108 (100)	806 (100)	154 (100)	50 (100)	127 (100)	793 (100)
p[1]	0.053		0.016		0.557		
Boys aged 14-16 years							
normal weight	241 (78.5)	102 (72.3)	200 (80.0)	140 (72.5)	47 (72.3)	94 (76.4)	202 (77.7)
overweight	66 (21.5)	39 (27.7)	50 (20.0)	53 (27.5)	18 (27.7)	29 (23.6)	58 (22.3)
Total N (%)	307 (100)	141 (100)	250 (100)	193 (100)	65 (100)	125 (100)	260 (100)
p[1]	0.153		0.065		0.656		
Girls aged 14-16 years							
normal weight	262 (82.9)	131 (73.6)	192 (84.2)	198 (75.6)	70 (80.5)	112 (75.7)	210 (81.4)
overweight	54 (17.1)	47 (26.4)	36 (15.8)	64 (24.4)	17 (19.5)	36 (24.3)	48 (18.6)
Total N (%)	316 (100)	178 (100)	228 (100)	262 (100)	87 (100)	148 (100)	258 (100)
p[1]	0.014		0.018		0.378		

[1]Chi2-test for the independence of overweight and a meal pattern variable.

The univariate results showed that those children (7-11 years) who skipped breakfast had an increased risk of childhood overweight compared with those eating a daily breakfast (gender-adjusted OR = 1.65, 95% CI 1.20– 2.26). Regarding meal frequency, those children (7-11 years) who ate the recommended number of meals were less likely to be overweight compared with those eating less than 4 meals a day or more than 6 meals a day (gender-adjusted OR = 0.67, 95% CI 0.50– 0.89). Instead, regarding overweight risk, the children eating a family dinner four or five times a week did not differ statistically significantly from those eating one less frequently. Among adolescents (14-16 years), the results were parallel with those regarding skipping breakfast (gender-adjusted OR = 1.56, 95% CI 1.14– 2.15), meal frequency (gender-adjusted OR = 0.62, 95% CI 0.45– 0.85) and family dinners (no category differed from reference category statistically significantly).

Controlling for the parental SEP (measured with maternal education) slightly attenuated the association between skipping breakfast and overweight and between meal frequency and overweight among children (7-11 years) but not among adolescents (14-16 years). Nonetheless, the statistically significant associations between skipping breakfast, meal frequency and overweight were maintained after the adjustment of SEP also for children.

6.2 ASSOCIATION BETWEEN FAMILY BACKGROUND FACTORS AND CHILDHOOD OVERWEIGHT (I)

In sub study I, the associations of parental BMI, education, labour market status, self-perceived income sufficiency, family structure with childhood overweight were investigated. Additionally, direct and indirect pathways between parental BMI, education and childhood overweight were examined. The analyses were performed separately for four groups: younger boys and girls (ca 3-8 years) and older boys and girls (ca 11-16 years).

In 2007-2009, the prevalence of overweight (including obesity) was 13 % among younger boys (ca 3-8 years) and 24 % in older boys (ca 11-16 years). In girls, 17% of younger girls and 20% of older girls were overweight, respectively.

Table 3 presents the odds ratios (OR) of childhood overweight in relation to the parental BMI, indicators of SEP and family type. The most consistent association was found for parental BMI: higher parental BMI was associated with an increased risk of overweight in all four age and gender groups of the children (Table 3). The association between the number of overweight parents and a child's overweight differed according to the age and gender of the children (Figure 4). For younger boys and girls and older boys, having one overweight parent already increased the risk of being overweight. However, among older girls the risk of being overweight increased only when both parents were overweight.

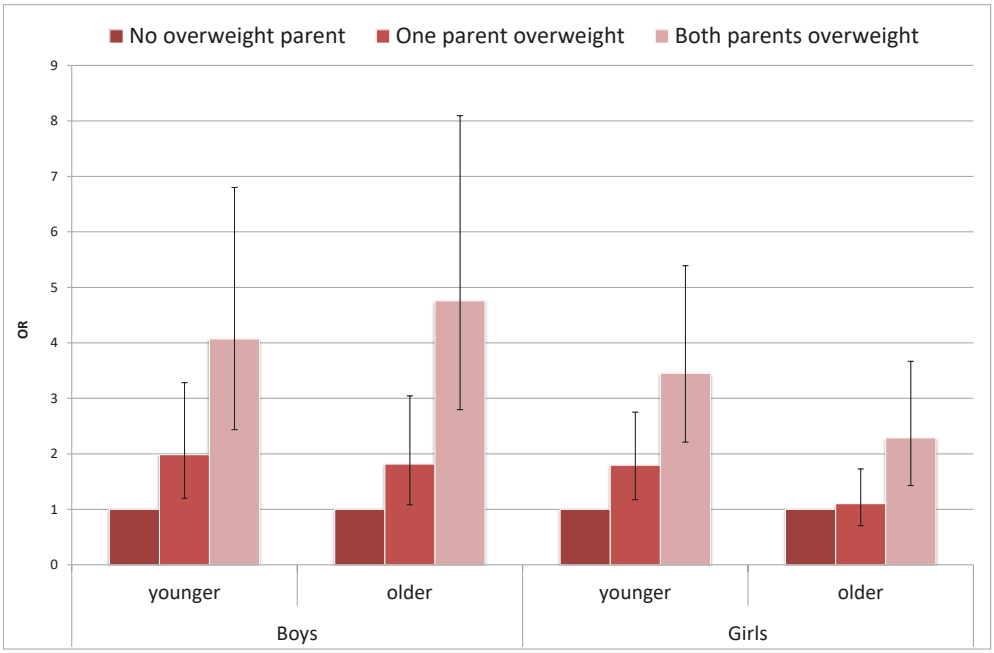


Figure 4. Odds ratio (OR, 95% CI) of childhood overweight according to the parental overweight status.

[Based on Parikka et al. 2015 (sub study I)]

Parental education as a family SEP indicator was of particular importance regarding childhood overweight. Higher levels of maternal and paternal education were associated with a lower risk of being overweight among boys in both age groups (Table 3). In girls, the same association was observed only between maternal education and being overweight for older girls. Regarding the parental labour market status, older boys of unemployed mothers and younger girls of full-time employed fathers or mothers were more likely to be overweight than the other children. Older girls living in an intact family or in a household reporting no difficulties to cover the family expenditure with disposable household income had a decreased risk of being overweight compared to other older girls, respectively.

Table 3. Associations between parental BMI, indicators of socioeconomic status, family type and childhood overweight (bivariate models).

	Boys		Girls	
	younger[1] OR (95%CI)	older[2] OR (95%CI)	younger[1] OR (95%CI)	older[2] OR (95%CI)
BMI				
Maternal BMI	**1.12 (1.08, 1.16)**	**1.10 (1.06, 1.15)**	**1.09 (1.06, 1.12)**	**1.10 (1.06, 1.14)**
Paternal BMI	**1.14 (1.10, 1.20)**	**1.13 (1.08, 1.19)**	**1.11 (1.06, 1.15)**	**1.08 (1.03, 1.13)**
Education				
Maternal education	**0.64 (0.50, 0.82)**	**0.75 (0.59, 0.94)**	0.82 (0.66, 1.01)	**0.77 (0.60, 0.98)**
Paternal education	**0.57 (0.44, 0.74)**	**0.75 (0.59, 0.94)**	0.87 (0.70, 1.06)	0.80 (0.62, 1.02)
Maternal labour market status				
Full-time employed vs others	1.11 (0.80, 1.55)	0.87 (0.61, 1.25)	**1.34 (1.00, 1.80)**	1.03 (0.72, 1.49)
Unemployed vs others	1.53 (0.80, 2.71)	**2.90 (1.60, 5.24)**	0.74 (0.40, 1.29)	0.51 (0.19, 1.11)
Paternal labour market status				
Full-time employed vs others	1.10 (0.69, 1.85)	0.84 (0.54, 1.33)	**1.69 (1.05, 2.87)**	1.18 (0.74, 1.95)
Unemployed vs others	0.64 (0.19, 1.60)	0.91 (0.36, 2.02)	0.42 (0.13, 1.06)	0.54 (0.19, 1.28)
Income				
Self-reported income sufficiency	0.99 (0.79, 1.23)	0.91 (0.74, 1.13)	1.00 (0.83, 1.21)	**0.77 (0.62, 0.96)**
Family type				
Reconstituted family vs others	0.91 (0.34, 2.01)	0.55 (0.27, 1.02)	1.61 (0.79, 3.05)	1.49 (0.86, 2.48)
Single parent family vs others	1.05 (0.60, 1.73)	1.35 (0.90, 2.01)	1.09 (0.68, 1.69)	1.16 (0.76, 1.73)
Intact family vs others	1.28 (0.81, 2.04)	1.06 (0.75, 1.51)	1.00 (0.68, 1.49)	**0.70 (0.49, 0.98)**

[1]Younger, ca 3-8 years

[2]Older, ca 11-16 years

[Based on Parikka et al. 2015 (sub study I)]

In the multivariate logistic regression analysis (separate models for mother and father), only the maternal and paternal BMI maintained a positive association with childhood overweight in all four age and gender groups; the odds ratios were almost identical with those from the univariate logistic regression model (results not shown). In addition to parental BMI, paternal education (OR 0.53 95% CI 0.40–0.71) and maternal education (OR 0.68 95%

CI 0.53–0.88) maintained statistically significant negative associations with overweight among younger boys.

A path analysis was used to test whether the associations between parental education and childhood overweight were direct or indirect, i.e. whether mediated by the parent's own BMI. Figure 5 presents the direct and indirect paths (mediated by parental BMI) for parental education on childhood overweight (the full path model). Four alternative path models were considered; three of them were sub models of the full path model (Model 0) (Figure 5).

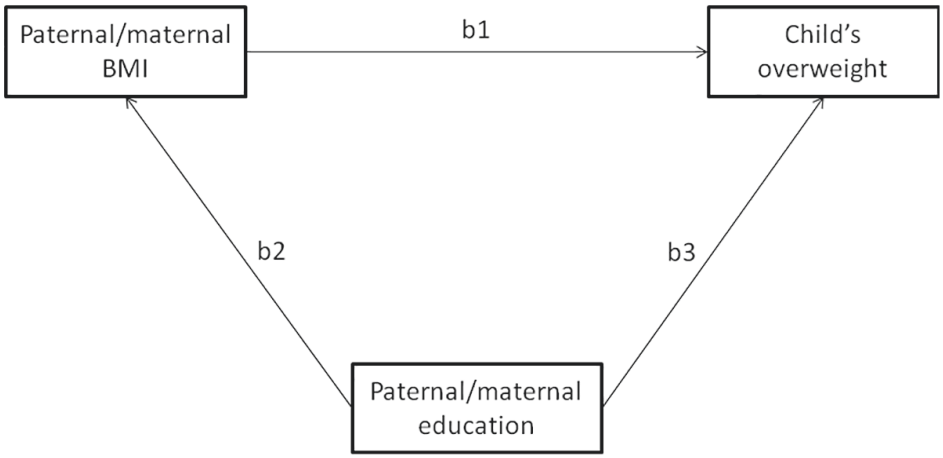


Figure 5. The full path model for paternal/maternal BMI, paternal/maternal education and childhood overweight.

[Based on Parikka et al. 2015 (sub study I)]

The fit of the models was tested by setting each sub model against the full path model. For younger boys the full model fitted best regarding both fathers and mothers. This means that both the paternal and maternal education had direct and indirect (mediated by parental BMI) inverse associations on childhood overweight. The direct associations of paternal or maternal education were inverse, indicating that the higher the paternal or maternal education level, the lower the risk of overweight in the younger boys (Table 4). The direct associations of both paternal and maternal education on overweight in younger boys were stronger than the indirect associations (b-coefficient for the direct vs. indirect association of education: paternal –0.21 vs. -0.04; maternal –0.17 vs. -0.04). Among older boys the full model also fitted best, but only in regard to fathers. Paternal education had both a direct and an indirect inverse association

(through paternal BMI) with overweight in older boys. The direct association was stronger than the indirect association (b-coefficient –0.12 vs. -0.03) (Table 4). Regarding mothers of the older boys, Model 2 fitted best. In other words, maternal education had only an indirect association mediated by the mother's own BMI (Table 4). In sub study I, a path analysis was not performed for the younger girls, because there was no association between parental education and childhood overweight in the logistic regression models. Similarly, paternal education was omitted from the path analyses concerning the older girls.

More general path models were fitted if both parents' educations were significant predictors of a child's overweight. In the model, paternal and maternal education together are assumed to measure the general family education level. This factor was named an education factor. According to the more general path model, 64–65% of variances for the maternal and paternal education variables was explained by the education factor in both younger and older boys. The education factor had both a direct (younger boys OR 0.85 95% CI 0.76, 0.93; older boys OR 0.91 95% CI 0.84, 0.99) and an indirect (mediated by maternal and paternal BMI) association on childhood overweight, both for younger and older boys. The associations of the education factor with both parents' BMIs were significant (younger boys: $x2 = 41.85$, $df = 2$ and $p < 0.001$; older boys: $x2 = 23.75$, $df = 2$ and $p < 0.001$). The general path model showed that when evaluating the association between the SEP of the family and childhood overweight, the education of both parents' matters.

To conclude, both parental BMI and education were consistently associated with childhood overweight. Children of overweight parents had an increased risk of being overweight. A direct association between the parental education and childhood overweight was found only among boys. Among older boys, only the paternal education had both a direct and an indirect inverse association (through paternal BMI) with being overweight. Older boys of unemployed mothers and younger girls of full-time employed fathers or mothers were more likely to be overweight than the other children. Older girls living in an intact family or in a household reporting no difficulties to cover the family expenditure with the disposable household income had a decreased risk of being overweight compared to other older girls, respectively.

Table 4. Associations between parental BMI, parental education and childhood overweight (path model, see figure 5).

	Boys younger[1]	older[2]	Girls younger[1]	older[2]
Path:	**b[3] (CI)**	**b[3] (CI)**	**b[3] (CI)**	**b[3] (CI)**
Paternal BMI				
paternal BMI → childhood overweight	0.07 (0.04, 0.09)	0.07 (0.04, 0.10)	-	-
paternal education → childhood overweight	-0.21 (-0.34, -0.09)	-0.12 (-0.24, -0.01)	-	-
paternal education → paternal BMI	-0.58 (-0.88, -0.32)	-0.48 (-0.83, -0.16)	-	-
paternal education through paternal BMI → childhood overweight	-0.04 (-0.07, -0.02)	-0.03 (-0.06, -0.01)	-	-
Maternal BMI				
maternal BMI → childhood overweight	0.06 (0.04, 0.08)	0.06 (0.04, 0.09)	-	0.06 (0.04, 0.08)
maternal education → childhood overweight	-0.17 (-0.28, -0.07)	0*	-	0*
maternal education → maternal BMI	-0.58 (-0.86, -0.31)	-0.65 (-0.97, -0.34)	-	-0.46 (-0.81, -0.14)
maternal education through maternal BMI → childhood overweight	-0.04 (-0.06, -0.02)	-0.04 (-0.07, -0.02)	-	-0.03 (-0.06, -0.01)

[1]Younger, ca 3-8 years

[2]Older, ca 11-16 years

[3]b, path coefficient

0* fixed i.e. estimated as 0

Parameter estimates from path analysis.

[Based on Parikka et al. 2015 (sub study I)]

6.3 ASSOCIATIONS BETWEEN FAMILY BACKGROUND FACTORS AND SKIPPING BREAKFAST, MEAL FREQUENCY AND FAMILY MEAL IN CHILDHOOD (II)

In sub study II, the associations and direct and indirect pathways between family SEP factors, family type and meal patterns in childhood on weekdays were examined. Meal patterns were measured by three outcome variables: skipping breakfast, recommended meal frequency (4–6 meals a day) and family dinner (four or five times a week). Analyses were performed separately for children (aged ca 7-11 years) and adolescents (aged ca 14-16 years).

In 2007-2009, the prevalence of eating 4–6 meals a day and family dinner decreased as the children grew older. The prevalence of eating 4–6 meals a day was 84% for children aged 7-11 years and 51 % for children aged 14-16 years. The prevalence of eating family dinner four or five times a week was 82% for children and 55% for adolescents, respectively. Furthermore, the prevalence of skipping breakfast was lower for children aged 7–11 years (11%) compared to adolescents aged 14–16 years (34%).

Table 4 shows the associations between the parental BMI, indicators of SEP, family type and meal pattern variables among 7-11 year-olds. Corresponding associations among 14-16 year-olds are presented only in text as they were less numerous. For children aged 7–11 years, maternal and paternal BMI, all SEP factors except maternal labour market status and family type had statistically significant associations with skipping breakfast in gender-standardized regression models (Table 4). Children with overweight and obese mothers, with unemployed mothers and fathers, and with fathers other than full-time employed or unemployed (part-time employed, students, stay-at-home father, military service, retired, other) were more likely to skip breakfast than the others. Furthermore, low levels of maternal and paternal education were associated with a higher risk of skipping breakfast. Children both in single-parent and reconstituted families had an increased risk of skipping breakfast compared with children living in both-parent families. Lastly, the perceived income insufficiency increased the risk of skipping breakfast in childhood. Among adolescents, however, only the father's unemployment (OR 2.07 95% CI 1.05–4.10), living in a reconstituted (OR 2.03 95% CI 1.27–3.25) or single-parent family (OR 1.81 95% CI 1.28–2.57) and perceived income insufficiency (OR 2.36 95% CI 1.65–3.40) increased the risk of not eating breakfast every weekday.

