



The transition from school to work life

Educational attainment and work environment
in a Danish youth cohort

PhD dissertation

Trine Nøhr Winding

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- II. Winding TN, Andersen JH, Labriola M, Nohr EA. Initial non-participation and loss to follow-up in a Danish youth cohort: implications for relative risk estimates. *J Epidemiol Community Health* 2014;68(2):137-144
- III. Winding TN, Labriola M, Nohr EA, Andersen JH. Risk factors for poor work environment among young workers (*submitted*)

Preface

This PhD thesis is based on studies carried out between 2011 and 2014 during my employment at the Department of Occupational Medicine, Regional Hospital West Jutland.

I wish to express my gratitude to all those who made this work possible.

First of all, I would like to thank the participants in the Vestliv cohort who have contributed by answering the comprehensive questionnaire material and The Danish Working Environment Research Fund for financial support.

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Trine Nøhr Winding
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Abbreviations

AAR:	The Academic Achievement Register
ATC:	Anatomical Therapeutic Chemical
BMI:	Body mass index
CES-DC:	The Center for Epidemiologic Studies Depression Scale for Children
CI:	Confidence interval
COPSOQ:	The Copenhagen Psychosocial Questionnaire
CPR:	Central Person Register
CRS:	Danish Civil Registration System
DER:	Danish Education Registers
DMQ:	Dutch Musculoskeletal Questionnaire
DRPIT:	Danish Registers on Personal Income and Transfer payments
ERI:	The effort-reward imbalance model
OR:	Odds ratio
P:	Prevalence
PD:	The Prescription Database
PER:	Population's Education Register
PR:	Prevalence ratio
ROR:	Relative odds ratio
SD:	Standard deviation
SF-36:	The Short Form (36) Health Survey
SOC:	Sense of coherence

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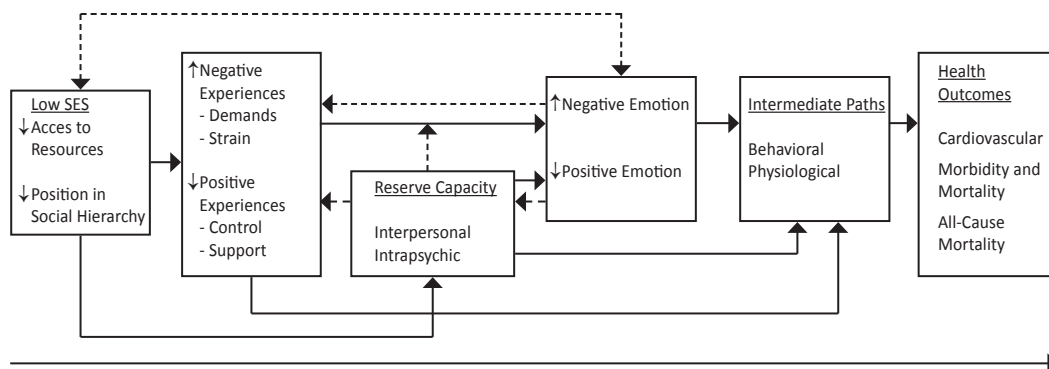
1. Introduction

Inequality in health is a result of complex circumstances, and life contains a series of critical transitions which can affect health and well-being by pushing people onto a more or less advantaged path (1). Childhood is a vulnerable period where the family's socioeconomic status as well as the psychological and cognitive development of the child affect later social status and health (2,3). In adolescence and among young adults, educational achievements as well as inclusion to the labour market are both critical transitions and important determinants of later development of inequality in health (1,2,4,5).

Those who have been disadvantaged from the beginning of their lives are at the greatest risk at each subsequent transition, and therefore it is important to study social inequality in health in a life-course perspective (6).

The Reserve Capacity Model illustrates the complex associations between socioeconomic status, personal and social resources, psychosocial and emotional experiences, and later development of health problems (Figure 1).

Figure 1. The Reserve Capacity Model



Gallo LC; Bogart LM; Vranceanu AM; Matthews KA. Socioeconomic status, resources, psychological experiences, and emotional responses: a test of the reserve capacity model. *J Pers Soc Psychol* 2005 Feb;88(2):386-99 (8).

It emphasises the importance of integrating these different aspects into the same methodological framework when trying to understand the association between socioeconomic status and health (7).

It should be noted that it is not the objective of this thesis and related papers to study social inequalities of health per se but to address some of the potential determinants which eventually can lead to poor health outcomes. Some of the strongest determinants of health are structural factors such as national wealth, income inequality, and access to education (9). To do well in the Danish well-fare system, it is essential to succeed in the educational system as well as on the labour market, and in a Danish report on determinants of inequality in a lifetime perspective, two of the twelve highlighted determinants were lack of educational attainment at age 9–18 and poor physical and psychosocial work environment at age 19–44 (2,10).

Addressing inequality in young people's educational attainment and work conditions has multiple potential benefits that extend beyond reductions in health inequalities. It will enable young people to maximise their capabilities, gain control over their lives, and eventually be able to participate equally in society (11).