When including all the statistically significant variables in the multivariate model, maternal overweight, lower paternal education, paternal unemployment, single parenthood and perceived income insufficiency remained statistically

significantly and positively associated with skipping breakfast in childhood. Among adolescents, only the perceived income insufficiency (OR 2.09 95 % CI 1.36-3.21) remained statistically significantly and positively associated with skipping breakfast in the multivariate model.

For children aged 7–11 years, the maternal and paternal BMI, and all socioeconomic indicators except the maternal labour market status and family type had a statistically significant association with meal frequency in bivariate models (Table 4). Children with overweight and obese mothers and obese fathers were less likely to eat the recommended 4–6 meals a day. Furthermore, low levels of maternal and paternal education and unemployment of mothers increased the risk of not eating 4–6 meals a day in childhood. Regarding the family type, both single parenthood and living in a reconstituted family pose a significant risk for children aged 7–11 years of not eating the recommended 4–6 meals a day, whereas adolescents seem to be unaffected by living in these family types. Instead, both children and adolescents living in families experiencing income insufficiency were less likely to eat 4–6 meals a day (for adolescents OR 0.57 95 % CI 0.41-0.81). Furthermore, adolescents who had a low educated father (OR 0.63 95 % CI 0.42-0.95) were less likely to eat the recommended 4–6 meals a day. The family type "other", that is those children living in a joint physical custody or in a foster family or together with grandparents or other relatives, had a statistically significant positive association with meal frequency (OR 2.37 95 % CI 1.04-5.42) among adolescents.

In the multivariate model including all the significant variables, maternal overweight, single parenthood, living in a reconstituted family and perceived income insufficiency remained statistically significantly and inversely associated with meal frequency in childhood. For adolescents, only perceived income insufficiency (OR 0.60 95 % CI 0.41-0.88) remained statistically significant in the multivariate model.

For children aged 7–11 years, the most consistent association was observed between the mother's labour market status and family type with family dinner frequency in bivariate models (Table 5). Children with mothers who were other than full-time employed or who were unemployed (part-time employed, students, stay-at-home mother, retired, other) were more likely to eat frequently (4–5 times a week) family dinners than the others. However, adolescents with unemployed mothers (OR 1.96 95 % CI 1.05-3.67) were more likely to frequently eat family dinners. Both children and adolescents living in single-parent families were less likely to eat family dinners frequently compared with other school-aged children (adolescents, OR 0.59 95 % CI 0.43-0.81). Perceived income insufficiency was inversely associated with family dinner frequency for adolescents (OR 0.58 95 % CI 0.42-0.80).

Table 5. Associations between meal pattern variables and parental BMI, indicators of socioeconomic position and family type among 7-11 year-olds (bivariate and multivariate gender-standardized models).

	Skipping breakfast[1]		Meal frequency[1]		Family dinner[2]	
	Bivariate OR (95%CI)	Multivariate OR (95%CI)	Bivariate OR (95%CI)	Multivariate OR (95%CI)	Bivariate OR (95%CI)	Multivariate OR (95%CI)
Maternal BMI						
<25	1	1	1	1	1	
25.0 – 29.9	1.70** (1.23, 2.36)	1.87** (1.26, 2.78)	0.67** (0.50, 0.88)	0.68* (0.49, 0.95)	0.76* (0.58, 0.99)	
≥30.0	1.77* (1.16, 2.72)	1.31 (0.75, 2.30)	0.63* (0.44, 0.92)	0.67 (0.43, 1.06)	0.95 (0.65, 1.39)	
p	0.001	0.05	0.002	0.02	0.26	
Paternal BMI						
<25	1	1	1	1	1	
25.0 – 29.9	1.26 (0.90, 1.77)	1.07 (0.72, 1.60)	0.89 (0.66, 1.19)	0.93 (0.67, 1.30)	0.88 (0.67, 1.16)	
≥30.0	1.59 (1.003, 2.53)	1.24 (0.71, 2.15)	0.61* (0.41, 0.91)	0.68 (0.43, 1.07)	0.88 (0.59, 1.30)	
p	0.04	0.50	0.03	0.14	0.39	
Maternal education						
Upper academic degree	1	1	1	1	1	
Lower academic degree	1.34 (0.82, 2.19)	0.76 (0.41, 1.40)	0.98 (0.67, 1.44)	1.41 (0.88, 2.27)	0.66* (0.47, 0.94)	
Secondary education	2.64*** (1.63, 4.27)	1.12 (0.60, 2.10)	0.57** (0.39, 0.83)	0.97 (0.59, 1.60)	0.77 (0.54, 1.12)	
p	<0.001	0.21	<0.001	0.33	0.42	
Paternal education						
Upper academic degree	1	1	1	1	1	
Lower academic degree	2.20* (1.07, 4.54)	2.56* (1.06, 6.17)	0.93 (0.57, 1.51)	0.85 (0.49, 1.49)	1.04 (0.71, 1.52)	
Secondary education	4.48*** (2.33, 8.65)	3.85** (1.64, 9.02)	0.48** (0.32, 0.73)	0.61 (0.36, 1.05)	0.99 (0.70, 1.38)	
p	<0.001	0.001	<0.001	0.04	0.85	

Table 5. cont.

Maternal labour market status						
Full-time employed	1		1		1	1
Unemployed	1.71* (1.03, 2.83)		0.52** (0.34, 0.82)		1.19 (0.73, 1.94)	1.49 (0.88, 2.52)
Other	0.94 (0.67, 1.30)		0.98 (0.74, 1.30)		1.51** (1.15, 1.98)	1.55** (1.17, 2.05)
p	0.87		0.68		0.03	0.004
Paternal labour market status						
Full-time employed	1	1	1	1	1	
Unemployed	3.06*** (1.75, 5.44)	2.20* (1.07, 4.50)	0.55* (0.32, 0.95)	0.98 (0.47,2.08)	0.90 (0.51, 1.61)	
Other	1.94** (1.27, 2.96)	1.60 (0.95, 2.69)	0.68 (0.46, 1.01)	0.99 (0.61, 1.61)	0.96 (0.65, 1.41)	
p	<0.001	0.01	0.02	0.70	0.97	
Family type						
Intact family	1	1	1	1	1	1
Reconstituted family	2.38*** (1.50, 3.79)	1.73 (0.85, 3.53)	0.43*** (0.28, 0.65)	0.41** (0.23, 0.72)	1.03 (0.64, 1.67)	0.98 (0.60, 1.59)
Single-parent family	2.32*** (1.64, 3.30)	2.23** (1.37, 3.65)	0.42*** (0.31, 0.57)	0.44*** (0.29, 0.68)	0.50*** (0.37, 0.67)	0.52*** (0.38, 0.70)
Other	0.20 (0.03, 1.46)	0.41 (0.06, 3.14)	3.68 (0.89, 15.25)	3.93 (0.52, 29.46)	0.71 (0.36, 1.42)	0.68 (0.34, 1.36)
p	<0.001	0.02	<0.001	0.004	<0.001	<0.001
Perceived income sufficiency						
Easy	1	1	1	1	1	
Quite easy	1.60* (1.10, 2.33)	1.33 (0.84, 2.10)	0.70* (0.52, 0.95)	0.77 (0.53, 1.10)	0.86 (0.65, 1.12)	
Hard	2.77*** (1.87, 4.10)	1.83* (1.09, 3.06)	0.47*** (0.34, 0.65)	0.60* (0.39, 0.92)	0.79 (0.58, 1.08)	
p	<0.001	0.01	<0.001	0.01	0.13	

p Significance of the explanatory variable
* Significance of the difference from the reference group. P< 0.05
[1] binary logistic regression analyses for skipping breakfast vs eating or with 4-6 meals a day vs other as dichotomous outcome variable
[2] ordinal regression analyses with family dinner (once a week or less, 2-3 times a week and 4-5 times a week) as ordinal outcome variable

[Modified from Parikka et al. 2018 (sub study II)]

In the multivariate model, single parenthood remained statistically significantly and inversely associated with family dinner frequency for children aged 7–11 years. Furthermore, the association between maternal labour market status as other (part-time employed, students, stay-at-home mother, retired, other) remained significantly and positively associated with family dinner frequency for children as well. For adolescents aged 14–16, both living in a single-parent family (OR 0.68 95 % CI 0.48-0.96) and perceived income insufficiency (OR 0.57 95 % CI 0.40-0.83) remained significantly and inversely associated with family dinner frequency. The mother's unemployment (OR 2.57 95 % CI 1.33-4.97) also remained significantly and positively associated with family dinner frequency for adolescents.

To clarify the interrelationship of parental SEP factors and the role of the family type as predictors of meal patterns in childhood, a path analysis was performed to identify direct and indirect pathways between these variables and the three outcome variables. A path analysis was not performed for adolescents because the parental SEP had less coherent associations with meal pattern variables for this age group. It was tested whether parental education and labour market status and family type were directly or indirectly (mediated by income sufficiency) associated with skipping breakfast, as well as the meal frequency and family dinners in childhood. The figure 6 depicts the tested direct and indirect paths with single-headed arrows (the full path model). Separate models were performed for mothers (Model A) and fathers (Model B) for each outcome variable.

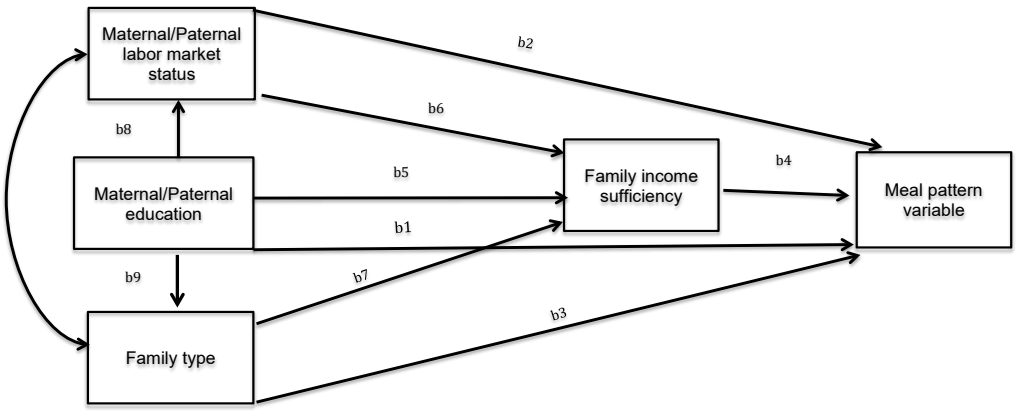


Figure 6. The full path model for paternal/maternal education, paternal/maternal labour market status, family type, income sufficiency and meal pattern variables in childhood.

[Modified from Parikka et al. 2018 (sub study II)]

Both the maternal and paternal education had a direct and indirect association (mediated through family type) with skipping breakfast in childhood. A direct association between the parental education and skipping breakfast was stronger than an indirect association (b-coefficients for direct and indirect association regarding mother's education −0.15 vs. −0.05; regarding father's education −0.22 vs −0.04). The family type was directly and indirectly (mediated by income sufficiency) associated with skipping breakfast. A direct association between the family type and skipping breakfast was stronger than the indirect association (b-coefficients for direct and indirect association 0.21 vs. 0.03). The parental labour market status was not directly or indirectly associated with skipping breakfast.

Regarding meal frequency, only paternal education had a direct and positive association with meal frequency for children. However, both the maternal and paternal education were indirectly associated with meal frequency, mediated through the family type. The family type had an inverse and only direct association with meal frequency. Finally, a path analysis showed that the family type was directly (b-coefficient −0.15) associated with family dinner but not indirectly. The family type also mediated the effect of the parental education on having family dinners.

The results from this study showed that family type and perceived family income sufficiency were the strongest determinants of childhood meal patterns. Furthermore, the impact of family background factors on meal consumption behaviour in childhood was stronger among younger children (7–11 years) compared with adolescents (14–16 years), however the associations for both age groups were primarily similar. The family type had a direct and strong association with all meal pattern variables studied among younger children (7–11 years) and it also mediated the effect of parental education on meal patterns. Thus, the family resources seemed to determine meal consumption behaviour in childhood more than parental educational level and labour market status.

6.4 ASSOCIATION BETWEEN EARLY CHILDHOOD FAMILY BACKGROUND FACTORS, CHANGE IN THEM AND MEAL FREQUENCY IN CHILDHOOD (III)

In sub study III, the association of meal frequency with parental socioeconomic factors (education, labour market status and income) and family type at baseline and the changes in them over a five-year follow-up period were investigated. Meal frequency was selected as an outcome variable as no prior investigations of interrelationships between the family SEP, family type and number of daily

meals among preschool or young school-aged children have been published. Furthermore, the meal frequency was statistically significantly associated with the weight status of younger and older girls: for boys the association was not statistically significant ($p>0.05$) (see supplementary analysis in 6.1). Data of a nationally representative sample of Finnish children aged 0.5–5 years at baseline and 5–10 years at follow-up and their families were used. A special focus was given to the role of the family type and its changes with respect to meal frequency. The outcome measure was the recommended number of meals (four to six meals a day) in childhood.

Associations between the SEP factors and family type and meal frequency in childhood are presented in Table 6. In the age- and gender-standardised bivariate model, living in a single-parent family at baseline increased the risk of not eating the recommended number of meals per day in childhood compared with those living in intact families (Table 6). For the family transition variable, only living in a single-parent, reconstituted or joint physical custody family throughout the follow-up period had a statistically significant and inverse association with meal frequency. All SEP indicators except the parental labour market position at the baseline had a statistically significant association with meal frequency in childhood.

In sub study III, models 1–3 were designed to clarify the pathways between the family background determinants. In model 1, both the family type at the baseline and a change in family type during follow-up were included in the same model. As the association between meal frequency disappeared for both family type variables when included together in the same model, only a change in family type was selected for models 2 and 3. The association between having a stable other than intact family (single-parent, reconstituted or joint-custody family) and a lower likelihood of the recommended meal frequency in childhood remained in model 2 when the mother's and father's education were adjusted (Table 6, model 2). The final model (model 3) was adjusted to include income sufficiency in the baseline along with all of the explanatory variables in model 2 and both income-related change variables (unemployment and income sufficiency). In model 3, a stable other than intact family type, a low level of maternal education and a decrease in perceived income sufficiency during the five-year follow-up period had an inverse association with the recommended meal frequency (four to six meals a day) for children aged 5–10 years. In regard to unemployment in the family during the follow-up period, the association with meal frequency disappeared after all adjustments. Instead, having a father with a lower academic degree was associated with a higher likelihood of having the recommended meal frequency in childhood.

Models 2 and 3 were analyzed using the family type as the baseline instead of a change in the family type variable. The results were similar concerning

family SEP variables, but a single-parent family at baseline remained statistically and inversely associated with the recommended meal frequency (in model 2, OR 0.34, 95% CI 0.19–0.62, $p < 0.001$; in model 3, OR 0.40, 95% CI 0.21–0.77, $p = 0.006$, other results not shown).

The results from sub study III showed that after adjustments, a mother's low level of education and a decrease in income sufficiency during the follow-up period increased the risk of not eating the recommended number of meals a day in childhood. Regarding the family type and changes, the recommended meal frequency was less likely for children who lived in single-parent, reconstituted or joint physical custody families during the follow-up period compared with children in intact families. However, controlling for a change in family income attenuated the difference between intact families and those who underwent a family transition before the follow-up period. A family transition during the follow-up period was not associated with the children's meal frequency.

Table 6. Associations between the recommended meal frequency in childhood (at follow-up) and family type and indicators of socioeconomic position (bivariate and multivariate age- and gender-standardised models) for children aged 5–10 years.

	Meal frequency in 2013							
	Bivariate[1]		Model I: AGE+SEX+FT+CFT		Model II: AGE+SEX+CFT+ME+PE		Model III	
	OR (95%CI)	p[2]	OR (95%CI)	p[2]	OR (95%CI)	p[2]	OR (95%CI)	p[2]
Family type at the time of the baseline (FT)								
Intact family	1		1					
Reconstituted or joint-custody family	0.81 (0.27, 2.40)	0.70	1.53 (0.31, 7.62)	0.60				
Single-parent family	0.39 (0.24, 0.65)	**<0.001**	0.76 (0.22, 2.60)	0.66				
Change in the family type during the follow-up period (CFT)								
Stable intact family	1		1		1		1	
Stable single-parent, reconstituted or joint-custody family	0.35 (0.20, 0.62)	**<0.001**	0.39 (0.10, 1.49)	0.17	0.39 (0.20, 0.79)	**0.01**	0.47 (0.23, 0.95)	**0.04**
New reconstituted or joint-custody family	1.04 (0.57, 1.89)	0.91	1.10 (0.55, 2.19)	0.79	1.13 (0.58, 2.18)	0.73	1.38 (0.69, 2.77)	0.36
New single-parent family	0.76 (0.39, 1.47)	0.42	0.75 (0.39, 1.45)	0.40	1.14 (0.51, 2.57)	0.75	1.23 (0.54, 2.80)	0.62
Maternal education at the time of the baseline (ME)								
Upper academic degree	1				1		1	
Lower academic degree	0.58 (0.36, 0.93)	**0.02**			0.64 (0.38, 1.10)	0.11	0.67 (0.39, 1.16)	0.15
Secondary education	0.34 (0.21, 0.54)	**<0.001**			0.48 (0.27, 0.86)	**0.01**	0.51 (0.29, 0.93)	**0.03**
Paternal education at the time of the baseline (PE)								
Upper academic degree	1				1		1	
Lower academic degree	1.33 (0.79, 2.26)	0.28			1.72 (0.95, 3.10)	0.07	1.82 (1.00, 3.32)	**0.05**
Secondary education	0.54 (0.35, 0.83)	**0.01**			0.75 (0.44, 1.28)	0.29	0.83 (0.48, 1.43)	0.49
Maternal labour market status at the time of the baseline								

Table 6 cont.