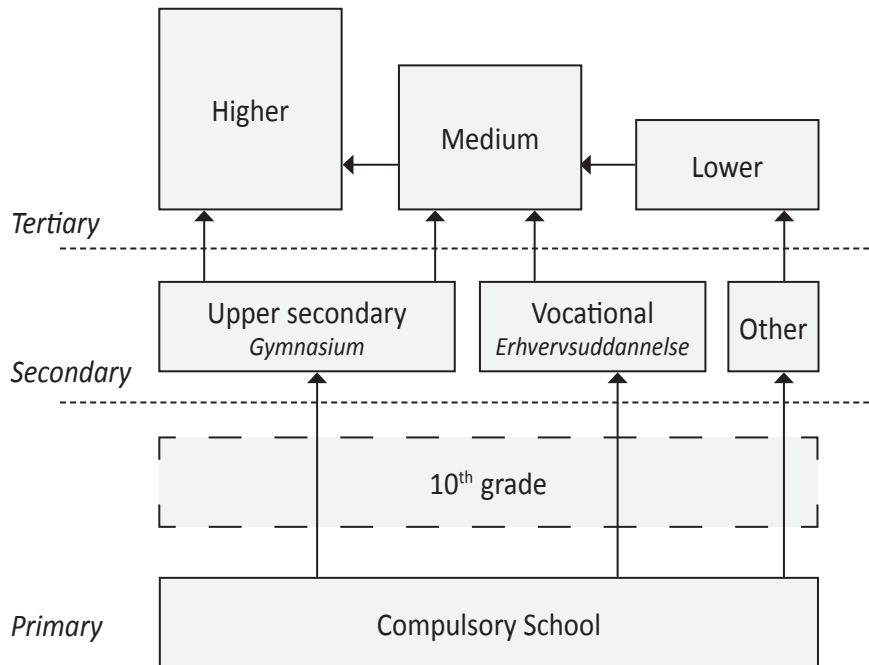
2. Background

The Danish educational system

The basic structure of the Danish educational system is outlined in Figure 2. It is characterised by three levels: primary/compulsory school consisting of 9 years required schooling, with an additionally optional 10th year and secondary education consisting primarily of two tracks, an upper secondary school academic track of 3 years (gymnasium in Danish) and vocational education (erhvervsuddannelse in Danish). Vocational education lasts between 2 and 4 years and typically is a mixture of theoretical courses at branch-specific schools and practical training in apprenticeships. The tertiary educations can be divided into short, medium and long durations and represent a variety of different types of education (12). Most young people in Denmark finish compulsory school at age 16 and secondary school around age 19.

The broad term secondary education was chosen instead of the term high school, because the precise stage of schooling provided by a high school varies considerable across countries and sometimes high school only refers to upper secondary education and not vocational education. When included studies have used the term high school, it will be referred to as such.

Figure 2. An outline of the Danish educational system



Educational attainment

In general, the educational level in Denmark has increased during the last 30 years. Today, only 21% of the adult population has compulsory school as their highest education (13). For young people to be able to meet the demands in work life, education is a key word. The need for unskilled workers is decreasing in the Danish labour market (14), and across OECD countries people with low educational attainment are less likely to be participants in the work force and more likely to be unemployed compared to people with high educational attainment (15). Furthermore, a widening social inequality in expected lifetime between those with secondary education and those with no secondary education has been reported during recent years (16).

A major transition in the Danish educational system is the one from compulsory school to secondary education (17,18), where the first critical differentiation of young people takes place between those who complete a secondary education and those who stop their educational career at that point (19,20). The Danish government has as a declared goal that by 2015, 95% of a year group should complete a secondary education and 60% a tertiary

education (21). In 2012, approximately 78% of the 25-year-olds including those who were attending a secondary education at the time had fulfilled that goal (22). However, approximately 10% graduate from secondary school after the age of 25, which is a trend that is also present in other Scandinavian countries like Norway and Finland (23).

The young people who do not complete a secondary education at any point in their life, which in Denmark is around 9%–15%, are at greatest risk of being marginalised and excluded from the labour market (2,24). Approximately 50% of 15–17-year olds that did not attend a secondary education in 2006 were on social security at the age of 18, and among 35-year-olds in 2008, 68% of those who had not completed a secondary education had a job compared to 89% of those who had completed a secondary education (25).

The Danish educational system also deals with the problem of drop-out, especially from vocational educations (26). In 2012, 48% of those who attained a vocational education dropped out compared to 13% in upper secondary school. Those figures do however not tell us anything about whether the young people complete a secondary education later on (27). The lack of a clear differentiation between drop-out to another education or drop-out to no further education is a problem in the public debate, but it seems that drop-out from secondary education increases the risk of sickness and disability in young adulthood independent of health, family background, and socioeconomic status (28).

If we are serious about reducing both social and health inequalities, we must maintain our focus on improving educational outcomes among young people. Reducing educational inequalities involves understanding the interaction between the different determinants of educational outcomes, including family background, individual characteristics, and childhood conditions (7,29).

Psychosocial work environment

The term psychosocial work environment covers different aspects that affect the work place and the way employees associate with each other at work, including the way work is organised and the interpersonal relations- All these aspects are important to the psychological well-being and health of the employee (30).

Since the 1950s, a major theoretical development in the field of job design has been going on, which has entailed many different theories and models (31). The most used model to understand aspects of psychosocial work environment is The Demand-Control Model,

developed by Robert Karasek in 1979 (32). The theory behind this model is that job strain is caused by the combination of high job demands (particularly work overload and time pressure) and low job control – “the working individual’s potential control over his tasks and his conduct during the working day” (32,33). Although Karasek and his colleagues stated that little control and high demands at work increase the risk of disease in spite individual psychosocial characteristics, they at the same time acknowledged the impact of background and personality characteristics on experienced psychosocial work environment (33).

An alternative model of understanding the complexity of psychosocial work environment is the Effort-Reward Imbalance (ERI) Model by Siegrist, which emphasises the rewards rather than the control structure of work. According to the ERI Model, work-related benefits depend upon a reciprocal relationship between efforts spent and rewards received at work (34). An imbalance will lead to arousal and stress, which, in turn, may lead to cardiovascular risks and other adverse reactions (35).

Most studies addressing the psychosocial work environment have used self-administered questionnaires like the Job Content Questionnaire (36), the Effort-Reward Imbalance Questionnaire (37), or the Copenhagen Psychosocial Questionnaire (COPSOQ) (38). The latter is a standardised and validated generic questionnaire (39,40) that covers a large variety of psychosocial working conditions, stressors as well as resources. It is not attached to one specific theory but based on inspiration from several psychosocial theories and models like the Job Strain Model and the ERI Model (41). COPSOQ I was developed in 1997 (38), and few years later a revised and extended version COPSOQ II was developed (42). A short, medium and long version was constructed with the purpose of researchers as well as employers to assess psychosocial factors at work (38,41). It has been used in many Danish research studies and has been translated into several languages (43,44).

Work environment and health

There is some empirical evidence showing that a demanding psychosocial work environment is an important risk factor for development of depression among adult workers (45-50). Although the burden of evidence is not quite as extensive, similar associations have been found among young workers. Melchior et al. found that 32-year-olds exposed to high psychological job demands had a 2-fold increased risk of major depression or generalised anxiety disorder compared to those with low job demands (51). This result is in line with the conclusion in a literature review from 2011 about occupational health and safety issues among young workers, which showed low decision latitude, high psychological demands, low social support, and high work intensity to be associated with various mental health problems, particularly depression and psychological distress (52).