Full-time employment	1							
Unemployed	0.75 (0.41, 1.38)	0.35						
Other	1.34 (0.92, 1.94)	0.12						
Paternal labour market status at the time of the baseline								
Full-time employment	1							
Unemployed	1.81 (0.58, 6.15)	0.29						
Other	0.66 (0.42, 1.03)	0.06						
Unemployment in the family during the follow-up period (CFL)								
No unemployment	1				1		1	
Unemployment at the time of the baseline	0.87 (0.46, 1.63)	0.66			0.99 (0.60, 1.64)	0.97	1.13 (0.56, 2.26)	0.74
Unemployment at the time of the follow-up	0.60 (0.38, 0.95)	**0.03**			0.72 (0.47, 1.08)	0.11	0.71 (0.42, 1.20)	0.20
Unemployment during the follow up period	0.29 (0.11, 0.76)	**0.01**			0.46 (0.19, 1.08)	0.07	0.50 (0.15, 1.64)	0.25
Others	0.24 (0.05, 1.27)	0.09			0.26 (0.05, 1.23)	0.09	0.16 (0.02, 1.73)	0.13
Self-reported income sufficiency at the time of the baseline (IS)								
Easy	1						1	
Quite easy	0.85 (0.59, 1.23)	0.39					0.90 (0.58, 1.41)	0.66
Hard	0.58 (0.40, 0.86)	**0.01**					0.60 (0.26, 1.43)	0.25
Change in the income sufficiency during the follow-up period (CIS)								
Remained easy or quite easy	1						1	
Income sufficiency improved	0.64 (0.42, 0.98)	**0.04**					0.81 (0.42, 1.54)	0.52
Income sufficiency worsened	0.51 (0.34, 0.75)	**0.001**					0.54 (0.35, 0.84)	**0.01**
Remained hard	0.46 (0.29, 0.72)	**0.001**					0.99 (0.40, 2.47)	0.99

[1] AGE+SEX+X, where X is one of the explanatory variables.
[2] Significance of the difference from the reference group; $p < 0.05$.

[Based on Parikka et al. 2021 (sub study II)]

7 DISCUSSION

The objective of the study was to identify the most important family background factors that determine overweight and meal patterns among children (ca 3-11 years) and adolescents (ca 14-16 years) in Finland. The study examined the direct and indirect pathways between parental BMI, family SEP factors, family type and overweight and meal patterns in childhood. Special focus was given to the effect of a transition in the family type and change in family SEP in childhood in a follow-up study setting.

7.1 MAIN RESULTS OF THE STUDY

The primary results of the study are fourfold. First, there were marked meal pattern related differences in overweight. Skipping breakfast and eating less than 4 meals a day or more than 6 meals a day was associated with overweight among both children and adolescents. The associations remained statistically significant even when SEP of the family (measured with maternal education) was taken into account. However, family dinner frequency was not associated with weight status of a child.

Second, parental BMI and education were the strongest determinants of childhood overweight. Children with both parents overweight had a significantly increased risk of being overweight compared with children who did not have overweight parents. A low SEP, as measured by parental education, was associated with higher childhood overweight. Furthermore, girls aged 11–16 living in intact families were less likely to be overweight compared to other girls.

Third, the family type and perceived family income sufficiency were the strongest determinants of childhood meal patterns. The impact of family background factors on meal consumption behaviour was stronger among younger children (7–11 years) compared with adolescents (14–16 years). The family type had a direct and strong association with all meal pattern variables studied among younger children (7–11 years) and it also mediated the effect of parental education on meal patterns.t

Fourth, the early childhood family background predicted meal frequency behaviour in children. A low SEP, as measured by mother's education, and a decrease in income sufficiency increased the risk of not eating the recommended number of meals in childhood. Moreover, children who lived in other than intact families were at a greater risk of not receiving the recommended number of

meals a day. However, controlling a change in family income attenuated the difference between the children in intact families and those who underwent a family transition before the follow-up period.

In sum, this study showed that there are clear socioeconomic inequalities in overweight and overweight-related meal patterns in childhood. The social gradient emerges in an early stage of childhood. A low SEP and deterioration of self-perceived income predict overweight-related eating behaviour in later childhood. The family type inequalities were seen in meal pattern variables in childhood and in overweight in adolescence among girls.

7.2 INTERPRETATION OF THE RESULTS AND COMPARISON TO EARLIER STUDIES

7.2.1 Associations between meal patterns in childhood and childhood overweight

There is considerable and consistent evidence on an inverse association between regular breakfast consumption, body mass index (BMI) and overweight among children and adolescents (e.g. Timlin et al. 2008; Van Lippevelde et al. 2013; Monzani et al. 2019; Wadolowska et al. 2019; Ober et al. 2021; Mäki et al. 2021). Our results are in line with findings showing that those children and adolescents who skip breakfast have an increased risk of childhood overweight compared to those eating breakfast on a daily basis. Roos et al. (2013) found that in Northern Europe, children having a family breakfast or a dinner less than once weekly were more likely to be overweight. This study, however, did not show a protective effect of more frequent family dinners on childhood overweight.

In previous studies, the association between meal frequency and childhood overweight has been ambiguous. In this study, we found a significant reduction of the risk of overweight among children (7-11 years) and adolescents (14-16 years) with the recommended number of meals. These results are in accordance with those from earlier studies showing the protective effect of a larger number of daily meals on overweight in children (Toschke et al. 2005; Vik et al. 2010; Jääskeläinen et al. 2013). One explanation for this could be related to earlier findings that both regular breakfast eating, and high meal frequency are the foundation of healthy eating for both children and adults as these have been found to be associated with higher diet quality (Gillman et al. 2000; Neumark-Sztainer et al., 2003; Pedersen et al. 2012). Small children need food frequently because they cannot eat large quantities at a time. Long intervals

between meals can result in uncontrolled eating and unnecessary snacking and thus cause overweight. Among adolescents, high meal frequency has been associated with lower risk of metabolic syndrome traits such as abdominal obesity and hypertriglyceridaemia, protecting thus healthy weight development (Jääskeläinen et al. 2013).

7.2.2 Socioeconomic inequalities in childhood overweight

The results of this study substantiate the previous findings that socioeconomic differences in overweight seem to emerge already in early childhood. Mekonnen et al. (2021) found that maternal and paternal educational differences in children's weight and BMI trajectories emerged during infancy and continued to the age of 8 years. In this study, socioeconomic differences in overweight, according to parental education, were seen at the age range of 3-8 years among boys but not among girls.

The current study also corroborates the earlier acknowledged finding that among various indicators of family SEP, parental education (along with parental occupation) is of particular importance in Western countries showing inverse associations most frequently with obesity measures (i.e. lower parental SEP in association with higher obesity) (Bammann et al. 2013; McCrory et al. 2019; Sares-Jäske et al. 2022). In the current investigation, both an income measure and a parental labour market position measure were included in the models, but after adjustments they showed no association with childhood overweight. These observations imply that education is a stronger predictor for childhood overweight in the Finnish child population than the other two key measures of SEP. Moreover, the current study showed that parental education had both direct and indirect (mediated by parental BMI) inverse associations with childhood overweight, but a direct association was found only among boys. The explanation for the direct association of parental education on childhood overweight may be that a higher parental education is presumed to be related to greater awareness of and ability to adopt healthy lifestyle recommendations. Regardless of their own BMI status, highly educated parents may have more resources and skills available to prevent the weight gain of their children than parents with a lower educational level (Lynch and Kaplan 2000).

However, this does not explain the direct association between parental education and childhood overweight in boys but not in girls. Similarly to our findings, previous studies have reported that family SEP–BMI relationships differ by gender, but the SEP measures operate in different ways. For example, Wang and Lim (2012) found that for U.S. children, among boys aged 2–9 years between 1999 and 2002, a significant inverse association appeared between family income and overweight, but no associations were significant among girls

aged 2–9 years. An inverse association between family income and overweight was statistically significant in adolescent girls, but not in boys. Moreover, the gender difference might relate to some extent to issues such as parenting style (e.g. authoritative, authoritarian, or permissive styles) or parenting role modelling in sport and food choices (Berge et al. 2010; Gebremariam et al. 2017). Previous research has revealed a link between parental education and the adoption of a parenting style. For example, a high level of education among mothers and a higher family income were positively associated with an authoritative (focuses on limit setting with connection) parenting style and negatively associated with an authoritarian (focuses on discipline and control) parenting style (Cobb-Clark et al. 2019). Regarding health behaviour, Berge et al. (2010) found that an authoritarian parenting style adopted by mothers was associated with higher adolescent weight status in boys but not is girls. They also found that fathers who did not model or encourage their daughters to have healthy dietary intake and to engage in physical activity, had daughters with higher BMIs (Berge et al. 2010).

The current study also gave support to the previously reported positive association between parental overweight and the child's overweight (Laitinen et al. 2001) and is in accordance with findings that there is an association between the number of overweight parents and the child's overweight (Freeman et al. 2012; Xu et al. 2011). In the current study, a higher parental BMI was associated with an increased risk of overweight in all four age and gender groups of the children. The importance of parental lifestyles and SEP for the risk of children being overweight is evident. Childhood overweight is known to reflect the health behaviour of the whole family (Lehto et al. 2012), and the associations of obesity-related behavioural factors (physical activity and nutrition) and SEP have been established in many adult populations (Wikström et al. 2011; Giskes et al. 2010). Further, parental education has been found to be associated with children's weight-related health behaviour, such as sedentary behaviour measured by screen time (Tandon et al. 2012), fruit and vegetable intake (Pearson et al. 2009) and physical activity (Kantomaa et al. 2007). As a significant parent-child relationship in weight status has been consistently shown in prior research (see also Fernandez-Alvira et al. 2013; Gebremariam et al. 2017; Lee et al. 2022), it indicates that parents play an important role in preventing children's obesity.

7.2.3 Socioeconomic inequalities in childhood meal patterns – associations and changes

This study supported earlier findings about the existence of a socioeconomic gradient in childhood meal patterns, which is suggested in some earlier studies in Western countries (Neumark-Sztainer et al. 2003; Wijtzes et al. 2015; van Ansem et al. 2014). Perceived family income insufficiency seems to be a particularly important SEP determinant for meal patterns. Both children (aged 7–11 y) and adolescents (aged 14–16 y) living in families with perceived income insufficiency had an increased risk of skipping breakfast and not eating the recommended 4–6 meals a day: the association remained when all other explanatory variables were included in the multivariate model. Perceived income insufficiency remained significantly associated with family dinner frequency only among adolescents when all other explanatory variables were adjusted for. The current results reflect those of Vereecken et al. (2009) who found family income differences linked to children skipping breakfast and those of the HBSC study by World Health Organisation (2016), which showed that daily family meals with parents tended to be more common among young people from high-affluence families. As, to my knowledge, there are no previous studies on the association between income insufficiency and the number of meals in childhood, no comparison with previous studies could be made.

There could be at least two explanations for the observed associations between family SEP, measured with income insufficiency, and meal patterns in childhood. The first could be that the cost of balanced meals may restrict the opportunities of families to adopt the nutrition recommendations by the National Nutrition Council in Finland (2016). According to the recommendations, both children and adults should eat every 3–4 hours, which translates into ca. 4–6 meals a day. The second explanation could be that children living in low-income families are more likely to be exposed to the poor psychosocial factors such as parental stress caused by income hardship. In many adult and child populations, research has established an association between low income and psychosocial stress, which can have significant physical and mental health implications, including higher mortality rates (Marmot 2002; Tarkiainen et al. 2012; Yoshikawa et al. 2012). Moreover, unhealthy behaviours such as smoking and overeating have been linked to stress in many adult population studies, and researchers suggest that these links are in large part due to the use of health-compromising behaviours to cope with stress (Park and Iacocca 2014).

Our findings are in line with the earlier studies suggesting that lower levels of parental educational attainment are associated with skipping breakfast (e.g. van Ansem et al. 2014; Pedersen et al. 2016), skipping other meals (e.g. Vik et al. 2013) and lower family meal frequency (e.g. Neumark-Sztainer et al. 2003, 2013). In the current study, the paternal education had a direct association

with skipping breakfast and the number of meals a day, whereas maternal education was directly associated only with skipping breakfast among younger children (aged 7-11 y). However, the earlier observations imply that education is a stronger predictor of skipping breakfast and other meals and fewer family meals than the other key measures for SEP (e.g. Hallström et al. 2012; van Ansem et al. 2014). Unlike earlier studies, we were able to analyse the impact of the family type together with various family SEP variables (perceived income sufficiency, parental education, labour market status) on three meal patterns of children and adolescents by using a path analysis. The current study showed that to a large extent, both the association between parental education and family dinner frequency, and the association between parental education and the number of meals, were mediated via the family type among children aged 7-11 years.

There are no previous studies on the relationship between family SEP change and meal patterns in childhood. However, in their systematic review of research assessing the impact of changes in the family SEP on the health of children and adolescents, Levesque et al. (2021) summarized that several consistent patterns emerged in the literature. Among these are increased income and improved physical health of the child, or decreased income and deteriorating physical health of the child. Our results are in agreement with these findings: adjusting for the family income at the baseline along with all the explanatory variables, a mother's low level of education at the baseline and a decrease in income sufficiency during the follow-up period increased the risk of not eating the recommended number of meals a day in childhood.

There are many mechanisms which can cause a deterioration of income in families with children. One of the causes pinpointed in the earlier literature is the transition from one family form to another (e.g. from having married parents to becoming a single-parent family). As a concomitant factor, reduced family income following separation may negatively affect children's health (Reiter et al. 2013). Thus, our finding that a decrease in income sufficiency and living in other than an intact family in early childhood increased the risk of not eating the recommended number of meals in childhood seems plausible.

Moreover, an explanation for the association between low level of maternal education, and meal patterns in early childhood might relate to parental lifestyle factors. Our results suggest that a mother's overweight has an influence on children's (aged 7–11 years) meal consumption: children with overweight mothers had a significantly increased risk of skipping breakfast, not eating the recommended 4–6 meals a day and having family dinners less frequently. Parental obesity-related behavioural factors, such as nutrition, have been shown to influence a child's eating behaviour (Keski-Rahkonen et al. 2003). Furthermore, an association between the parental educational level

and children's breakfast consumption has been shown to be partly mediated by parental breakfast consumption (van Ansem et al. 2014). The importance of the parental lifestyle and family SEP regarding meal patterns especially among younger school-aged children seems evident.

7.2.4 Family type inequalities in childhood overweight and meal patterns—associations and changes

In this study, a consistent association between the family type and childhood overweight was not found. This somewhat contrasts with many recent studies which have focused on the association between the family structure, specifically whether a child lives in a single parent household, and childhood overweight and obesity, suggesting a significant relationship (Yannakoulia et al. 2008; Schmeer 2012; Formisano et al 2014; Duriancik and Goff 2019). Instead, this study showed that only 11-16-year-old girls living in nuclear families had a reduced risk of overweight compared to same-aged girls living in other family types. No such statistically significant association was observed among boys. This finding is in line with the study by Häkkänen et al. (2020) showing that Finnish girls (aged ca 11-12 years) of divorced or single parent families, compared to girls from intact families, shifted at a higher rate from overweight to obesity. Additionally, Burkill et al. (2021) reported that in their cohort study of children born between 2000 and 2001 in the UK, for girls the effect of family structure on overweight was much more evident than was the case for boys.

The differential effect of the family structure on childhood BMI by sex is still incompletely understood. However, an earlier study by Vanhala et al. (2011) suggested that families tend to monitor the weight and healthy eating of girls to a greater extent than that of boys as parents recognize their child is overweight more frequently if the child is female. If the family has material and time resources to access and prepare healthier meals and lives in a more affluent, generally less obesogenic environment, the protective effect on BMI may be stronger for girls than for boys because of greater familial intervention. This could partially explain the greater differences between those families with (e.g. nuclear families) and without (e.g. single parent families) such resources for girls, relative to boys.

Earlier studies suggest a consistent association between skipping breakfast and living in a single-parent family among both children and adolescents (Pearson et al. 2009; Stewart and Menning 2009; Vereecken et al. 2009; Jorgensen et al. 2011; Levin et al. 2012; Yelick 2017). The findings from the current study correspond partially with these results: children living in a single-parent family were less likely to eat daily breakfast and have frequent family dinners and had less likely the recommended number of meals

a day compared to other children. However, this study implies that among adolescents, family type differences in meal pattern are less pronounced: only an inverse association between single parenthood and family dinner frequency was statistically significant when all other factors were adjusted for.

One possible explanation for the stronger impact of the family type, and especially of single parenthood, on meal patterns among children compared with adolescents may relate to social influences other than the parents and family. It is often argued that, during adolescence, people become increasingly influenced by their peers and the media at the expense of the parents. However, earlier results from a Danish study of adolescent–parent dyads did not support this interpretation (Pedersen et al. 2016). Pedersen et al. examined the influences of adolescent healthy eating, including the social influence of parents and friends. They proposed that when it comes to adolescents' fruit and vegetable intake, parents remain the main influencers, with what they do being more important than what they say. The results from the current study did not support this view either, as an inverse association between single parenthood and family dinner frequency among adolescents remained statistically significant when adjustments were made for the family SEP.