With regard to the physical work environment, hard physical work and heavy lifting among adult Danish workers are associated with development of muscular skeletal complaints later in life (53-55) and high mechanical workload is associated with development of neck and shoulder pain among young women in the transition from technical school to working life (56).

Work environment among young people

The transition from school to work life is a critical period in young people's lives. A successful integration of young workers into the work force is essential in striving to reduce risk of later work-related health problems and prevent young employees from losing their connections to the labour market later in life (1,57-59). A good work environment at the apprenticeship is likewise necessary to inspire towards finishing vocational education.

Many studies on work environment among young workers have focused on occupational injuries (52,60,61). Compared to their older colleagues, young workers in Denmark have been found to attract more injuries, and they perform more physical hard work (61,62). Studies examining the psychosocial work environment of young workers in the Nordic countries indicate that apart from the fact that they are experiencing less influence on how and when to do their job compared to older workers (62), the psychosocial work environment of young workers is in general good and in many ways better than the work environment of their older colleagues (60,63). A recent review of the literature concludes that young workers have a lower risk of developing occupational diseases than older workers in relation to both physical and psychosocial aspects (60). The reason for this could be that occupational diseases often need a cumulative exposure and/or latency period to develop. Thus for many young workers, the symptoms will not appear until later in life.

Childhood factors might influence the experienced work environment of young people. First, social or biological traits may increase an individual's probability of selecting themselves into a high strain work environment. Childhood socioeconomic status may select people to lower academic careers and more stressful work environments. Also, poor health and increased vulnerability could potentially select young people into stressful work environments, and poor school performance during childhood and adolescence may also restrict the possibility of achieving a high occupational status and thereby reduce the chances of getting the job they hoped for, which could again have impact on the experienced work environment.

In order to facilitate a positive entrance into work life, it is essential to get more knowledge about individual and family background factors that hinder or facilitate young people from being well functioning and well integrated on the labour market when the effect of the other family and individual risk factors are taken into account.

Risk factors of adverse educational attainment and work environment among young people

In some cases, the distinction between school and work can be difficult. With regard to vocational education, it could be categorised both as an education and as a job since for long periods the young people are a natural part of a work place and thus its work environment.

Most previous studies investigating risk factors of educational attainment or experienced work environment among young people have focused on family background aspects. However, early cognitive, psychological, physical and social aspects also affect later educational attainment and work life outcomes (64,65).

In order to cover family as well as individual risk factors in this PhD project, measures of socioeconomic status, school abilities, personal resources/vulnerability, and mental as well as physical health were considered. A way of defining vulnerability is as a dynamic process of negative adaption in the face of adversity (6). This broad definition is in this thesis delimited to cover the way individuals think about themselves and their situation, operationalised as sense of meaningfulness and self-esteem. The following four domains of late childhood risk factors were finally chosen: 1. school performance, 2. vulnerability, 3. health, and 4. family background. The specific variables contained in the four domains are described in further detail in the materials and methods section.

Risk factors of poor educational attainment

School performance:

Previous studies have shown school performance to be positively related to educational attainment (66-68), but the role of school performance has not yet been adequately investigated in relation to theoretical versus more practical secondary educations.

Vulnerability:

Only a limited number of studies have addressed the association between vulnerability in childhood and educational attainment. In two cross-sectional studies young people with a high sense of coherence (SOC) were more likely to plan further education and had better primary and secondary marks compared to those with low SOC (69,70). The studies did not measure educational attainment as an outcome, and due to the low quality design, causality is unclear. The importance of self-esteem was addressed in a study by Mahaffy et al., which did not find any strong association with educational attainment (71), whereas more recent studies did support an association (72,73).

Health:

A range of health outcomes have previously been found to be associated with poor educational outcome. Poor self-rated health was found to be related to lack of timely high school completion or drop-out (74-77), and a recent published study showed self-rated health of 5- to 14-year-old children to be associated with years of completed schooling at 10-year follow-up (78).

Results from previous work are conflicting regarding obesity. Some studies found obesity during adolescence to be associated with lower educational attainment (75,79,80), whereas a study by Viner et al. did not (81).

Some studies have shown depressive symptoms and anxiety to be associated with decreased educational attainment or drop-out (82-84), whereas the results of others have been inconclusive (85,86).

Family background:

The most frequently examined risk factors related to educational attainment are measures of family socioeconomic status (66,67,87,88). Parental education and income have shown strong associations with later educational attainment (66,67,88) regardless of differences in welfare and education systems in the specific country (17). Family structure is also related to educational attainment (89), and studies have found adolescents from one-parent families to be less likely to graduate from high school than adolescents from two-parent families (90,91).

Focusing only on studies reporting on completion of secondary education after compulsory school, a systematic review of the literature summarised that especially low family socioeconomic status, lack of parental engagement in school, low school performance and attitude, lacking proximity and accessibility of the education, and degree of part time job were important risk factors regarding non-completion of secondary education or dropping out (29). Table 1 contains follow-up studies with outcome evaluation, no later than age 25, that are not included in this review. Only exposures and outcomes of interest for this thesis are included.