Another explanation may be related to the lack of time to prepare homemade meals, limited financial resources and greater instability due to a family transition and single parenthood (Yelick 2017; Formisano et al. 2014). Whereas children are largely dependent on their parents or care givers to prepare their meals, adolescents can make their own breakfast and a healthy snack or reheat a meal if the foods are available at home, or they can buy healthy foods if their parents provide them with money. In single-parent families, where a larger number of responsibilities are placed on one parent, the time for daily family dinner preparation or eating together with a child may be less achievable. This study offers some support for this as the inclusion of family background factors (education, labour market position, income, BMI) reduced the effect of the family type on skipping breakfast, and on the number of daily meals, only modestly for children, whereas for adolescents, after the inclusion of the family SEP variables, the family type failed to reach statistical significance, except for family dinner frequency. Thus, for adolescents the associations between the family type and skipping breakfast, and the family type and number of daily meals were explained by family SEP variables, and especially by family income. For children, the majority of these associations remained unexplained. Some measures relating, for example, to family functioning such as communication, problem solving or roles (Yoshikawa et al. 2012) or psychosocial factors such as parental stress or lack of social support might have explained the associations more.

Whereas evidence of an association between skipping meals and living in single-parent families is rather consistent, the impact of living in a reconstituted

family on meal patterns is inconclusive (Jorgensen et al. 2011; Levin et al. 2012; Vereecken et al. 2009; Yelick 2017). The current study found that the impact of the family type on meal patterns among children was especially strong: the family type had a direct association with the recommended number of meals a day, and both living in single-parent families or in a reconstituted family had an inverse association with the number of daily meals. Kristiansen et al. (2020) suggests that parental conflict after a family break-up may continue for years. Moreover, a reconstituted family could be a different stressor than divorce, as the child will have to adjust to new family members. Even though the presence of a step parent usually results in an improved financial situation and parents may be able to spend more time with their children, it could also result in new rules and routines, or moving away from home, school, or friends (Kristiansen et al. 2020). The current study showed that children of reconstituted families had an increased risk of not eating the recommended number of meals a day. One possible explanation for this finding could relate to family complexity due to the presence of a step parent, a step sibling(s) or a half sibling(s) and to new rules and routines, as suggested by Kristiansen et al. (2020).

To my knowledge, there are no previous studies on the relationship between family transitions and meal frequency in childhood. The result of the current study of that relationship are not unambiguous. The study showed that children aged 5-10 years at the follow-up, who lived in stable single-parent families, or reconstituted or joint physical custody families during the follow-up period had an increased risk of not receiving the recommended number of meals a day. Some of these children, especially those living in stable reconstituted or stable joint physical custody families, had most likely undergone a family transition before the five-year follow-up period. From this perspective the finding is in line with previous findings that the transition from one family form to another rather than the family type as such may negatively affect children's health through concomitant factors (e.g. parental conflict, loss of parental contact and reduced family income following separation) (Coleman and Glenn 2010; Reiter et al. 2013). On the other hand, this finding does not necessarily support the earlier literature on the negative effects of a family transition on child health. The rationale behind this is that the current study showed that single parenthood at baseline was unfavourably associated with the recommended meal frequency. Furthermore, stability of single parenthood during the follow-up period was associated with meal frequency, whereas living in a new reconstituted family or joint-custody family or in a new single parent family was not statistically significantly associated with the recommended number of meals a day in childhood. A single-parent family could be the result of a divorce, but it could also result from the loss of a parent or simply be the original intended family context.

Taken together, the results of the current study support earlier study by Fismen et al. (2022) concluding that the family type is not a proxy for the SEP but that family type differences are driven also by other underlying mechanisms than just the material and educational dimensions of the SEP. Whereas family type differences in meal pattern variables could be somewhat explained or mediated by the material dimension of the SEP, most associations remained unexplained after the inclusion of all selected family background variables. In the follow-up study, controlling for a change in family income notably affected the association between the change in family type and the recommended number of daily meals. Still, after adjustments for all SEP variables, the difference between children in stable single-parent, reconstituted or joint physical custody families and those living in stable intact families remained statistically significant.

7.3 METHODOLOGICAL CONSIDERATIONS

This study utilised unique population study data on a cohort of Finnish children and their families to investigate family background differences in childhood overweight and meal patterns. The family SEP was measured with three parental SEP variables (education, labour market status, income) along with the family type, making the investigation of family background differences more reliable than would have been the case with fewer measures. The study included a large sample size and age range, and measured data on the height and weight of children. Children were classified as overweight (including obesity) according to the international age- and gender-specific BMI cut-off points of the IOTF criteria (Cole et al. 2000). The IOTF reference (Cole et al. 2000) is widely used in international scientific studies, and in Finland. Other widely used criteria are the WHO growth references (WHO Growth reference data 2007,) which have been developed for both clinical and public health applications. Later, Saari et al. (2011) published an age- and gender-specific BMI growth reference for Finnish children. However, in the current study, the IOTF criteria were used as both IOTF and WHO growth references are designed for international use and for comparisons between countries (de Onis et al. 2007).

A major strength in the investigation was the possibility to utilise the self-reported data on meal patterns of children and examine the associations in accordance with the national eating recommendations for families with children. The feasibility and reliability of the meal pattern variables was based on national recommendations (National nutrition council 2016), concluding that a regular meal schedule is the foundation of healthy eating for both children and adults.

Although the study sample is not a national random sample, it covers different geographical areas and socioeconomic groups in Finland, making it reasonably representative of the Finnish child population. The response rate in baseline was very high: 83 percent in the child health clinics and 77 percent in the school healthcare units. Additionally, in the follow-up, the overall participation rate was 48 percent. The follow-up data was more often missing from single parents and parents with a low education or low income. Despite of possible bias due to the loss of follow-up data, socioeconomic and family type differences were seen in sub study III. The selection bias most likely diluted the associations and effects. Moreover, as more single parents were lost at the follow-up compared with those who responded, we were unable to analyse stable single-parent families as an individual group due to the small number of cases. Lastly, our 5-year follow-up period might also be too short to show the accumulation effect of family transitions during the follow-up period on children's meal frequency. This might partly explain why no significant association between a new single-parent family and the recommended meal frequency for children was found.

An additional strength in the investigation was the use of structural equation modelling. To my knowledge, there are no other studies examining the direct and indirect associations between the family type, parental SEP factors and meal frequency, skipping breakfast, and family dinner in childhood. Moreover, follow-up survey data enabled us to study the interrelationship between family SEP factors, family type, changes in both of these, and the meal frequency in childhood in a prospective setting.

Various limitations need to be discussed. Although the data collection followed a standard protocol and the nurses had strong routines for measuring and recording the anthropometric measurements, the clinics used their own scales and stadiometers, which may have caused some inaccuracy in the measures for height and weight. In addition, we did not have information on whether the mother was pregnant and how a potential pregnancy was taken into account when filling in the questionnaire, including self-reported weight and height. Moreover, in this study we used odds ratios (OR) instead of relative risks (RR) to examine the strength of the associations between childhood overweight and explanatory variables in the cross-sectional study setting. However, it should be kept in mind that ORs can somewhat differ from RR and overestimate the relative risk in age groups where childhood overweight prevalence is high (Schmidt and Kohlmann 2008).

The indicator of household income was based on self-reported information on income sufficiency, as the informed consent collected from participants did not include permission to link the parents' data to register-based information on individual or household income. Thus, we lack more comprehensive and

objective measures of family financial status, such as disposable household income. A scoping review by Sares-Jäske et al. (2022) concluded that composite SEP (80%), parental education (69%) and parental occupation (64%) indicators most frequently showed inverse associations with childhood obesity measures (i.e. lower parental SEP associating with higher obesity). In the current study, the parental occupation was not used as one of the family SEP measures as the occupation was asked in the questionnaire with an open-ended question and registry-based classification of parents by their occupation was not applicable. The categorisation of the occupation data, generated through open-ended questions, turned out to be too time-consuming and difficult.

The data used in the current study does not include information on the parents' meal patterns, which could mediate the association between family SEP factors and meal patterns for children. Unfortunately, the only nutrition-related variable for the parents was BMI. Psychosocial factors such as parental stress or lack of social support might also have been useful to include in the study. Additionally, measures relating to family functioning and parenting styles might have explained the associations between family background factors and meal patterns in more detail.

7.4 IMPLICATIONS FOR FUTURE STUDIES

Several areas for future studies remain. Continuous monitoring of the SEP differences in childhood overweight and obesity in a large age range would be needed, as indicated by the observed SEP differences already at the age of 3-8 years. Additionally, a closer investigation of changes in children's overweight status over time by age, gender and region would yield additional information for public health practices. A national monitoring system with up-to-date data already exists, but it does not include information on SEP differences and overweight in children. The FinChildren register monitors the prevalence of overweight and obesity in Finnish children and adolescents aged 2 to 16 years (Vuorenmaa et al. 2022). Data is routinely collected from health check-ups performed at child health clinics and school healthcare and transferred through patient information systems to the Register of Primary Healthcare Visits (AvoHilmo). Overweight and obesity results are annually published on THL's web-based portal by gender and age at national and municipality levels (thl.fi/finlapsetrekisteri). The inclusion of the monitoring of SEP differences to this reporting system would be highly valuable.

This study does not provide an answer to the question about why parental education had a stronger association with overweight for boys than girls. The gender difference might relate to parenting style or parenting role modelling

(Berge et al. 2010; Gebremariam et al. 2017). However, this finding needs further exploration. Qualitative data could enrich our understanding of individual behaviour and of how health behaviour is shaped by social influences on boys and girls.

The current study showed that the family type and perceived family income sufficiency were the strongest determinants of childhood meal patterns. This might relate to some extent both to home environment and psychosocial factors such as parental stress caused by income hardship. Research has established an association between low income and psychosocial stress in adult populations suggesting that stress can have significant physical and mental health implications, including higher mortality rates (Marmot 2002; Tarkiainen et al. 2012; Yoshikawa et al. 2012). Additionally, health behaviours such as eating and exercising have been linked to stress (e.g. Park and Iococca 2013). The tendency of a parent to overeat in response to stress may negatively affect the eating behaviour of children. An earlier study by Thomas et al. (2020) found that adverse life events during childhood were associated with emotional overeating and more restrained eating among 10-year-old children (Thomas et al. 2020). Moreover, as family functioning is suggested to be poorer in poor families and family structure and functioning are linked to health (Freistadt and Strohschein 2013), it is critical to consider the pathways between these constructs. Taken together, there is a need to further explore how psychosocial factors, family functioning, parenting influences and parenting styles modify the observed associations between family SEP factors, family type, and meal patterns in childhood.

In addition to meal patterns, child risk factors for obesity include dietary intake, physical activity and sedentary behaviour (Davison and Birch 2001). Subsequently, short sleep durations have been revealed as a potential risk for overweight and obesity in childhood and adolescence (Fatima and Mamun 2015). In childhood, fruit and vegetable consumption, physical activity and sedentary time are reported to be associated with parental education, parental occupation status and family income (e.g. Pearson et al. 2009; Kantomaa et al. 2007; Tandon et al. 2012). Instead, health behaviour inequalities related to family type have been less explored in European child populations. Investigating family background differences in childhood eating habits, physical activity and sleep remains of great importance in terms of curbing the future inequalities in childhood overweight. Research on childhood physical activity and sleep trajectories by both family SEP and family type should be carried out to increase the currently limited knowledge about how these factors modify the associations between physical activity, sleep habits and overweight in childhood.

This study suggests that future research should embrace new measures to study family contexts. As mentioned earlier, family diversity has increased

over the past decades. However, different family types might include quite heterogenous family contexts. Previous statistics have shown that income difficulties are more general in one-parent families than in two-parent families: about 46 percent of one-parent families have experienced at least minor economic difficulties (Official Statistics of Finland 2018). The risk of food poverty has also increased especially among lone parents and large families who struggle to meet the budget standard for a socially acceptable, healthy diet that allows for social participation (O'Connell et al. 2019). However, the financial and social contribution of non-cohabiting parent or relatives may vary to a great extent. In this study, we had no data on expense sharing between parents or the quality of parental relationships after separation. These questions were not included in the questionnaire. A closer understanding of the impact of different family types on the health behaviour of children might need up-to-date and representative data with a large sample size and age range, and a large variety of data on physical placement arrangements and expense sharing after separation and as well as other family-related issues.

7.5 POLICY IMPLICATIONS

The present investigation has highlighted several aspects that are relevant for public health and future policymaking, in order to prevent overweight and promote healthy eating behaviour in childhood. The findings highlight the importance of targeting the whole family in public health interventions to reduce SEP differences in overweight in early life. To promote health equality in eating behaviour, several national policy actions and population-based national and community level initiatives are highly relevant to acknowledge.

In Finland, universal healthcare institutions, such as maternity and child health clinics and school healthcare services reach children and their families across the socioeconomic spectrum. In the statutory extensive health examinations, the participation of both parents or at least one parent is required. The examination is implemented in the maternity and child health clinics for children aged 4 months, 18 months and 4 years, and in the school health services for grade 1, grade 5 and grade 8 pupils. The purpose is to assess the physical, mental and social condition of children, provide vaccinations and to support the well-being of the whole family, with attention to relationships and parenting (Hakulinen-Viitanen et al. 2012). In maternity and child health clinics and in school healthcare services, the height and weight of the child are measured and changes in weight are monitored. Early identification of excess weight gain is important so that professionals can support children and

parents with lighter and shorter interventions than at later stages of obesity (Häkkänen et al. 2020).

In light of the results, gender-specific interventions in obesity prevention might be more effective than universal ones, as overweight and associations with family background characteristics differ between girls and boys. As obesity in childhood is prevalent and cardiovascular risk factors are found to be present already in childhood (Dalla Valle et al. 2018), both prevention and treatment are needed. Individualised, but structured prevention and treatment practices of school healthcare (Häkkänen 2021) should be used in countering obesity.

Also, early childhood education, pre-primary education and schools serve as institutions that shape children's health behaviour. In early childhood and pre-primary education, the main themes of health education are physical activity, eating and sleeping. Teachers in day care establishments consider encouragement, discussion, and participation of children as key elements in the implementation of these health education themes (Palonen 2018). In the Finnish primary school grades 1 through 6, health education is integrated in environmental studies classes. In grades 7 through 9, health education is taught as a specific subject (Finnish National Agency for Education 2014). Health education is also given during the school day in different situations related to hygiene and eating together, for example. This offers learning opportunities for both children and parents if children are encouraged to talk about these issues at home and cooperation between schools and homes is reinforced.

Along with public health interventions, the results of the current study imply on the policy level that controlling childhood overweight and reducing inequalities should include national policy actions and population-based community level interventions. According to WHO (2012), comprehensive childhood obesity prevention includes several and simultaneous policies undertaken by state government such as leadership in health promotion, laws and regulations, food taxes and subsidies, and restricting the social marketing of unhealthy foods for children. The starting points are the national dietary guidelines (in Finland, National nutrition council 2016) followed by a broad range of national initiatives, policies and a robust health monitoring system that can create a supportive environment for the implementation of the national dietary guidelines and the promotion of health equity across the socioeconomic spectrum. Community-based interventions or programmes are typically applied across multiple settings, tailored to the local environment and implemented locally (WHO 2012).

National nutrition policies in Finland such as free school lunches are important, as they can provide the opportunity for children from vulnerable families to have at least one healthy daily meal (Hoppu et. al. 2010) and thus narrow the nutrition-related inequalities in childhood. Moreover, eating a

balanced school lunch has been associated with overall healthier eating patterns outside schools (Tilles-Tirkkonen et al. 2011). The development of day care and school meals should be kept high on future policymaking agendas and seen as an investment in the future, as it promotes the health of children and a culture of good manners. It can help fight climate change and help to consider the entire meal environment.

An example of the national policy initiative in Finland to control childhood obesity and to reduce inequalities is the attempt of the national health authorities to design a "health-related tax" (or "public health product tax" in some countries) to discourage unhealthy food and beverage purchases. In this taxation, all foods including excessive amounts of sugar would be considered including sweets and desserts, sugar-sweetened cereals and sugar-sweetened beverages. Additionally, products including excessive salt such as salty snacks could be considered. In many Western countries, including Finland, children are known to eat too little fruit and vegetables (Khalsa et al. 2017) and too much sugar (Erkkola et al. 2009) compared to recommendations. The earlier literature consistently concludes that increasing the cost of unhealthy foods through taxation and reducing the cost of healthy foods through subsidies can influence the consumption of these products leading to both health gains and health expenditure savings (Blakely et al. 2020; Caro et al. 2017; Moore and Fielding 2019; WHO 2016). In Hungary, prof. Eva Martos concluded that four years after its introduction, the tax had achieved its public health goals as consumers reduced the consumption of unhealthy foods, manufacturers changed their ingredients or completely eliminated the taxed components, and planned tax revenue was generated (WHO 2016). Further, designing health-related taxes and increasing the cost of unhealthy foods may reduce the inequalities in overweight among children and promote health equity as it has shown to have a larger impact on budgets of lower socioeconomic groups (Djojosoeparto et al. 2020). In Hungary, due to the tax, a higher proportion of adults with a lower level of education than of those with higher education changed their consumption and chose a cheaper product (WHO 2016). To date, the Finnish government has not introduced a health-oriented tax regarding products with excessive sugar (not just soft drinks) although the national health authorities have acknowledged its potential to be pro-equity (THL and VRN 2015). The Finnish Food and Drink Industry Federation (ETL) has criticised the plans, saying that the proposed tax would have a small effect on sugar consumption but cause big problems for Finnish firms.