2. Background

Table 1. Overview of studies on risk factors of educational attainment among young people*

First author	Ref.#	Year	N	Population	Follow-up	Primary exposure	Primary outcome
Fletcher	(82)	2010	2400	7 th to 12 th grade	At mean age of 22	Depressive symptoms (CES-D)	Years of schooling Drop-out of high school
Jackson	(76)	2009	9000	Age 12 to 17	6 years later	General health (1 item)	Timely high school graduation
Lê	(78)	2013	2368	Age 5 to 14	10 years later	General health (1 item)	Years of schooling
Marjoribanks	(68)	2005	9304	Age 14	5 years later	Academic achievement (Sum of tests in math and reading) Educational aspiration (6-point scale indicating how much education hoped to attain) Family background	Educational attainment (10 point scale)
Song	(91)	2012	21420	8 th grade students	2 and 4 years later	Family structure Family socioeconomic status Family social capital School engagement	Drop-out of high school
Wojtkiewicz	(90)	1993	8381	Up to age 15	Age 20	Family structure	Completed 12 years of schooling
Fergusson	(85)	2002	1265	Age 14 to 16	Age 16 to 21	Major depression (interview and diagnostic criteria)	Educational achievement (School leaving age, school performance, involvement in tertiary education)
DeRidder	(75)	2013	8949	Age 13 to 21	Age 24	Somatic disease Somatic symptoms Psychological distress Insomnia Concentration difficulties Self-rated health BMI Maternal educational level Family living situation	Drop-out of high school
Haas	(77)	2008	8050	Age 12 to 16	Age 20	Self-reported health status (1 item) Academic achievement (mathematical knowledge, arithmetic reasoning, word knowledge, and paragraph comprehension) 8th grade marks Psychosocial relationships (to peers and to school) Social and demographic variables	Drop-out of high school

* Not included in the review by Labriola et al. 2012 (29).

Risk factors of poor work environment

School performance:

Studies that investigated the association between school performance and work environment in young people found low school marks at age 16 to be associated with low job control and high job strain at age 31 (92). In addition, a study demonstrated that students who had earned lower grades in high school later reported receiving less support from their work colleagues than did students who had performed well academically (93).

Vulnerability:

Studies investigating different aspects of childhood vulnerability like deficient maternal nurturing attitudes or lack of social-emotional competence in high school have found these to be related to reporting of poor work environment (93,94). Despite the fact that school level high SOC seems to modify the association between individual level adverse work environment and health among 9th grade students (95), no convincing association between SOC and psychosocial work environment one year later among 20–40-year-olds was found (96). Self-esteem has been found to be positively related to job performance and job satisfaction among adult workers (97,98), but no studies investigating the association between childhood self-esteem and the experiencing of poor work environment later in life could be identified.

Health:

An association between depression or anxiety and psychosocial working conditions in young adult workers has been demonstrated (51), but since this finding is based on a cross-sectional design, causality is unclear. Healthy life style like youth leisure time physical activity and sports participation have been found to be related to lower chronic job strain (99), but further studies focusing on the relation between childhood health and work environment in early adulthood are needed.

Family background:

Previous work has demonstrated a social gradient for physical and psychosocial working conditions (58,100,101) in adult populations, and a study by Elovainio et al. has shown low family socioeconomic status in adolescence to be associated with low job control and high job strain jobs at age 31 (92). Other adverse family conditions in late childhood like residential mobility and crowding or parental unemployment have also been demonstrated to be associated with the reporting of job strain later in life (102).

Table 2 contains follow-up studies that investigate childhood risk factors associated with a poor physical or psychosocial work environment. Follow-up studies investigating risk fac-

2. Background

tors up to the age of 21 are included. Due to the limited number of relevant studies, it was decided to include those investigating exposures related to the exposures dealt with in the present study.

Table 2. Overview of studies on risk factors of work environment among young people

First author	Ref.#	Year	N	Population	Follow-up	Primary exposure	Primary outcome
Elovainio	(92)	2007	4293	Age 14	Age 31	Maternal antenatal depression Low birth weight Childhood socioeconomic status Early adolescence health risk behaviours (smoking, alcohol) Academic performance (School marks at age 16)	Work characteristics (job control, job demands) Psychological distress
Fitzgerald	(93)	2005	57	9 th or 10 th grade students	5 years later	Social Problem Solving Skill (Means-Ends Problem Solving (MEPS)) Academic Performance and adjustment (mean of semester grades, during high school and mean days of school absences per semester)	Job Control Job support Work Status (working full-time or part-time)
Hintsanen	(94)	2010	823	Age 3 to 18 Age 6 to 21	Age 24 to 39	Deficient nurturing attitudes (intolerance and low emotional warmth by the mother)	Adulthood work stress (Job demands and efforts, job control, job strain, reward)
Westerlund	(102)	2012	673	Age 16	Age 43	Adversity in adolescence (residential mobility and crowding, parental loss, parental unemployment, and parental physical and mental illness)	Job strain Allostatic load (body fat, blood pressure, inflammatory markers, glucose, blood lipids, and cortisol regulation)
Wulff	(103)	2009	697	Age 10 to 16	Age 26	Mental ability (verbal, inductive, spatial, and general intelligence, mean of age 10 and 13) School satisfaction (at age 13 and 16) School achievement (grades at ages 13 and 16)	Job satisfaction (four items from a questionnaire on work)
Yang	(99)	2010	664	Age 9, 12, 15, and 18	27 years later (Age 36, 39, 42, and 45)	Youth leisure time physical activity Sports participation	Chronic work stress (a three-item scale adapted from the Occupational Stress Questionnaire)

Non-participation in follow-up studies

A well-known problem in epidemiologic studies is non-participation. Studies based on questionnaire information have noted declining participation rates through the recent 10-15 years. This can be a serious threat to the internal as well as external validity of a study and may potentially lead to selection bias (104).

Initially non-participation has in various studies been found to be related to poor socio-economic status and health conditions (105-115) as well as to other covariates like, age, and gender (111,115-117). Loss to follow-up occurs in most clinical trials and observational studies with more than one collection time.

The reasons for initial non-participation and loss to follow-up can be numerous. The participants may be unwilling to participate because they find the questionnaire too time consuming, irrelevant, or even offensive. They may move or forget to change their address or they may even die. The reasons why participants refuse to respond are usually unknown, which makes it difficult to estimate the effect as well a direction of the bias.

Missing data is also a well-known problem in epidemiology and implies problems in cohort studies, especially when using questionnaire information. Missing data ranges from missing an item to a whole page in a questionnaire. A way of addressing the problem with missing data is multiple imputation. The idea behind multiple imputation is to fill in the missing data with data generated from a statistical modelling (118,119).

Participants in prospective cohort studies cannot base their decision to take part in the study upon future outcome. However, if the characteristics related to non-participants correlate with risk factors for the outcome under study, non-participation is related to both exposure and outcome, and some bias due to selection cannot be ruled out. Loss to follow-up is in general considered a much greater threat to the validity of the internal comparisons than initial non-participation (112,116,120). However, even though certain characteristics may be related to those who decide to participate in a cohort study, it does not necessarily introduce any important selection bias for the associations under study (120-122).

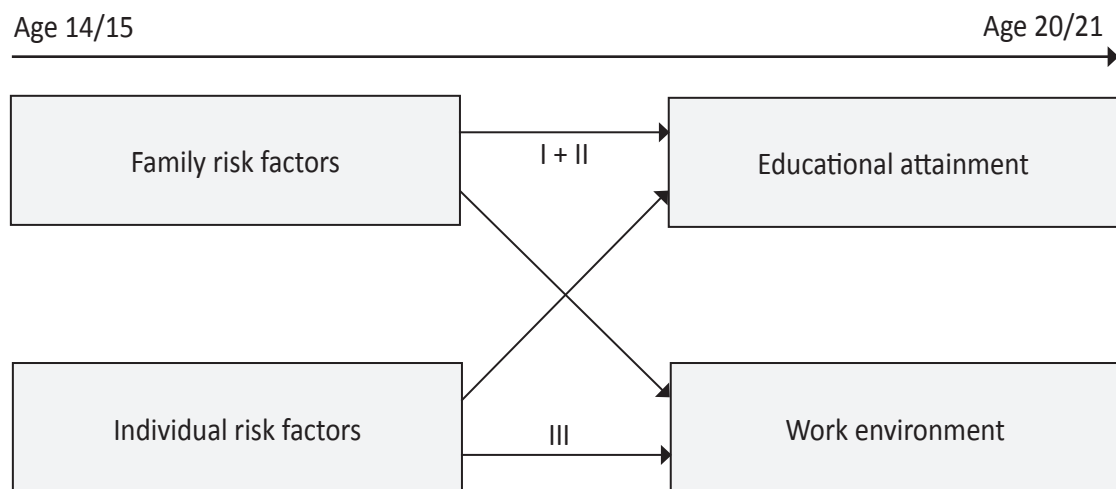
Synthesis

Young people at age 20/21 are in very different places and stage in their lives. Some are still attending secondary education, some have finished school and are working, and some have already lost connection with the educational system and the labour market. This important period in life covers many potential determinants of future well-being and work-participation. This thesis sets out to use self-reported data and register information to investigate the influence of individual and family risk factors on the transition from the educational system to work life, using the cohort “Vestliv”.

3. Aim of the thesis

The overall aim of this thesis was to provide further insight into the influence of late childhood risk factors on educational attainment and experienced work environment among Danish 20/21-year-olds in the transition from school to work life. Furthermore, the data material gave rise to a need of a methodological study with the purpose of estimating selection problems in the Vestliv cohort.

Figure 3. Aim of studies



Study I:

The aim was to investigate to what degree individual factors like low school performance, increased vulnerability, and health problems explained differences in educational attainment after compulsory school.

Study II:

The aim was to investigate whether participants at baseline differed from the source population and whether participants at follow-ups differed from the baseline population. Furthermore, the study aimed to examine if initial non-participation and loss to follow-up affected the associations between family or individual risk factors and educational attainment.

Study III:

The aims were to describe and compare the work environment of working Danish 20/21-year-olds with the Danish general working population and to investigate whether family or individual factors at age 14/15 were associated with the assessment of physical and psychosocial work environment at age 20/21.

4. Materials and methods

The Vestliv cohort

The Vestliv project is a cohort study with the main purpose of exploring aspects of inequality and social differentiation on well-being and health in a life course perspective. Individuals born in 1983 or 1989 and living in the former Ringkjøbing County in early April 2004 were invited to participate. Furthermore, the Vestliv data material contains information on the parents of the 1989 cohort as well as qualitative interviews from a subgroup of the 1989 cohort. The questionnaire material consists of a range of questions covering socioeconomic-, psychological-, social-, as well as health-related aspects.

The questionnaire data used in this PhD project stemmed from the 1989 cohort. Using The Central Office of Civil Registration (or Central Person Register) and information from public schools, the potential participants were identified by using the personal identification number (CPR number), which is given to every inhabitant in Denmark at birth or at immigration (123). Altogether 3681 individuals defined the source population.

Recruitment and data collection

At baseline in 2004, the potential participants were 14/15 years old. Recruitment took place at the schools within the county and a baseline questionnaire was filled out during school hours. Those not at school on the day of collection received the questionnaire by mail. This resulted in a participation rate of 83%.

4. Materials and methods

A follow-up was conducted in 2007 when the young people were 17/18 years old, using both emailed and postal questionnaires. A second follow-up was carried out in 2010 when the young people were 20/21 years old, using only emailed questionnaires. All potential responders (N=3681) were invited at each follow-up except those who had travelled abroad, had said no to participating in research activities, or had died. The data collection points and response rates of the 1989 cohort are presented in Table 3.

Table 3. Collection points and response rates

	Data collections		
	2004	2007	2010
Cohort 1989 (N=3681)	Age: 14/15 n: 3054 Response rate: 83%	Age: 17/18 n: 2400 Response rate: 65%	Age: 20/21 n: 2145 Response rate: 58%

Register information

Besides information from questionnaires, various register information was obtained from Statistics Denmark. By using the CPR number, linkages between the different registers and databases were done.

The Danish Civil Registration System (CRS)

The Danish Civil Registration System (CRS) contains information for administrative use on all persons alive and living in Denmark. The register includes individual information on the CPR number, name, gender, date of birth, place of birth, citizenship, identity of parents, and continuously updated information on vital status, place of residence, and civil status (identity of spouses) (123). Information about addresses, gender, and age of the potential participants was identified prior to questionnaire collection in 2004. With use of the register, the participants were linked to their parents or guardians, and additionally, information about the family unit was obtained.

Danish Registers on Personal Income and Transfer payments (DRPIT)

The Danish Register on Personal Income and Transfer payments includes data on the income composition of anyone who is economically active, with or without residence in Denmark. It includes more than 160 variables, which are generally considered of high quality as they come from administrative registers (124). We used the register to obtain data on household income for the participant's residence at baseline.

Danish Education Registers (DER)

The Danish Education Registers include all individuals attending an education in Denmark and link information within and across years through the CPR number. Each year, the educational institutions provide individual-level information on enrolment status, completed levels of education, and exams.