The office of prime minister Sanna Marin funded a study project titled "Marketing of unhealthy foods to children and youth - Situation in Finland and rules for regulation" (Fogelholm et al. 2021). Based on the results of the project, stricter and more restrictive marketing regulations are needed, especially to

better protect young people aged 13-16. The regulation of marketing needs to be developed in such a way that differences in the purchase of unhealthy foods by education, income, family size and living area can be reduced. The researchers also pinpointed that it is important for regulation to take into account the fact that marketing has strongly shifted onto social media. Central to nutrition policy guidance is the classification of foods as unfavourable ("unhealthy"), recommended ("healthy"), and others in terms of health. Therefore, a system based on nutrition profiling should be introduced in Finland which describes the nutritional quality of food in a sufficiently diverse way, not only by indicating an unhealthy or a healthy alternative (Fogelholm et al. 2021).

There are many community-based interventions that can reduce overweight and promote healthy eating and physical activity of children and young people. Mäki et al. (2022) have listed several local practices relating to the physical and food environment. These practices include actions relating to the facilities for physical activity (i.e. municipal citizens should be engaged with developing parks and public playgrounds); land use (i.e municipalities should invest in walking/cycling paths that facilitate active commuting to school); and foodscape (i.e schools should remove candy and soft drink vending machines and make healthy snacks during school day available). They also pinpoint the involvement of children in decision-making in the community (Mäki et al. 2022).

Parental overweight and the low SEP of the family should be better taken into account in identifying families in special need of supportive strategies. Higher SEP populations are usually more motivated to participate in voluntary interventions; however, it has been shown that if lifestyle interventions reach low SEP populations, equally good results can be achieved (Hankonen et al. 2009). Policy makers and practitioners must ensure that obesity prevention does not deepen existing socioeconomic and family type inequalities.

8 CONCLUDING REMARKS

This study provided a comprehensive picture of socioeconomic and family type differences in overweight and meal patterns among children in Finland. A population-based child health survey data with a both cross-sectional and 5-year follow-up setting was used. This investigation identified family background factors contributing to the socioeconomic and family type differences and explored the direct and indirect pathways between parental BMI, family SEP factors, family type and overweight and meal frequency in childhood. The results highlight the need to prevent childhood overweight, promote healthy eating behaviour and reduce SEP inequalities.

The mechanisms studied here were those that influence the development of health inequalities over the life course. The results revealed that SEP differences in meal patterns were important, underlying the observed SEP inequalities in overweight and those inequalities which emerge at an early stage of childhood. A low SEP and the deterioration of self-perceived income during childhood were important factors predicting overweight-related eating behaviour in later childhood. Family type inequalities were seen in meal pattern variables in childhood and in overweight in adolescence among girls.

Differences in eating behaviour and physical activity due to family background factors can be reduced in early childhood education and in schools. Eating food based on dietary guidelines and education on healthy diets promote healthy eating behaviour and good health in childhood. Moreover, in the Finnish universal healthcare institutions (maternity and child health clinics, school healthcare services) the weight development of the child is monitored providing the possibility for the early identification of excess weight gain and for sensitive intervention. Despite of these national policies and public interventions, Finland has not been able to narrow the differences in childhood overweight and healthy eating patterns between SEP groups and family types. Supportive and more intensive actions should be taken to reduce these inequalities and such actions should be executed simultaneously in several domains of society. National monitoring of childhood overweight should include SEP differences. Children and families who need special support should be identified as early as possible. Increasing the cost of unhealthy foods through new taxation and reducing the cost of healthy foods through subsidies should be introduced as these would reduce inequalities in overweight by affecting the lower SEP families more. Effective community-based interventions targeting the physical and food environment should be implemented as these can reach all children from different family backgrounds. More limitations for marketing unhealthy

foods to children and youth could also be initiated focusing especially on social media. Finally, protection of income security in changing life situations is needed.

Last, further studies are required to examine gender differences in the associations between the family SEP and childhood overweight. The gender differences are meaningful as parental education had a stronger association with overweight in boys than girls. Furthermore, a closer understanding on how psychosocial factors, family functioning, parental influences and parenting styles modify the observed association between the family SEP, family type and meal patterns in childhood would be beneficial. Investigating family background differences in childhood dietary intake, physical activity and sleep are pivotal to reducing health inequalities for children in the future. Finally, new measures to study family contexts might need up-to-date, representative data of Finnish children and their families with a large sample size and age range.

ACKNOWLEDGEMENTS

This work was carried out at the Finnish Institute for Health and Welfare (THL). I would like to thank my former Head of unit, Anne Lounamaa and current Head of Unit Markku Peltonen for giving me the opportunity to conduct this research and to finalise my thesis. I am extremely thankful to our Team leader Annamari Lundqvist for her endless support and understanding that have helped me to combine PhD research, project management and parenting. I would like to thank the Juho Vainio Foundation for the financial support for this thesis. I also gratefully acknowledge the financial support from the Ministry for Social Affairs and Health and Academy of Finland for financing the data gathering, without which this thesis would not exist.

I owe my deepest gratitude to my supervisors Professor Tiina Laatikainen and Tuija Martelin, PhD. Their wide knowledge on public health and conducting research, guidance, and their overall supportive attitude for this long journey were of utmost importance to me throughout this thesis. Their superfast replies to messages irrespective of the time of the day should also not be understated. I am deeply grateful to Tiina for taking me to be part of LATE 2013-2014 follow-up survey. This was the first time I participated in planning and conducting a population survey and it has had a far-reaching impact on my career in THL, including conducting this thesis. Tuija, it has been a true pleasure working with you and learning from you. Your encouraging and warm presence, broad understanding and uncompromised attention to quality and detail have had a profound impact on me. You have always found time to listen and guide me through the joys and sorrows I have experienced during this thesis project. I wish you happy and well-deserved retirement days.

Looking at the list of co-authors of the sub-studies, one sees that I have been very privileged to work with and learn from such distinguished experts in the field of public health, social epidemiology, and inequality in young people' health. Thank you Päivi Mäki, Susanna Lehtinen-Jacks, Laura Kestilä and Sakari Karvonen for your invaluable expertise. My sincere thanks are also due to Esko Levälahti for his statistical expertise. You have tireless answered my numerous questions during this work and helped me through difficult methodological issues. I also wish to acknowledge the many important people behind the data used in this study.

I would also like to acknowledge all the co-workers in our team whom I have been very privileged to work with over the last years. The greatest thanks from my colleagues deserve Lilli Hedman-Huhtala, Noora Holm, Jonna Ikonen, Heikki Kilpeläinen and Timo Koskela, who have provided me with support

and understanding during the most hectic times of this work. Thank you for being such excellent colleagues.

I would like to thank the two official reviewers, Adjunct Professor Hanna Lagström and Adjunct Professor Leena Koivusilta, for contributing their time and providing their valuable remarks. Their comments improved the quality of this work notably. I am also grateful to Adjunct Professor Sirpa Sarlio for accepting the role of an opponent at my thesis defence. I particularly wish to thank the Custos, Professor Tea Lallukka for her approachability and kindness and for all the quick responses and constructive feedback. I would also like to thank my thesis committee members Adjunct Professor Jouni Lahti and Antti Impinen, PhD, for their comments and encouragement in finalising this work. I want to express my gratitude to all the participants in the Doctoral Programme in Population, Health, and Living Conditions (VTE) seminar for giving me valuable comments on my work.

To my friends Sanna, Jyri, Laura and Antti, thank you for your friendship and support all those years.

Finally, my deepest gratitude goes to my family. To Ville, for being such a great brother and always being there for me. To my father Seppo, for your unconditional support throughout different phases of life. To my mom Lea, you have always believed in me and encouraged me to pursue my dreams. I have felt safe and loved. I am eternally grateful to your efforts. To my darling daughter Emma, for the blessing of being your mum. Your presence and joy of life has kept me grounded to what is truly important. Without you this work would not have been completed.

Helsinki, May 2023

Suvi Parikka

REFERENCES

Akkoyun-Farinez J, Omorou AY, Langlois J, Spitz E, Böhme P, Quinet M, et al. Measuring adolescents' weight socioeconomic gradient using parental socioeconomic position. Eur J Public Health 2018; 6: 1097-102. doi: 10.1093/eurpub/cky064.

Anderson PM and Butcher KE. Childhood obesity: trends and potential causes. Future Child 2006; 1: 19-45. doi: 10.1353/foc.2006.0001.

Arkes J. Longitudinal association between marital disruption and child BMI and obesity. Obesity (Silver Spring) 2012; 8: 1696-702. doi: 10.1038/oby.2012.84.

Asparouhov TM and Muthen B. Robust Chi Square Difference Testing with Mean and Variance Adjusted Test Statistics. Mplus Web Notes: No. 10, 2006.

Augustine J and Kimbro R. Associations and Intervening Mechanisms Between Family Structure and Young Children's Obesity. Journal of Family Issues 2015; 16: 2277-302. doi: 10.1177/0192513X15621344.

Baranowski T and Nader PR. Family health behaviour. New York: Wiley, 1986.

Barker D. Mothers, Babies and Health in Later Life. 2.edition ed. Edinburgh: Churchill Livingstone, 1998.

Barrett AE and Turner RJ. Family structure and mental health: the mediating effects of socioeconomic status, family process, and social stress. J Health Soc Behav 2005; 2: 156-69. doi: 10.1177/002214650504600203.

Berg N. Accumulation of Disadvantage from Adolescence to Midlife. A 26-Year Follow-Up Study of 16-Year Old Adolescents. Helsinki: Finnish Institute for Health and Welfare, 2017.

Berge JM, Hoppmann C, Hanson C, Neumark-Sztainer D. Perspectives about family meals from single-headed and dual-headed households: a qualitative analysis. J Acad Nutr Diet 2013; 12: 1632-9. doi: 10.1016/j.jand.2013.08.023 [doi].

Berge JM, Wall M, Hsueh T, Fulkerson JA, Larson N, Neumark-Sztainer D. The protective role of family meals for youth obesity: 10-year longitudinal associations. J Pediatr 2015; 2: 296-301. doi: S0022-3476(14)00777-X.

Berge JM, Wall M, Bauer KW, Neumark-Sztainer D. Parenting Characteristics in the Home Environment and Adolescent Overweight: A Latent Class Analysis. Obesity 2010; 4: 818-25. doi: 10.1038/oby.2009.324.

Blakely T, Cleghorn C, Mizdrak A, Waterlander W, Nghiem N, Swinburn B, Wilson N, Ni MC. The effect of food taxes and subsidies on population health and health costs: a modelling study. Lancet Public Health 2020; 7. doi: S2468-2667(20)30116-X.

Bramlett MD and Blumberg SJ. Family structure and children's physical and mental health. Health Aff (Millwood) 2007; 2: 549-58. doi: 26/2/549.

Buoncristiano M, Williams J, Simmonds P, Nurk E, Ahrens W, Nardone P et al. Socioeconomic inequalities in overweight and obesity among 6-to 9-year-old children in 24 countries from the World Health Organization European region. Obesity Reviews 2021; 22: e13213.

Burkill S, Waterhouse P, Pazzagli L. The association between family structure and children's BMI over time-the mediating role of income. Ann Epidemiol 2021;55: 83–90. doi: S1047-2797(20)30397-5.

Byrne LK, Cook KE, Skouteris H, Do M. Parental status and childhood obesity in Australia. Int J Pediatr Obes 2011; 5-6: 415-8. doi: 10.3109/17477166.2011.598938.

Bzostek SH and Beck AN. Familial instability and young children's physical health. Soc Sci Med 2011; 2: 282-92. doi: 10.1016/j.socscimed.2011.04.014.

Carlson MJ and Corcoran ME. Family Structure and Children's Behavioural and Cognitive Outcomes. Journal of Marriage and Family 2001; 3: 779-92. doi: 10.1111/j.1741-3737.2001.00779.x.

Caro JC, Smith-Taillie L, Ng SW, Popkin B. Designing a food tax to impact food-related non-communicable diseases: the case of Chile. Food Policy 2017: 86-100. doi: 10.1016/j.foodpol.2017.08.001.

Carper JL, Orlet Fisher J, Birch LL. Young girls' emerging dietary restraint and disinhibition are related to parental control in child feeding. Appetite 2000;35(2):121-9. doi: 10.1006/appe.2000.0343.

Chung A, Backholer K, Wong E, Palermo C, Keating C, Peeters A. Trends in child and adolescent obesity prevalence in economically advanced countries according to socioeconomic position: a systematic review. Obes Rev 2016; 3: 276-95. doi: 10.1111/obr.12360.

Cobb-Clark DA, Salamanca N and Zhu A. Parenting style as an investment in human development. J Popul Econ 2019; 32: 1315–1352. https://doi.org/10.1007/s00148-018-0703-2

Coleman L and Glenn F. The Varied Impact of Couple Relationship Breakdown on Children: Implications for Practice and Policy. Children & Society 2010; 3: 238-49. doi: 10.1111/j.1099-0860.2009.00289.x.

Commission on Social Determinants of Health. Closing the gap in a generation: health equity through action on the social determinants of health: final report: executive summary. Geneva: World Health Organization, 2008.

Currie J and Stabile M. Socioeconomic Status and Child Health: Why Is the Relationship Stronger for Older Children? Am Econ Rev 2003; 5: 1813-23. doi: 10.1257/000282803322655563.

Dahlgren G and Whitehead M. European Strategies for Tackling Social Inequities in Health: Levelling up Part 2. Copenhagen, WHO Regional office for Europe Copenhagen, 2006.

Dalla Valle M, Laatikainen T, Potinkara H, Nykänen P, Jääskeläinen J. Girls and Boys Have a Different Cardiometabolic Response to Obesity Treatment. Front Endocrinol (Lausanne) 2018; 579. doi: 10.3389/fendo.2018.00579.

Davison KK and Birch LL. Childhood overweight: a contextual model and recommendations for future research. Obes Rev 2001;2(3):159-71. doi: 10.1046/j.1467-789x.2001.00036.x.

de la Haye K, Robins G, Mohr P, Wilson C. How physical activity shapes, and is shaped by, adolescent friendships. Soc Sci Med 2011; 5: 719-28. doi: 10.1016/j.socscimed.2011.06.023.

de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C and Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. Bull World Health Organ 2007; 85: 660-667. Obes Rev 2001;2(3):159-71.

De Spiegelaere M, Dramaix M, Hennart P. The influence of socioeconomic status on the incidence and evolution of obesity during early adolescence. Int J Obes Relat Metab Disord 1998; 3: 268-74. doi: 10.1038/sj.ijo.0800581.

Demment MM, Haas JD, Olson CM. Changes in family income status and the development of overweight and obesity from 2 to 15 years: a longitudinal study. BMC Public Health 2014: 417.doi: 10.1186/1471-2458-14-417.

Djojosoeparto SK, Eykelenboom M, Poelman MP, van Stralen MM, Renders CM, Olthof MR, Steenhuis I, Kamphuis C on behalf of the PEN Consortium. Stakeholder views on the potential impact of a sugar-sweetened beverages tax on the budgets, dietary intake, and health of lower and higher socioeconomic groups in the Netherlands. Arch Public Health 2020; 1. doi: 10.1186/s13690-020-00507-x.

Duriancik D and Goff C. Children of single-parent households are at a higher risk of obesity: A systematic review. J Child Health Care 2019; 3: 358-69. doi: 10.1177/1367493519852463.

Elsenburg LK, van Wijk, Kim J E, Liefbroer AC, Smidt N. Accumulation of adverse childhood events and overweight in children: A systematic review and meta-analysis. Obesity (Silver Spring) 2017; 5: 820-32. doi: 10.1002/oby.21797.

Engberg E, Ray C, Määttä S, Figueiredo RAO, Leppänen MH, Pajulahti R, Koivusilta L, Korkalo L, Nissinen K, Vepsäläinen H, Sajaniemi N, Erkkola M, Roos E. Parental Happiness Associates With the Co-occurrence of Preschool-Aged Children's Healthy Energy Balance-Related Behaviours. J Happiness Stud 2022; 23: 1493–507. doi: 10.1007/s10902-021-00459-1.

Eriksson J, Forsén T, Tuomilehto J, Winter PD, Osmond C, Barker DJ. Catch-up growth in childhood and death from coronary heart disease: longitudinal study. BMJ 1999; 7181: 427-31. doi: 10.1136/bmj.318.7181.427.

Eriksson J, Forsén T, Tuomilehto J, Osmond C, Barker D. Fetal and childhood growth and hypertension in adult life. Hypertension 2000; 5: 790-4. doi: 10.1161/01.hyp.36.5.790.

Eriksson J, Ylihärsilä H, Kajantie E, Forsén T. Ohjelmoituvatko kansantautimme jo sikiökaudella ja varhaislapsuudessa? Suomen lääkärilehti 2003a: 3767-72.

Eriksson J, Forsén T, Tuomilehto J, Osmond C, Barker DJ. Early adiposity rebound in childhood and risk of Type 2 diabetes in adult life. Diabetologia 2003b; 2: 190-4. doi: 10.1007/s00125-002-1012-5.

Erkkola M, Kronberg-Kippilä C, Kyttälä P, Lehtisalo J, Reinivuo H, Tapanainen H, Veijola R, Knip M, Ovaskainen M-L, Virtanen S. Sucrose in the diet of 3-year-old Finnish children: sources, determinants and impact on food and nutrient intake. Br J Nutr 2009; 8: 1209-17. doi: 10.1017/S0007114508057619.

Erola J, Lehti H, Baier T, Karhula A. Socioeconomic Background and Gene–Environment Interplay in Social Stratification across the Early Life Course. Eur Sociol Rev 2021; 1: 1-17. J Happiness Stud 2022; 23: 1493–507. doi: 10.1093/esr/jcab026.

Ettinger AK, Riley AW, Price CE. Increasing Maternal Employment Influences Child Overweight/Obesity Among Ethnically Diverse Families. J Fam Issues 2018; 10: 2836-61. doi: 10.1177/0192513X18760968.

Fatima Y, Doi SAR, Mamun AA. Longitudinal impact of sleep on overweight and obesity in children and adolescents: a systematic review and bias-adjusted meta-analysis. Obes Rev 2015; 2: 137-49. doi: 10.1111/obr.12245.

Feng J, Glass TA, Curriero FC, Stewart WF, Schwartz BS. The built environment and obesity: a systematic review of the epidemiologic evidence. Health Place 2010; 2: 175-90. doi: 10.1016/j.healthplace.2009.09.008.

Fernandez-Alvira JM, te Velde SJ, De Bourdeaudhuij I, Bere E, Manios Y, Kovacs E, Jan N, Brug J, Luis AM. Parental education associations with children's body composition: mediation effects of energy balance-related behaviours within the ENERGY-project. Int J Behav Nutr Phys Act 2013; 10: 80. doi: 10.1186/1479-5868-10-80

Finnish National Agency for Education. Perusopetuksen opetussuunnitelman perusteet (Online). 2014. Available: https://www.oph.fi/sites/default/files/documents/perusopetuksen_opetussuunnitelman_perusteet_2014.pdf (Accessed 16.1.2023).

Fismen A, Smith ORF, Samdal O, Helleve A, Haug E. Associations between family structure and adolescents' food habits. Public Health Nutr 2022; 3: 702-9. doi: 10.1017/S1368980020004334.

Fitzgerald A, Heary C, Kelly C, Nixon E, Shevlin M. Self-efficacy for healthy eating and peer support for unhealthy eating are associated with adolescents' food intake patterns. Appetite 2013;63:48-58. doi:10.1016/j.appet.2012.12.011.

Flay BR, Hu FB, Siddiqui O, Day LE, Hedeker D, Petraitis J, Richardson J, Sussman S. Differential influence of parental smoking and friends' smoking on adolescent initiation and escalation of smoking. J Health Soc Behav 1994;35(3):248-65.

Fogelholm M, Närvänen E, Erkkola M, Lähteenmäki-Uutela A, Kaivonen I, Nikkola A, Sutinen, U-M, Uusitalo, L. Epäterveellisten elintarvikkeiden markkinointi lapsille ja nuorille: Tilanne Suomessa ja pelisääntöjä markkinoinnin säätelyyn. Valtioneuvoston kanslia, 2021.

Fomby P and Cherlin AJ. Family Instability and Child Well-Being. Am Sociol Rev 2007;72(2):181-204. doi: 10.1177/000312240707200203.

Formisano A, Hunsberger M, Bammann K, Vanaelst B, Molnar D, Moreno LA, Tornaritis M, Veidebaum T, Lissner L, Barba G, Siani A. Family structure and childhood obesity: results of the IDEFICS Project. Public Health Nutr 2014; 10: 2307-15. doi: 10.1017/S1368980013002474.

Franks PW, Hanson RL, Knowler WC, Sievers ML, Bennett PH, Looker HC. Childhood obesity, other cardiovascular risk factors, and premature death. N Engl J Med 2010; 6: 485-93. doi: 10.1056/NEJMoa0904130.

Freedman DS, Khan LK, Serdula MK, Dietz WH, Srinivasan SR, Berenson GS. The relation of childhood BMI to adult adiposity: the Bogalusa Heart Study. Pediatrics 2005; 1: 22-7. doi: 10.1542/peds.2004-0220.

Freeman E, Fletcher R, Collins CE, Morgan PJ, Burrows T, Callister R. Preventing and treating childhood obesity: time to target fathers.Int J Obes (Lond) 2012;36(1):12-5. doi:10.1038/ijo.2011.198.

Freistadt J and Strohschein L. Family Structure Differences in Family Functioning: Interactive Effects of Social Capital and Family Structure. J Fam Issues 2013; 34(7): 952–74. doi: 10.1177/0192513X12447054.

Fulkerson JA, Neumark-Sztainer D, Hannan PJ, Story M. Family meal frequency and weight status among adolescents: cross-sectional and 5-year longitudinal associations. Obesity (Silver Spring) 2008; 11: 2529-34. doi: 10.1038/oby.2008.388.

Garrido-Miguel M, Cavero-Redondo I, Álvarez-Bueno C, Rodríguez-Artalejo F, Moreno LA, Ruiz JR, Ahrens W, Martínez-Vizcaíno V. Prevalence and Trends of Overweight and Obesity in European Children From 1999 to 2016: A Systematic Review and Meta-analysis. JAMA Pediatr 2019 Oct 1;173(10):e192430. doi: 10.1001/jamapediatrics.2019.2430.

Gebremariam MK, Lien N, Nianogo RA, Arah OA. Mediators of socioeconomic differences in adiposity among youth: a systematic review. Obes Rev 2017; 8: 880-98. doi: 10.1111/obr.12547.

Gillman MW, Rifas-Shiman SL, Frazier AL, Rockett HR, Camargo CAJ, Field AE, Berkey CS, Colditz GA. Family dinner and diet quality among older children and adolescents. Arch Fam Med 2000; 3: 235-40. doi:10.1001/archfami.9.3.235.

Giskes K, Avendano M, Brug J, Kunst AE. A systematic review of studies on socioeconomic inequalities in dietary intakes associated with weight gain and overweight/obesity conducted among European adults. Obes Rev 2010; 6: 413-29. doi: 10.1111/j.1467-789X.2009.00658.x.

Goisis A, Özcan B, Van Kerm P. Do Children Carry the Weight of Divorce? Demography 2019; 3: 785-811. https://doi.org/10.1007/s13524-019-00784-4

Grapentine T. Path vs structural equation modeling do the relative merits of path analysis and structure equation modeling outweight their limitations? Discussion paper, 2000.

Häkkänen P. Overweight and obesity development and school health care interventions over primary school years. University of Helsinki, 2021.

Häkkänen P, But A, Ketola E, Laatikainen T. Weight transitions and psychosocial factors: A longitudinal cohort study of Finnish primary school children with overweight. Prev Med Rep 2020; 20:101239. doi: 10.1016/j.pmedr.2020.101239.

Hakulinen-Viitanen T, Hietanen-Peltola M, Hastrup A, Wallin M, Pelkonen M. Laaja terveystarkastus. Ohjeistus äitiys- ja lastenneuvolatoimintaan sekä kouluterveydenhuoltoon. THL, 2012.

Hallström L, Vereecken CA, Labayen I, Ruiz JR, Le Donne C, García MC, Gilbert CC, Martínez SG, Grammatikaki E, Huybrechts I, Kafatos A, Kersting M, Manios Y, Molnár D, Patterson E, Widhalm K, De Vriendt T, Moreno LA, Sjöström M: Breakfast habits among European adolescents and their association with sociodemographic factors: the HELENA (Healthy Lifestyle in Europe by Nutrition in Adolescence) study. Public Health Nutr 2012: 15; 1879-1889. doi:10.1017/S1368980012000341.

Hanifi R ja Nieminen T. Kaksi kotia 110 000 lapsella – joka kolmas asuu yhtä paljon molemmissa. Tieto ja trendit. Helsinki: Tilastokeskus, 2022.

Hankonen N, Absetz P, Haukkala A, Uutela A. Socioeconomic status and psychosocial mechanisms of lifestyle change in a type 2 diabetes prevention trial. Ann Behav Med 2009; 2: 160-5. doi: 10.1007/s12160-009-9144-1.

Haug E, Rasmussen M, Samdal O, Iannotti R, Kelly C, Borraccino A, Vereecken C, Melkevik O, Lazzeri G, Giacchi M, Ercan O, Due P, Ravens-Sieberer U, Currie C, Morgan A, Ahluwalia N, and the HBSC Obesity Writing Group. Overweight in school-aged children and its relationship with demographic and lifestyle factors: results from the WHO-Collaborative Health Behaviour in School-aged Children (HBSC) study. Int J Public Health 2009; Suppl 2: 167-79. doi: 10.1007/s00038-009-5408-6.

Hoppu U, Lehtisalo J, Tapanainen H, Pietinen P. Dietary habits and nutrient intake of Finnish adolescents. Public Health Nutr 2010; 6A: 965-72. doi: 10.1017/S1368980010001175.

Jääskeläinen A, Schwab U, Kolehmainen M, Pirkola J, Järvelin M, Laitinen J. Associations of meal frequency and breakfast with obesity and metabolic syndrome traits in adolescents of Northern Finland Birth Cohort 1986. Nutr Metab Cardiovasc Dis 2013; 10: 1002-9. doi: S0939-4753(12)00179-2 [pii].

Jääskeläinen S, Mäki P, Peltomäki H, Mäntymaa P. Lasten ja nuorten ylipaino ja lihavuus 2020. Helsinki: THL, 2021.

Jones A. Parental Socioeconomic Instability and Child Obesity. Biodemography Soc Biol 2018; 1: 15-29; doi: 10.1080/19485565.2018.1449630.

Jorgensen A, Pedersen TP, Meilstrup CR, Rasmussen M. The influence of family structure on breakfast habits among adolescents. Dan Med Bull 2011;58(5):A4262.

Juonala M, Magnussen CG, Berenson GS, Venn A, Burns TL, Sabin MA, Srinivasan SR, Daniels SR, Davis PH, Chen W, Sun C, Cheung M, Viikari J, Dwyer T, Raitakari O. Childhood adiposity, adult adiposity, and cardiovascular risk factors. N Engl J Med 2011; 20: 1876-85. doi: 10.1056/NEJMoa1010112.

Kaikkonen R, Mäki P, Hakulinen-Viitanen T, Markkula J, Wikström K, Ovaskainen M, Virtanen S, Laatikainen T. Health and well-being inequalities among children and their families. Lasten ja lapsiperheiden terveys- ja hyvinvointierot. Helsinki: THL, 2012.

Kakinami L, Gauvin L, Séguin L, Lambert M, Nikiema B, Paradis G. Persistent and occasional poverty and children's food consumption: evidence from a longitudinal Québec birth cohort. J Epidemiol Community Health. 2014; 10: 987-92. doi: 10.1136/jech-2014-203951.

Kantomaa MT, Tammelin TH, Nayha S, Taanila AM. Adolescents' physical activity in relation to family income and parents' education. Prev Med 2007; 5: 410-5. doi: 10.1016/j.ypmed.2007.01.008.

Karvonen S and Rahkonen O. Subjective social status and health in young people. Sociol Health Illn 2011; 3: 372-83. doi: 10.1111/j.1467-9566.2010.01285.x.

Kautiainen S, Koivisto AM, Koivusilta L, Lintonen T, Virtanen SM, Rimpela A. Sociodemographic factors and a secular trend of adolescent overweight in Finland. Int J Pediatr Obes 2009; 4: 360-70. doi: 10.3109/17477160902811173.

Keski-Rahkonen A, Kaprio J, Rissanen A, Virkkunen M, Rose RJ. Skipping breakfast and health-compromising behaviours in adolescents and adults. Eur J Clin Nutr 2003; 7: 842-53. doi: 10.1038/sj.ejcn.1601618.

Kestilä L ja Rahkonen O. Lapsuuden elinolot ja aikuisuuden terveys. In Laaksonen M and Silventoinen K (eds.) Sosiaaliepidemiologia: väestön terveyserot ja niihin vaikuttavat sosiaaliset tekijät. Helsinki: Gaudeamus Helsinki University Press, 2011.

Kestilä L. Pathways to health: determinants of health, health behaviour and health inequalities in early adulthood. Helsinki: National Public Health Institute, 2008.

Khalsa AS, Kharofa R, Ollberding NJ, Bishop L, Copeland KA. Attainment of '5-2-1-0' obesity recommendations in preschool-aged children. Prev Med Rep 2017: 79-87. doi: 10.1016/j.pmedr.2017.08.003.

Kiernan K, McLanahan S, Holmes J, Wright M. Fragile Families in the US and UK: Working Paper WP 11-04-FF, 2011.

Kjonniksen L, Torsheim T, Wold B. Tracking of leisure-time physical activity during adolescence and young adulthood: a 10-year longitudinal study. Int J Behav Nutr Phys Act 2008;5:69. doi:10.1186/1479-5868-5-69.

Knai C, Lobstein T, Darmon N, Rutter H, McKee M. Socioeconomic patterning of childhood overweight status in Europe. Int J Environ Res Public Health 2012; 4: 1472-89. doi: 10.3390/ijerph9041472.

Koletzko B,Toschke AM. Meal patterns and frequencies: do they affect body weight in children and adolescents? Crit Rev Food Sci Nutr 2010; 2: 100-5. doi: 10.1080/10408390903467431.

Kristiansen H, Roelants M, Bjerknes R, Juliusson PB. Norwegian children and adolescents in blended families are at risk of larger one-year BMI increments. Acta Paediatr 2020; 3: 587-94. doi: 10.1111/apa.15019.

Kuh D, Ben-Shlomo Y, Lynch J, Hallqvist J, Power C. Life course epidemiology. J Epidemiol Community Health 2003; 10: 778-83. doi: 10.1136/jech.57.10.778.

Lahelma E and Rahkonen O. Sosioekonominen asema. In Laaksonen M and Silventoinen K (eds.) Sosiaaliepidemiologia: väestön terveyserot ja niihin vaikuttavat sosiaaliset tekijät. Helsinki: Gaudeamus Helsinki University Press, 2011.

Lahelma E. Health and Social Stratification. Chichester: Wiley Blackwell, 2010.

Lahelma E, Martikainen P, Laaksonen M, Aittomäki A. Pathways between socioeconomic determinants of health. J Epidemiol Community Health 2004; 4: 327-32. doi: 10.1136/jech.2003.011148.

Laitinen J, Power C, Jarvelin MR. Family social class, maternal body mass index, childhood body mass index, and age at menarche as predictors of adult obesity. Am J Clin Nutr 2001; 3: 287-94.

Lajunen HR, Kaprio J, Rose RJ, Pulkkinen L, Silventoinen K. Genetic and environmental influences on BMI from late childhood to adolescence are modified by parental education. Obesity (Silver Spring) 2012; 3: 583-9. doi: 10.1038/oby.2011.304.

Lange D, Plachta-Danielzik S, Landsberg B, Müller MJ. Social inequality, migration, and healthy environments as determinants of overweight of children and adolescents. Results of the Kiel Obesity Prevention Study (KOPS). Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz 2010; 7: 707-15. doi: 10.1007/s00103-010-1081-4.

Larson N, MacLehose R, Fulkerson JA, Berge JM, Story M, Neumark-Sztainer D. Eating breakfast and dinner together as a family: associations with sociodemographic characteristics and implications for diet quality and weight status. J Acad Nutr Diet 2013; 12: 1601-9. doi: 10.1016/j.jand.2013.08.011.

Lazzeri G, Ahluwalia N, Niclasen B, Pammolli A, Vereecken C, Rasmussen M, Pedersen TP, Kelly C. Trends from 2002 to 2010 in Daily Breakfast Consumption and its Socio-Demographic Correlates in Adolescents across 31 Countries Participating in the HBSC Study. PLoS One 2016; 3. doi: 10.1371/journal.pone.0151052.

Leech RM, Worsley A, Timperio A, McNaughton SA. Understanding meal patterns: definitions, methodology and impact on nutrient intake and diet quality. Nutr Res Rev 2015 ;28(1):1-21. doi: 10.1017/S0954422414000262.

Lehto R, Ray C, Roos E. Longitudinal associations between family characteristics and measures of childhood obesity. Int J Public Health 2012; 3: 495-503. doi: 10.1007/s00038-011-0281-5.

Levesque AR, MacDonald S, Berg SA, Reka R. Assessing the Impact of Changes in Household Socioeconomic Status on the Health of Children and Adolescents: A Systematic Review. Adolesc Res Rev 2021;6(2):91-123. doi:10.1007/s40894-021-00151-8.

Levin KA, Kirby J, Currie C. Family structure and breakfast consumption of 11-15 year old boys and girls in Scotland, 1994-2010: a repeated cross-sectional study. BMC Public Health 2012;12:228. doi: 10.1186/1471-2458-12-228.

Lipek T, Igel U, Gausche R, Kiess W, Grande G. Obesogenic environments: environmental approaches to obesity prevention. J Pediatr Endocrinol Metab 2015; 5-6: 485-95. doi: 10.1515/jpem-2015-0127

Llewellyn CH. Genetic susceptibility to the "obesogenic" environment: the role of eating behaviour in obesity and an appetite for change. Am J Clin Nutr 2018; 3: 429-30. doi: 10.1093/ajcn/nqy210.

Lynch J and Kaplan G. Socioeconomic position. Oxford: Oxford Univesity Press, 2000.