We used information from the Population's Education Register (PER) on the highest completed education of the parents, which is obtained for 96.4% of the Danish population aged 15–69. From the Student Register (SR) and the Academic Achievement Register (AAR), we used information about 9th grade exam scores and type of academic track in secondary school. Information on educational status was used to generate an educational attainment outcome variable of the 20/21-year-olds. Generally, the registers are considered of high quality (125).

The Prescription Database (PD)

The sale of prescription medication must be reported in Denmark. The Prescription Database contains information about the total amount of prescription medication sold in Denmark every year and is based on the standardised international Anatomical Therapeutic Chemical (ATC) classification system (126). In this PhD project, information about medication for pain and nervous symptoms was used, and the following four ATC classifications were included: painkilling drugs (N02), drugs for anxiety and sleep disturbance (N05B and N05C), and drugs against depression (N06A) (127).

Study designs and samples

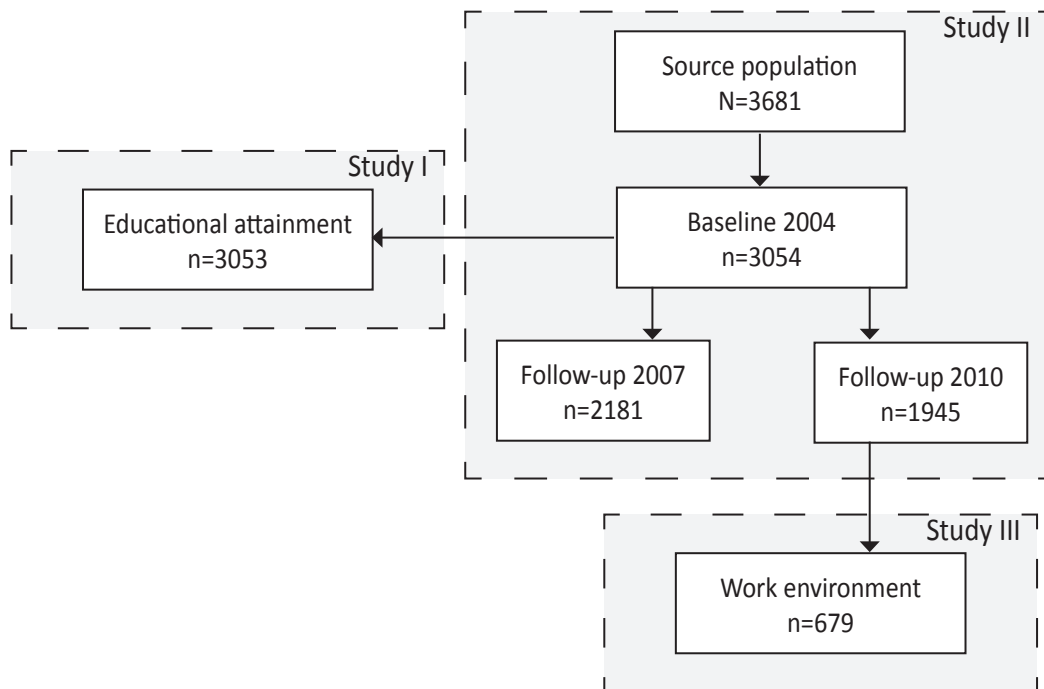
The three studies in this PhD project are all based on both questionnaire and register information. Each study used a subsample of the complete cohort depending on the aim of the study.

Study I included the complete baseline population except for one individual in whom outcome information was missing (n=3053).

Study II included responder's at all three collection points as well as the source population.

Study III included those who responded at baseline and at follow-up in 2010 with information on at least one of the outcomes. The responders should be working and not attending an education at age 20/21, except for those who were attending a vocational education with an apprenticeship (n=679). An overview of the samples used in the three studies is presented in Figure 4.

Figure 4. Overview of study samples



An overview of study topic, study design, inclusion, sample, data sources, independent and dependent variables, and data analyses of the three studies is provided in Table 4.

Table 4. Overview of study design

	Study I	Study II	Study III
Topic	Educational attainment among 20/21 year olds	Estimation of selection bias	Work environment among 20/21 year olds
Design	Cohort study	Cohort study	Cohort study
Inclusion criteria	Answered the baseline questionnaire and obtained outcome information from register	All potential participants with register information (source population)	Answered questionnaires at baseline and follow-up in 2010, were working or in an apprenticeship at age 20/21 and obtained information on at least one of the outcomes
Sample size	3053	3681(3054/2181/1945)	679
Data sources	Baseline questionnaire, CRS, DRPIT, DER	Baseline questionnaire, CRS, DRPIT, DER, PD	All three questionnaires, CPR, DRPIT, DER
Independent variables (exposure)	Grades in math and Danish, SF-36 (one item), depressive symptoms, BMI, sense of meaningfulness, self-esteem, highest attained education in the household, household income, family type	Grades in math and Danish, SF-36 (one item), depressive symptoms, BMI, sense of meaningfulness, self-esteem, highest attained education in the household, household income, family type, drug use	Grades in math and Danish, SF-36 (one item), depressive symptoms, sense of meaningfulness, self-esteem, highest attained education in the household, household income
Dependent variables (outcome)	Educational attainment (secondary education)	Educational attainment (secondary education)	Psychosocial work environment (six aspects), physical work environment (two aspects)
Data analysis	Multinomial logistic regression	Prevalences (P), Prevalence Ratios (PR), Odds Ratios (OR), Relative Odds Ratios (ROR)	Multivariate linear regression

Outcomes

Educational attainment after compulsory school (Studies I and II)

In Studies I and II, the outcome measure was educational attainment after compulsory school. This was measured in October 2010 when the participants were 20/21 years old and was based on register information from the Danish Education Registers (125). We used information about start and end time points as well as type of completed education to divide the participants into the following four categories: 1. "Completed", consisting of participants who had completed a secondary education; 2. "Still studying", consisting of those who were still attending a secondary education; 3. "Dropped out", if they had dropped out of their last secondary education and never attended another and 4. "Never attained", if they had never attended a secondary education. Information about type of secondary education was used to divide the participants into one of the two educational tracks "upper secondary school" or "vocational education". Due to this categorisation, those who had never attained a secondary education were excluded. If the participants had dropped out of more than one secondary education, they were categorised according to the education last attended.