Mackenbach J. Health inequalities. Persistence and change in European welfare states. Oxford: Oxford University Press, 2019.

Mackinnon DP, Lockwood CM, Williams J. Confidence Limits for the Indirect Effect: Distribution of the Product and Resampling Methods. Multivariate Behav Res 2004; 1: 99. doi: 10.1207/s15327906mbr3901_4.

Mäki P, Hakulinen-Viitanen T, Kaikkonen R, Koponen P, Ovaskainen M, Sippola R, Virtanen S, Laatikainen T, LATE työryhmä (toim.). Lasten terveys. LATE-tutkimuksen perustulokset lasten kasvusta, kehityksestä, terveydestä, terveystottumuksista ja kasvuympäristöstä. Yliopistopaino, Helsinki: THL, 2010.

Mäki P, Häkkänen P, Kinnunen M, Koivumäki T, Kuusipalo H, Männistö S. Kuntapäättäjänä rakennat terveyttä edistävää arkea lapsille, nuorille ja lapsiperheille. Helsinki: THL, 2022.

Mäki P, Ikonen R, Hedman L, Raulio S, Laatikainen T. Ylipainon ja elintapojen yhteys selittyy osittain nuoren sosioekonomisilla tekijöillä. Suomen Lääkärilehti 2021; 76.

Mäki P, Hedman L, Oksanen J, Levälahti E, Laatikainen T, Halme N. Nuorten ylipainon yhteys perheen sosiodemografisiin ja -ekonomisiin tekijöihin – Kouluterveyskyselyn tuloksia. Tutkimuksesta tiiviisti 29/2019. Helsinki: THL, 2019.

Manco M and Dallapiccola B. Genetics of pediatric obesity. Pediatrics 2012; 1: 123-33. doi: 10.1542/peds.2011-2717.

Marmot M. The Influence of Income on Health: Views of an Epidemiologist. Health Affairs 2002; 2: 31-46.

Martin MA, Lippert AM, Chandler KD, Lemmon M. Does mothers' employment affect adolescents' weight and activity levels? Improving our empirical estimates. SSM Popul Health 2018: 291-300. doi: 10.1016/j.ssmph.2018.03.003.

Mauskopf SS, O'Leary AK, Banihashemi A, Weiner M, Cookston JT. Divorce and eating behaviours: a 5-day within-subject study of preadolescent obesity risk. Child Obes 2015; 2: 122-9. doi: 10.1089/chi.2014.0053.

McCrory C, Leahy S, Ribeiro AI, Fraga S, Barros H, Avendano M, Vineis P, Layte R, for the LIFEPATH consortium. Maternal educational inequalities in measured body mass index trajectories in three European countries. Paediatr Perinat Epidemiol 2019; 3: 226-37. doi: 10.1111/ppe.12552.

McLanahan S and Percheski C. Family Structure and the Reproduction of Inequalities. Annual Review of Sociology 2008; 1: 257-76.

McLaren L. Socioeconomic status and obesity. Epidemiol Rev 2007; 29-48. doi: 10.1093/epirev/mxm001.

Meadows SO, McLanahan SS, Brooks-Gunn J. Stability and Change in Family Structure and Maternal Health Trajectories. Am Sociol Rev 2008; 2: 314-34. doi: 10.1177/000312240807300207.

Mekonnen T, Papadopoulou E, Arah OA, Brantsæter AL, Lien N, Gebremariam MK. Socioeconomic inequalities in children's weight, height and BMI trajectories in Norway. Sci Rep 2021; 1. doi: 10.1038/s41598-021-84615-w.

Merikukka M. Lapsuuden elinolojen yhteydet aikuisuuden hyvinvointiin: Kansallinen syntymäkohortti 1987 -rekisteritutkimus. Oulun yliopisto, 2020.

Miettinen A, Hakovirta M, Saarikallio-Torp M, Haapanen M, Kurki P, Kalliomaa-Puha L, Sihvonen E, Heinonen H-M, Kivistö N. Lasten vuoroasuminen ja sosiaaliturva: Vuoroasumisen nykytila ja merkitys etuus- ja palvelujärjestelmän kannalta. Valtioneuvoston kanslia, 2020.

Mikkilä V, Räsänen L, Raitakari OT, Pietinen P, Viikari J. Consistent dietary patterns identified from childhood to adulthood: the cardiovascular risk in Young Finns Study. Br J Nutr 2005; 6: 923-31. doi: 10.1079/bjn20051418.

Min J, Xue H, Wang Y. Association between household poverty dynamics and childhood overweight risk and health behaviours in the United States: a 8-year nationally representative longitudinal study of 16 800 children. Pediatr Obes 2018; 10: 590-7. doi: 10.1111/ijpo.12292.

Mollborn S and Lawrence E. Family, Peer, and School Influences on Children's Developing Health Lifestyles. J Health Soc Behav 2018; 1: 133-50. doi: 10.1177/0022146517750637.

Mollborn S, Domingue BW, Boardman JD. Norms as Group-Level Constructs: Investigating School-Level Teen Pregnancy Norms and Behaviours. Soc Forces 2014; 1: 241-67. doi: 10.1093/sf/sou063.

Monzani A, Ricotti R, Caputo M, Solito A, Archero F, Bellone S, Prodam F. A Systematic Review of the Association of Skipping Breakfast with Weight and Cardiometabolic Risk Factors in Children and Adolescents. What Should We Better Investigate in the Future? Nutrients 2019; 2. doi: 10.3390/nu11020387.

Moore JB and Fielding BA. Taxing confectionery, biscuits, and cakes to control obesity. BMJ 2019;366:l5298. doi: 10.1136/bmj.l5298.

Morgen CS, Mortensen LH, Rasmussen M, Andersen AN, Sørensen TIA, Due P. Parental socioeconomic position and development of overweight in adolescence: longitudinal study of Danish adolescents. BMC Public Health 2010;10:520. doi: 10.1186/1471-2458-10-520.

Mustajoki P. Obesogenic food environment explains most of the obesity epidemic. Duodecim 2015; 15: 1345-52.

National nutrition council. Eating together - food recommendations for families with children. Tampere, Finland: Juvenes Print Tampere. 2016.

Neumark-Sztainer D, Wall M, Fulkerson JA, Larson N. Changes in the frequency of family meals from 1999 to 2010 in the homes of adolescents: trends by sociodemographic characteristics. J Adolesc Health 2013; 2: 201-6. doi: 10.1016/j.jadohealth.2012.06.004.

Neumark-Sztainer D, Hannan PJ, Story M, Croll J, Perry C. Family meal patterns: associations with sociodemographic characteristics and improved dietary intake among adolescents. J Am Diet Assoc 2003; 3: 317-22. doi: 10.1053/jada.2003.50048.

Niemeier HM, Raynor HA, Lloyd-Richardson EE, Rogers ML, Wing RR. Fast food consumption and skipping breakfast: predictors of weight gain from adolescence to adulthood in a nationally representative sample. J Adolesc Health 2006;39(6):842-9. doi:10.1016/j.jadohealth.2006.07.001.

Ober P, Sobek C, Stein N, Spielau U, Abel S, Kiess W, Meigen C, Poulain T, Igel U, Lipek T, Vogel M. And yet Again: Having Breakfast Is Positively Associated with Lower BMI and Healthier General Eating Behaviour in Schoolchildren. Nutrients 2021; 4. doi: 10.3390/nu13041351.

O'Connell R, Owen C, Padley M, Simon A, Brannen J. Which Types of Family are at Risk of Food Poverty in the UK? A Relative Deprivation Approach. Social Policy and Society 2019;18(1):1-18. doi:10.1017/S1474746418000015.

Oddo VM and Jones-Smith JC. Gains in income during early childhood are associated with decreases in BMI z scores among children in the United States. Am J Clin Nutr 2015; 6: 1225-31. doi: 10.3945/ajcn.114.096693.

Official Statistics of Finland. Families [e-publication]. ISSN=1798-3231. Helsinki: Statistics Finland, 2020. (Accessed 2.1.2023)

Official Statistics of Finland. Income distribution statistics [e-publication]. Helsinki: Statistics Finland, 2018. (Accessed 2.1.2023)

Osborne C, Berger LM, Magnuson K. Family structure transitions and changes in maternal resources and well-being. Demography 2012; 1: 23-47; doi: 10.1007/s13524-011-0080-x.

Osborne C and McLanahan S. Partnership Instability and Child Well-Being. Journal of Marriage and Family 2007; 4: 1065-83. doi: 10.1111/j.1741-3737.2007.00431.x.

Palonen S. Ruoka- ja liikuntakasvatus varhaiskasvatuksessa. Varhaiskasvatustieteen kandidaatintutkielma. Jyväskylän yliopisto; 2018.

Park CL and Iacocca MO. A stress and coping perspective on health behaviours: theoretical and methodological considerations. Anxiety Stress Coping 2014; 2: 123-37. doi: 10.1080/10615806.2013.860969.

Pearson N, Biddle SJ, Gorely T. Family correlates of breakfast consumption among children and adolescents. A systematic review. Appetite 2009; 1: 1-7. doi: 10.1016/j.appet.2008.08.006.

Pedersen TP, Holstein BE, Damsgaard MT, Rasmussen M. Breakfast frequency among adolescents: associations with measures of family functioning. Public Health Nutr 2016; 9: 1552-64. doi: 10.1017/S1368980016000112.

Pedersen TP, Meilstrup C, Holstein BE, Rasmussen M. Fruit and vegetable intake is associated with frequency of breakfast, lunch and evening meal: cross-sectional study of 11-, 13-, and 15-year-olds. Int J Behav Nutr Phys Act 2012; 9. doi: 10.1186/1479-5868-9-9.

Poulsen PH, Biering K, Winding TN, Nohr EA, Andersen JH. How does childhood socioeconomic position affect overweight and obesity in adolescence and early adulthood: a longitudinal study. BMC Obes 2018. doi: 10.1186/s40608-018-0210-8.

Power C and Matthews S. Origins of health inequalities in a national population sample. Lancet 1997; 350(9091):1584-9. doi: S0140-6736(97)07474-6 [pii].

Quarmby T, Dagkas S, Bridge M. Associations between children's physical activities, sedentary behaviours and family structure: a sequential mixed methods approach. Health Educ Res 2011; 1: 63-76. doi: 10.1093/her/cyq071.

Rampersaud GC, Pereira MA, Girard BL, Adams J, Metzl JD. Breakfast habits, nutritional status, body weight, and academic performance in children and adolescents. J Am Diet Assoc 2005; 5. doi: S0002822305001513 [pii].

Reilly JJ and Kelly J. Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: systematic review. Int J Obes (Lond). 2011; 7: 891-8. doi: 10.1038/ijo.2010.222; 10.1038/ijo.2010.222.

Reiter SF, Hjorleifsson S, Breidablik H, Meland E. Impact of divorce and loss of parental contact on health complaints among adolescents. Journal of Public Health 2013; 2: 278-85.

Ristikari T, Keski-Säntti M, Sutela E, Haapakorva P, Kiilakoski T, Pekkarinen E, Kääriälä A, Aaltonen M, Huotari T, Merikukka M, Salo J, Juutinen A, Pesonen-Smith A ja Gissler M. Suomi lasten kasvuympäristönä. Kahdeksantoista vuoden seuranta vuonna 1997 syntyneistä [Finland as a growth environment for children. 18-year follow-up of those born in Finland 1997]. Finnish Institute for Health and Welfare (THL). Report 7/2018. Finnish Youth research network/ Finnish youth research society, publications 210. Helsinki, Finland 2018.

Rokholm B, Silventoinen K, Ängquist L, Skytthe A, Kyvik KO, Sørensen TIA. Increased genetic variance of BMI with a higher prevalence of obesity. PLoS One 2011; 6. doi: 10.1371/journal.pone.0020816.

Roos E, Pajunen T, Ray C, Lynch C, Kristiansdottir AG, Halldorsson TI, Thorsdottir I, te Velde SJ, Krawinkel M, Behrendt I, Vaz de Almeida MD, Franchini B, Papadaki A, Moschandreas J, Ribič CH, Petrova S, Duleva S, Simčič I, Yngve A. Does eating family meals and having the television on during dinner correlate with overweight? A sub-study of the PRO GREENS project, looking at children from nine European countries. Public Health Nutr 2014; 11: 2528-36. doi: 10.1017/S1368980013002954.

Saari A, Sankilampi U, Hannila ML, Kiviniemi V, Kesseli K and Dunkel L. New Finnish growth references for children and adolescents aged 0 to 20 years: Length/height for-age, weight-for-length/height, and body mass index-for-age. Ann Med 2011;43: 235-248.

Sahoo K, Sahoo B, Choudhury AK, Sofi NY, Kumar R, Bhadoria AS. Childhood obesity: causes and consequences. J Family Med Prim Care 2015; 2: 187-92. doi: 10.4103/2249-4863.154628.

Sallis JF and Owen N. Ecological models of health behaviour. In Glanz K, Rimer BK and Viswanath K (eds.). Health behaviour: Theory, research, and practice. US: Jossey-Bass/Wiley, 2015, pp. 43–64.

Sares-Jäske L, Grönqvist A, Mäki P, Tolonen H, Laatikainen T. Family socioeconomic status and childhood adiposity in Europe - A scoping review. Prev Med 2022: 107095. doi: 10.1016/j.ypmed.2022.107095.

Scharte M, Bolte G, for the GME Study Group. Increased health risks of children with single mothers: the impact of socio-economic and environmental factors. Eur J Public Health 2012; 3: 469-75. doi: 10.1093/eurpub/cks062.

Schmeer KK. Family structure and obesity in early childhood. Soc Sci Res 2012; 4: 820-32.

Schmidt CO and Kohlmann T. When to use the odds ratio or the relative risk? Int J Public Health 2008; 53: 165–167. https://doi.org/10.1007/s00038-008-7068-3

Shrewsbury V and Wardle J. Socioeconomic status and adiposity in childhood: a systematic review of cross-sectional studies 1990-2005. Obesity (Silver Spring). 2008; 2: 275-84. doi: 10.1038/oby.2007.35; 10.1038/oby.2007.35.

Silventoinen K, Hasselbalch AL, Lallukka T, Bogl L, Pietiläinen KH, Heitmann BL, Schousboe K, Rissanen A, Kyvik KO, Sørensen T, Jaakko Kaprio. Modification effects of physical activity and protein intake on heritability of body size and composition. Am J Clin Nutr 2009; 4: 1096-103. doi: 10.3945/ajcn.2009.27689.

Sisson SB, Sheffield-Morris A, Spicer P, Lora K, Latorre C. Influence of family structure on obesogenic behaviours and placement of bedroom TVs of American children: National Survey of Children's Health 2007. Prev Med 2014; 48-53. doi: S0091-7435(14)00027-9 [pii].

Sjöberg A, Hallberg L, Höglund D, Hulthén L. Meal pattern, food choice, nutrient intake and lifestyle factors in The Göteborg Adolescence Study. Eur J Clin Nutr 2003; 12: 1569-78. doi: 10.1038/sj.ejcn.1601726.

Skafida V and Treanor MC. Do changes in objective and subjective family income predict change in children's diets over time? Unique insights using a longitudinal cohort study and fixed effects analysis. J Epidemiol Community Health 2014; 6: 534-41. doi: 10.1136/jech-2013-203308.

Stahlmann K, Hebestreit A, DeHenauw S, Hunsberger M, Kaprio J, Lissner L, Molnár D, Ayala-Marín AM, Reisch LA, Russo P, Tornaritis M, Veidebaum T, Pohlabeln H, Bogl LH. A cross-sectional study of obesogenic behaviours and family rules according to family structure in European children. International Journal of Behavioural Nutrition and Physical Activity 2020; 1: 32. doi: 10.1186/s12966-020-00939-2.

Stewart SD and Menning CL. Family structure, nonresident father involvement, and adolescent eating patterns. J Adolesc Health 2009; 2: 193-201. doi: 10.1016/j.jadohealth.2009.01.005.

Swinburn B, Egger G and Raza F. Dissecting obesogenic environments: the development and application of a framework for identifying and prioritizing environmental interventions for obesity. Prev Med 1999; 563-70. doi: S0091-7435(99)90585-6 [pii].

Swinburn B, Sacks G and Ravussin E. Increased food energy supply is more than sufficient to explain the US epidemic of obesity. Am J Clin Nutr 2009; 6: 1453-6. doi: 10.3945/ajcn.2009.28595.

Szajewska H and Ruszczyński M. Systematic Review Demonstrating that Breakfast Consumption Influences Body Weight Outcomes in Children and Adolescents in Europe. Critical Reviews in Food Science and Nutrition 2010; 2: 113-9. doi: 10.1080/10408390903467514.

Tandon PS, Zhou C, Sallis JF, Cain KL, Frank LD, Saelens BE. Home environment relationships with children's physical activity, sedentary time, and screen time by socioeconomic status. Int J Behav Nutr Phys Act 2012. doi: 10.1186/1479-5868-9-88; 10.1186/1479-5868-9-88.

Tarkiainen L, Martikainen P, Laaksonen M, Valkonen T. Trends in life expectancy by income from 1988 to 2007: decomposition by age and cause of death. J Epidemiol Community Health 2012; 7: 573-8. doi: 10.1136/jech.2010.123182 [doi].

Taveras EM, Rifas-Shiman SL, Berkey CS, Rockett HRH, Field AE, Frazier AL, Colditz GA, Gillman MW. Family dinner and adolescent overweight. Obes Res 2005; 5: 900-6. doi: 10.1038/oby.2005.104. PMID: 15919844.

THL, VRN. Makeis-, jäätelö- ja virvoitusjuomavero tulisi muuttaa terveysperusteiseksi koskemaan laajemminkin lisättyä sokeria. 2015.

Thomas R, Siliquini R, Hillegers MH, Jansen PW. The association of adverse life events with children's emotional overeating and restrained eating in a population-based cohort. Int J Eat Disord 2020; 10: 1709-18; doi: 10.1002/eat.23351.

Thomson E, Hanson TL, McLanahan SS. Family structure and child well-being: Economic resources vs. parental behaviours. Social forces 1994; 1: 221-42.

Thomson E and McLanahan SS. Reflections on family structure and child well-being: Economic resources vs. parental socialization. Social Forces 2012; 1: 45-53.

Tilles-Tirkkonen T, Pentikäinen S, Lappi J, Karhunen L, Poutanen K, Mykkänen H. The quality of school lunch consumed reflects overall eating patterns in 11-16-year-old schoolchildren in Finland. Public Health Nutr 2011; 12: 2092-8. doi: 10.1017/S1368980011001388.

Timlin MT, Pereira MA, Story M, Neumark-Sztainer D. Breakfast eating and weight change in a 5-year prospective analysis of adolescents: Project EAT (Eating Among Teens). Pediatrics 2008; 3: 638. doi: 10.1542/peds.2007-1035.

Toschke AM, Thorsteinsdottir KH, von Kries R, GME Study Group. Meal frequency, breakfast consumption and childhood obesity. Int .J .Pediatr .Obes . 2009; 4: 242-8; doi: 10.3109/17477160902763341.

Toschke AM, Küchenhoff H, Koletzko B, Kries R. Meal Frequency and Childhood Obesity. Obesity 2005; 11: 1932-8. doi: 10.1038/oby.2005.238.

Townsend P and Davidson N. Inequalities in health: The Black Report. London 1982, Penguin.

Valdés J, Rodríguez-Artalejo F, Aguilar L, Jaén-Casquero MB, Royo-Bordonada MÁ. Frequency of family meals and childhood overweight: a systematic review. Pediatr Obes 2013; 1: e1-e13. doi: 10.1111/j.2047-6310.2012.00104.x.

van Ansem WJ, Schrijvers CT, Rodenburg G, van de Mheen D. Maternal educational level and children's healthy eating behaviour: role of the home food environment (cross-sectional results from the INPACT study). Int J Behav Nutr Phys Act 2014; doi: 10.1186/s12966-014-0113-0 [doi].

Van Lippevelde W, Te Velde SJ, Verloigne M, Van Stralen MM, De Bourdeaudhuij I, Manios Y, Bere E, Vik FN, Jan N, Fernández Alvira JM, Chinapaw MJ, Bringolf-Isler B, Kovacs E, Brug J, Maes L. Associations between family-related factors, breakfast consumption and BMI among 10- to 12-year-old European children: the cross-sectional ENERGY-study. PLoS One 2013; 11. doi: 10.1371/journal.pone.0079550 [doi].

Vandenbroeck P, Goossens J, Clemens M. Foresight Tackling Obesities: Future Choices — Obesity System Atlas, 2007. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/295153/07-1177-obesity-system-atlas.pdf (Accessed 16.1.2023).

Verduci E, Bronsky J, Embleton N, Gerasimidis K, Indrio F, Köglmeier J, de Koning B, Lapillonne A, Moltu SJ, Norsa L, Domellöf M; ESPGHAN Committee on Nutrition. Role of Dietary Factors, Food Habits, and Lifestyle in Childhood Obesity Development: A Position Paper From the European Society for Paediatric Gastroenterology, Hepatology and Nutrition Committee on Nutrition. J Pediatr Gastroenterol Nutr 2021; 5: 769-83; doi: 10.1097/MPG.0000000000003075.

Vereecken C, Dupuy M, Rasmussen M, Kelly C, Nansel TR, Al Sabbah H, et al. Breakfast consumption and its socio-demographic and lifestyle correlates in schoolchildren in 41 countries participating in the HBSC study. Int J Public Health 2009: 180-90. doi: 10.1007/s00038-009-5409-5 [doi].

Vik FN, Overby NC, Lien N, Bere E. Number of meals eaten in relation to weight status among Norwegian adolescents. Scand J Public Health 2010; 5 Suppl: 13-8. doi: 10.1177/1403494810378920 [doi].

Vik FN, Bjørnarå HB, Overby NC, Lien N, Androutsos O, Maes L, Jan N, Kovacs E, Moreno LA, Dössegger A, Manios Y, Brug J, Bere E. Associations between eating meals, watching TV while eating meals and weight status among children, ages 10-12 years in eight European countries: the ENERGY cross-sectional study. Int J Behav Nutr Phys Act 2013. doi: 10.1186/1479-5868-10-58.

Viner RM, Ozer EM, Denny S, Marmot M, Resnick M, Fatusi A, Currie C. Adolescence and the social determinants of health. The Lancet 2012; 9826: 1641-52. doi: 10.1016/S0140-6736(12)60149-4.

Vuorenmaa M, Mäki P, Kauppala T. Lasten ja nuorten ylipaino ja lihavuus 2021 - Lasten ja nuorten ylipainon yleisyydessä ei muutosta vuosien 2020 ja 2021 välillä – yleisyys edelleen korkealla tasolla. Helsinki: THL. 2022.

Wadolowska L, Hamulka J, Kowalkowska J, Ulewicz N, Gornicka M, Jeruszka-Bielak M, Kostecka M, Wawrzyniak A. Skipping Breakfast and a Meal at School: Its Correlates in Adiposity Context. Report from the ABC of Healthy Eating Study of Polish Teenagers. Nutrients 2019; 7. doi: 10.3390/nu11071563.

Wang Y and Lim H. The global childhood obesity epidemic and the association between socio-economic status and childhood obesity. Int Rev Psychiatry 2012; 3: 176-88. doi: 10.3109/09540261.2012.688195.

Wijtzes AI, Jansen W, Jaddoe VW, Franco OH, Hofman A, van Lenthe FJ, Raat H. Social Inequalities in Young Children's Meal Skipping Behaviours: The Generation R Study. PLoS One. 2015; 7. doi: 10.1371/journal.pone.0134487.

Wikström K, Lindström J, Tuomilehto J, Saaristo TE, Korpi-Hyövälti E, Oksa H, Vanhala M, Niskanen L, Keinänen-Kiukaanniemi S, Uusitupa M, Peltonen M. Socio-economic differences in dysglycemia and lifestyle-related risk factors in the Finnish middle-aged population. Eur J Public Health 2011; 6: 768-74. doi: 10.1093/eurpub/ckq164.

Wolch J, Jerrett M, Reynolds K, McConnell R, Chang R, Dahmann N, Brady K, Gilliland F, Su JG, Berhane K. Childhood obesity and proximity to urban parks and recreational resources: a longitudinal cohort study. Health Place 2011; 1: 207-14. doi: 10.1016/j.healthplace.2010.10.001.

World Health Organization (WHO). Growth reference data for 5-19 years. (Online). WHO, 2007. Available: https://www.who.int/growthref/en/ (Accessed 16.1.2023).

World Health Organization (WHO). Population-based approaches to childhood obesity prevention. WHO, 2012.

World Health Organisation (WHO). Assessment of the impact of a public health product tax. Final report. The Regional Office for Europe, 2016.

World Health Organization (WHO). Growing up unequal: gender and socioeconomic differences in young people's health and well-being. Regional Office for Europe, 2016.

World Health Organisation (WHO). Obesity and overweight. 2021.

Xu L, Dubois L, Burnier D, Girard M, Prud'homme D. Parental overweight/obesity, social factors, and child overweight/obesity at 7 years of age. Pediatr Int. 2011; 6: 826-31. doi: 10.1111/j.1442-200X.2011.03374.x.

Yannakoulia M, Papanikolaou K, Hatzopoulou I, Efstathiou E, Papoutsakis C, Dedoussis GV. Association between family divorce and children's BMI and meal patterns: the GENDAI Study. Obesity (Silver Spring) 2008; 6: 1382-7. doi: 10.1038/oby.2008.70.

Yelick A. The Effects of Family Structure on Consumption and Exercise Patterns for Adolescent Youth. Child Adolescent Soc Work J 2017; 4: 381-95. doi: 10.1007/s10560-016-0468-y.

Yoshikawa H, Aber JL, Beardslee WR. The effects of poverty on the mental, emotional, and behavioural health of children and youth: implications for prevention. Am Psychol 2012; 4: 272-84. doi: 10.1037/a0028015.

APPENDIX 1. PREVIOUS STUDIES OF CHILDHOOD OVERWEIGHT – MEAL PATTERNS ASSOCIATIONS

Study	Country	Study design	Age range, years	Overweight measure	Meal variable	Study period	Study participants	Main findings
Keski-Rahkonen et al. 2003	Finland	Cohort trial, postal survey for twins and their parents	16 years	self-reported height and weight, BMI	skipping breakfast	1991-1995	16-y-old girls and boys (n=5448) and their parents (n=4660)	Smoking, infrequent exercise, a low education level at 16, female sex, frequent alcohol use, behavioural disinhibition, and high body mass index (BMI) were significantly associated with adolescent breakfast skipping.
Mäki et al. 2021	Finland	Cross-sectional study, child-reported questionnaires administered in school classrooms	14-17 years	self-reported height and weight, BMI	skipping breakfast, skipping school lunch	2019	nationally representative sample of 14-15-y-old boys and girls (n=89 570), 16-17-y-old boys and girls (n=69 683)	Overweight was associated with skipping breakfast. The association remained statistically significant when socioeconomic background factors of the family were taken into account.
Monzani et al. 2019	37 studies from European, Asian, African and American countries	Systematic review of 32 cross-sectional postal surveys/health interviews, 5 longitudinal parent-reported surveys	2-18 years	measured/ self-reported/ parent-reported, BMI	skipping breakfast	2008-2018	286 804 children and adolescents living in 33 countries	Children and adolescents who skip breakfast are at higher risk to be or become overweight/obese. The lack of association was shown mainly in infants.
Rampersaud et al. 2005	United States, UK, Australia, South Africa, Saudi-Arabia, Czech Republic, Spain, Sweden, Finland	Systematic review of 18 cross-sectional and 1 longitudinal studies with postal survey/ self-reported questionnaire/ health and diet interview	1-19 years	measured/ self-reported/ parent-reported height and weight	skipping breakfast	1970-2004	around 74 000 children and adolescents	Skipping breakfast is a common behaviour observed in overweight or obese children and adolescents and may be related to dieting and disordered eating habits.

Haug et al. 2009	41 countries participating in the WHO Collaborative HBSC survey	Cross-sectional study, child-reported questionnaires administered in school classrooms	11-, 13-, and 15-year-olds from 41 countries	self-reported height and weight	daily breakfast consumption	2005-2006	nationally representative samples in 41 countries (n=171 809).	Overweight was consistently negatively associated with breakfast consumption
Timlin et al. 2008	United States	5-year longitudinal study, in-class child-reported Food Frequency Questionnaire and health examination	15 years (time 1), 19 years (time 2)	measured height and weight, BMI	breakfast frequency during a week	1998-1999 (time 1) and 2003-2004 (time 2)	4746 students	At times 1 and 2, independent inverse associations between breakfast frequency and BMI was found. In prospective age and gender adjusted analyses, the breakfast frequency was inversely associated with weight gain.
Niemeier et al. 2006	United States	Longitudinal school-based study with questionnaire and health examination	11–21 years (time 1) and 18–27 years (time 2)	measured height and weight, BMI	daily breakfast consumption	1996 (time 1), 2001-2002 (time 2)	9919 adolescents	Fast food consumption and skipping breakfast are associated with increased weight gain from adolescence to adulthood.
Ober et al. 2021	Germany	Cross-sectional study, child-reported in-class questionnaire and health examination, parent-reported survey	9-15 years	measured height and weight, BMI	school-related meal patterns, regular skipping breakfast	2018-2019	1215 children, 1037 parents	Children who regularly skipped breakfast showed stronger association with overweight than children who skipped breakfast only occasionally. The associations persisted after controlling for parental SEP and weight status.
Wadolowska et al. 2019	Poland	Cross-sectional study, child-reported in-class questionnaire and health examination	11-13 years	measured weight, height, and waist circumference, BMI	skipping breakfast and a meal at school	2015-2016	1566 children	In comparison to ”never-skippers,” ”frequent breakfast skippers” were more likely to be overweight/obese and centrally obese, while skippers a few times a week of both of these meals were more likely to be overweight/obese.

Study	Country	Study design	Age range, years	Overweight measure	Meal variable	Study period	Study participants	Main findings
Szajewska and Ruszczynski 2010	European countries	Systematic review of 16 cross-sectional studies or cohort trials			breakfast consumption, skipping breakfast		59 000 children/ adolescents from Europe	Breakfast has a protective effect against becoming overweight or obese. One trial showed that this effect was significant only for boys. Four studies showed an increase in BMI in breakfast skippers. In one study, this effect was significant only for boys.
Van Lippevelde et al. 2013	Belgium, Greece, Hungary, the Netherlands, Norway, Slovenia, Spain, and Switzerland	Cross-sectional study, questionnaire and anthropometric data collected from students in classrooms, parent-reported questionnaire	10-12 years	measured weight and height, BMI	breakfast consumption (child-reported), parental breakfast consumption (parent-reported)	2010	6374 children, 6374 parents	Permissiveness concerning skipping breakfast, negotiating about breakfast, and family breakfast frequency were associated with children's zBMI. Breakfast frequency was negatively associated with the BMI-z-score.
Roos et al. 2013	Sweden, the Netherlands, Iceland, Germany, Finland, Portugal, Greece, Bulgaria and Slovenia	Cross-sectional study, child-reported in-class questionnaire, parent-reported in-home questionnaire	11 years	parent-reported weight and height, BMI	family breakfast and dinner	2009	6316 children	In Northern Europe, children having a family breakfast or dinner less than once weekly were more likely to be overweight. No association was found in the Southern and Eastern European countries.
Gillman et al. 2000	United States	Cross-sectional study, parent-reported postal survey	9–14 years	self-reported weight and height, BMI	family dinner frequency	2000-2002	16 202 children	A modest inverse association between age-adjusted BMI and family dinner frequency.
Taveras et al. 2005	United States	Cross-sectional study, parent-reported postal survey	9–14 years	self-reported weight and height, BMI	family dinner frequency	1996	14 431 children	The odds of being overweight were significantly lower among youth who reported eating family dinner most or every day in a typical week during the past year. Family SEP was controlled for.

Fulkerson et al. 2008	United States	5-year longitudinal study, in-class survey in baseline, child-reported postal survey in follow-up	ca 11-18 years	self-reported weight and height, BMI	number of family meals during a week	1999-2004	2516 adolescents	In cross-sectional models, inverse associations between family meal frequency and overweight were observed for females. Longitudinal associations were not significant. Neither cross-sectional nor longitudinal associations were significant for males.
Berge et al. 2015	United States	Cross-sectional study, in-home anthropometric data, parent-reported survey	2-5 years	measured weight and height, BMI	family meal frequency by meal types: breakfast, dinner, lunch	2012-2014	1134 children, 1134 parents	Family meal frequency by meal type was not associated with BMI percentile for non-Hispanic or Hispanic preschool children.
Larson et al. 2013	United States	Cross-sectional study, questionnaire collected from students in classrooms, health examination for children	ca 11-18 years	measured weight and height, BMI	family breakfast and family dinner frequency	2009-2010	2793 adolescents	Family breakfast frequency was associated with better diet quality (such as higher intake of fruit, whole grains, and fiber) and lower risk for overweight/obesity.
Valdes et al. 2013	United States, Canada, New Zealand, Korea and Japan	11 cross-sectional studies, 4 longitudinal studies	0-18 years	measured/ self-reported/ parent-reported weight and height	great variability regarding the measurement of family meal frequency	2005–2012	not accounted	The review found inconsistent and weak evidence of an inverse association between family meal frequency and risk of childhood overweight.
Lee et al 2016	South Korea	Cross-sectional study, postal survey for children and their parents	5-11 years	self-reported/ parent-reported weight and height, BMI	family breakfast and family dinner frequency	2008-2012	2904 children	Having family meals three or more times per week was associated with a 12% reduction in children and adolescent overweight risk.
Vik et al. 2010	Norway	Cross-sectional study, in-class questionnaire	14-16 years	self-reported weight and height, BMI	number of meals (four meals a day)	2005	2870 children	Number of meals eaten was associated with being overweight. Those children who ate four meals a day were less likely to be overweight than those who ate two or three meals.

Study	Country	Study design	Age range, years	Overweight measure	Meal variable	Study period	Study participants	Main findings
Jääskeläinen et al. 2013	Finland	Longitudinal 16 year follow-up study, postal survey filled by children and parents, health examination	16 years	measured weight, height and waist circumference, BMI	number of meals (five meals a day)	2001-2002	6247 adolescents	After adjustment for early life factors, the five-meal-a-day pattern was associated with reduced risks of overweight/obesity in both genders.
Toschke et al. 2005	Germany	Cross-sectional study, parent-reported questionnaire, health examination for children	5-6 years	measured weight, height and waist circumference, BMI	number of meals (five meals or more)	2001-2002	4370 children	A protective effect of an increased daily meal frequency (five meals or more) on obesity in children was observed and appeared to be independent of other risk factors for childhood obesity.