Work environment (Study III)

Psychosocial work environment

Information on psychosocial work environment was derived from the 2010 follow-up questionnaire and was based on selected items from the short edition of the "Copenhagen Psychosocial Questionnaire" (COPSOQ II) (42). Items measuring six of the 23 different aspect of psychosocial work environment contained in the COPSOQ II questionnaire were used. The items were answered by ticking a 5-point Likert scale and transformed to scales measuring: quantitative demands, work pace, emotional demands, influence, trust, and fairness at the work place, with scores in the range from 0 to 8. Good work environment was indicated by low scores on the three scales measuring quantitative demands, work pace, and emotional demands and high scores on the three scales measuring influence, trust, and fairness. The results were compared to the psychosocial work environment of a representative sample of Danish wage earners (n=3517) between ages 20 and 60 (128). The items of the scales are shown in Appendix A.

Physical work environment

Information about the physical work environment came from the 2010 follow-up questionnaire and consists of four items originally derived from the Dutch Musculoskeletal Questionnaire (DMQ) (129). The items were answered by ticking a 4-point Likert scale and transformed to scales measuring monotonous repetitive work and physical hard work. Scores were in the range from 2 to 8 with low scores indicating a good work environment. The DMQ does not provide exact numbers of movements or kilos lifted but ask about the frequency with which this kind of work is performed. The mean values of the two scales were compared to the mean values of a large Danish sample of employees (n=20 464) between ages 19 and 64 (130). For further details about the items of the scales, see Appendix A.

Exposure variables

In order to cover aspects of school performance, vulnerability, health, and family background, the exposure variables were chosen and categorised in relation to these four domains. The wording and a further description of the questionnaire items used are presented in Appendix A.

School performance

Exam grades at the end of 9th grade were used as indicators of school ability and performance. We used information on 9th grade oral Danish and written math exam grades as exposures in all three studies. Information came from the Danish Education Registers (125). Before September 2007, grades were given using the so-called 13-point scale (00, 03, 5, 6, 7, 8, 9, 10, 11, 13). A dichotomous variable indicating “high grades” (8–13 equivalent to B+ and above) and “low grades” (00–7 equivalent to B and below) was generated. In the period 2004–2007, 90% and 91% of the participants completed exams in written maths and oral Danish, respectively.

Vulnerability

Sense of meaningfulness

Antonovsky has developed the salutogenic model, which emphasises that a strong SOC is crucial in successfully coping with daily stressors and maintaining good health (131). The

original SOC scale consists of 29 items arranged in three sub-scales: comprehensibility, manageability, and meaningfulness (132,133). A revised short version for children has been developed, and from this version we used the 4 items related to sense of meaningfulness (134,135). According to Antonovsky, sense of meaningfulness is the most important of the three aspects and is a belief that things in life are interesting and a source of satisfaction, that things are really worthwhile, and that there is good reason or purpose to care about what happens (131). The information came from the baseline questionnaire and was used as exposure in all three studies. The wording of the items were identical to the one used in the Danish part of the international *Health Behaviour in School-aged Children (HBSC)* study (136), with an item score between 1 and 5 and a total score between 4 and 20. High scores indicate high sense of meaningfulness, and data was categorised with a cut-off point at the 25% percentile as normal/high score (>12) and low score (≤ 12). The value of the 25% percentile was identical in all three studies despite different sample sizes.

Self-esteem

Self-esteem is the individual's overall emotional evaluation of his or her own worth. It is a judgment of oneself as well as an attitude towards the self. Rosenberg's self-esteem scale was developed for use in studies of the adaptation of youth self-esteem. The scale is a 10-item scale with items answered on a 4-point Likert scale (137). For this PhD project we used six items from the scale with scores from 1 to 4 and a total score between 6 and 24 (138). Information was collected by questionnaire at baseline in 2004. High scores indicate high self-esteem, and data was categorised with a cut-off point at the 25% percentile as normal/high self-esteem score (>17) and low self-esteem score (≤ 17). The value of the 25% percentile was identical in all three studies despite different sample sizes.

Health

Self-rated health

Self-rated health is used as a general indicator of health in all three studies, as it is a strong predictor of functional ability (139), future health problems (140), as well as mortality (141).

Information was collected by questionnaire at baseline in 2004 and was measured using a single item from SF-36 (142): "In general, would you say your health is..." with five response alternatives, which were subsequently dichotomised to indicate high (excellent, very good) versus low (good, not so good, bad) self-rated health.

Depressive symptoms

Depressive symptoms were measured using the abbreviated 4-item validated version of

‘The Center for Epidemiologic Studies Depression Scale for Children’ (CES-DC). The 4-item scale has proved almost as accurate a screen (at cut-off points of 3 and above) as the entire set of 20 items (143). Information about depressive symptoms has been used as exposure in all three studies, and information came from the baseline questionnaire, with scores ranking from 0 to 3 and a total score from 0 to 12. Higher scores indicate increased levels of depression. The recommended cut-off at 3 and above was used to dichotomise the responses into two categories: “depressive symptoms” and “no depressive symptoms”.

Body mass index (BMI)

The body mass index (BMI) is a simple measure to assess how much an individual's body weight departs from what is normal or desirable for a person of his or her height. It is calculated as the weight in kilograms divided by the square of the height in metres (kg/m^2) (144). BMI correlates well with body fat and can be used as a population measure of obesity (145). The categorisation of BMI has been based on its association with mortality (145), but the thresholds of children are different from those of adults because the body mass in relation to height changes during childhood (146).

In this PhD project, BMI was used as an exposure measure in studies I and II, and information about weight and height came from the baseline questionnaire. BMI was categorised into low weight ($\text{BMI} < 17 \text{ kg}/\text{m}^2$ for both boys and girls), normal weight ($17 \text{ kg}/\text{m}^2 - 23.29 \text{ kg}/\text{m}^2$ for boys and $17 \text{ kg}/\text{m}^2 - 23.94 \text{ kg}/\text{m}^2$ for girls), and overweight ($\text{BMI} > 23.29 \text{ kg}/\text{m}^2$ for boys and $\text{BMI} > 23.94 \text{ kg}/\text{m}^2$ for girls), using thresholds for 15-year-old children (146).

Prescription medication

Prescription medication was used as a measure of health of the young participants. Information on prescribed medication was used in Study II and consisted of data from The Prescription Database in the period 2005–2006 (126). The total number of times each participant got prescribed medication was calculated on the basis of the four ATC classifications (painkillers (N02), drugs for anxiety and sleep disturbance (N05B and N05C), and drugs against depression (N06A)) and combined into a dichotomous variable defined as “no drug use” or “drug use”.

Family background

Socioeconomic status

Measuring socioeconomic status is challenging, especially among children and adolescents. Education and income are not valid measures for children/adolescents themselves, because they are still attending school and therefore have little economic power. Consequently, the participants were classified by their parents' socioeconomic status, by obtaining informa-

tion about family household income and highest education in the household in year 2003. Information came from the Danish Registers on Personal Income and Transfer payments and from the Danish Education Registers (124,125).

The originally categorisation of highest attained education in the household: compulsory school (<10 years), secondary education (10-12 years), short or medium long tertiary education (13-15 years), and long tertiary education (>15 years) was used in Study I (125). In Studies II and III the two highest categories were pooled, and the following three categories were used: < 10 years, 10-12 years, and >12 years. Yearly household income was divided into tertiles corresponding to lowest (<64,540 EUR), middle (64,540 – 82,402 EUR), and highest tertile (>82,402 EUR) (124), and used as an exposure in all three studies. If the parents were divorced, information stemmed from the household where the participant's address had been listed.

Family unit

Information about family type at the end of 2003 came from The Danish Civil Registration System (123). The six original categories, 1. civil partnership with home-living children, 2. single with home-living children, 3. married couple with home-living children, 4. cohabitant couple with home-living children, 5. couples living together with home-living children, 6. a child not living at home, were dichotomised into "living with one adult or not living with adults" (2 or 6) or "living with two adults" (1, 3, 4 or 5), and the variable was used in Studies I and II.

Covariates

Age when completing compulsory school

In order to take into account differences in age at the time the participants completed compulsory school, a variable indicating age when completing compulsory school was created by calculating the age in the year the participant passed most of the 9th grade exams. The information was derived from the Education Registers (125). A continuous variable ranking from 15 to 18 years, with information on 3668 of the 3681 individuals defining the source population, was generated and applied as a confounder variable in the regression models in Studies I and II.

Gender

Information about gender was derived from The Danish Civil Registration System (123). It was applied as a confounder variable in Studies I and II. In Study III stratification on gender was performed.

Job type

The participants in Study III were categorised as either employees or being in an apprenticeship by the age 20/21. The information came from the 2010 follow-up questionnaire, and the variable was applied as a confounder variable in the regression models in Study III.

Statistical analyses

All analyses were performed using STATA statistical package (version 12.0; Stata, College Station, TX, USA). P values < 0.05 were considered statistically significant, and results were presented with 95% confidence intervals (CI) or standard deviations (SD).

Study I

We used multinomial logistic regression to estimate crude and adjusted odds ratios for subtypes of educational attainment (four categories) according to individual and family risk factors. Those who had completed a secondary education were used as reference. The risk factors were chosen a priori, and the adjusted analyses were carried out in two steps. First, individual risk factors were adjusted for all other individual risk factors and vice versa for family risk factors. Secondly, all risk factors were mutually adjusted. Gender and age when completing 9th grade were included in all models. Additionally, the two types of educational tracks, upper secondary school and vocational education were examined separately.

Study II

Participation

The pattern of participation was examined by comparing prevalences (P) of risk factors in the source and baseline population by estimating prevalence ratios

$PR = (P_{\text{Baseline population}} / P_{\text{Source population}})$. The same was done for the follow-ups in 2007 and 2010 where risk factors for responders were compared with those for the baseline population.

Impact of initial non-participation on relative risk estimates for educational attainment.

Multinomial logistic regression was used to estimate odds ratios for associations between different risk factors and educational attainment in the source population, the baseline

population, and the follow-up populations in 2007 and 2010. To examine the impact of the initial non-participation, relative odds ratios (ROR) were computed as the ratio of the OR for the baseline population and the OR in the source population ($ROR = \frac{OR_{\text{Baseline population}}}{OR_{\text{Source population}}}$).

Impact of loss to follow-up on relative risk estimates for educational attainment.

Similarly, loss to follow-up was examined by computing RORs as the ratio of the OR for the follow-up populations in 2007 or 2010 and the OR of the baseline population ($ROR = \frac{OR_{\text{Follow-up population}}}{OR_{\text{Baseline population}}}$).

To calculate 95% confidence intervals (CI) of the PR and the ROR estimates, the following approximate formula was applied: $se(\hat{\theta}_{Sub} - \hat{\theta}_{Tot}) = \sqrt{se(\hat{\theta}_{Sub})^2 - se(\hat{\theta}_{Tot})^2}$ (121), where $\hat{\theta}_{Tot}$ is the estimate of the total sample and $\hat{\theta}_{Sub}$ is the estimate in a subsample. This formula has been used in previous studies (107,121,122) and has in a Danish simulation study shown to give valid confidence intervals for relative odds ratios when the expected bias related to the selection is modest (121).

All analyses were adjusted for gender and age when completing 9th grade.

Study III

The means and mean differences of the eight work environment outcomes were calculated according to all risk factors using linear regression models. Adjustments were performed in two steps. At first, the individual risk factors were adjusted for family risk factors and vice versa. Secondly, every risk factor was adjusted for all other risk factors. Furthermore, the statistical models were adjusted for whether the young people were in an apprenticeship or employees. Gender differences were presented in a crude, stratified analysis. Additionally, a sub-analysis that took into account the answers of four questionnaire-based risk factors collected both at baseline in 2004 and at follow-up in 2007 was performed, and the responses of the participants were categorised into those who: 1) scored positive at both time points, 2) scored negative in 2004 and positive in 2007, 3) scored positive in 2004 and negative in 2007, 4) scored negative at both time points. Those who scored positive at both time points were used as reference group.

5. Results

Summary of results

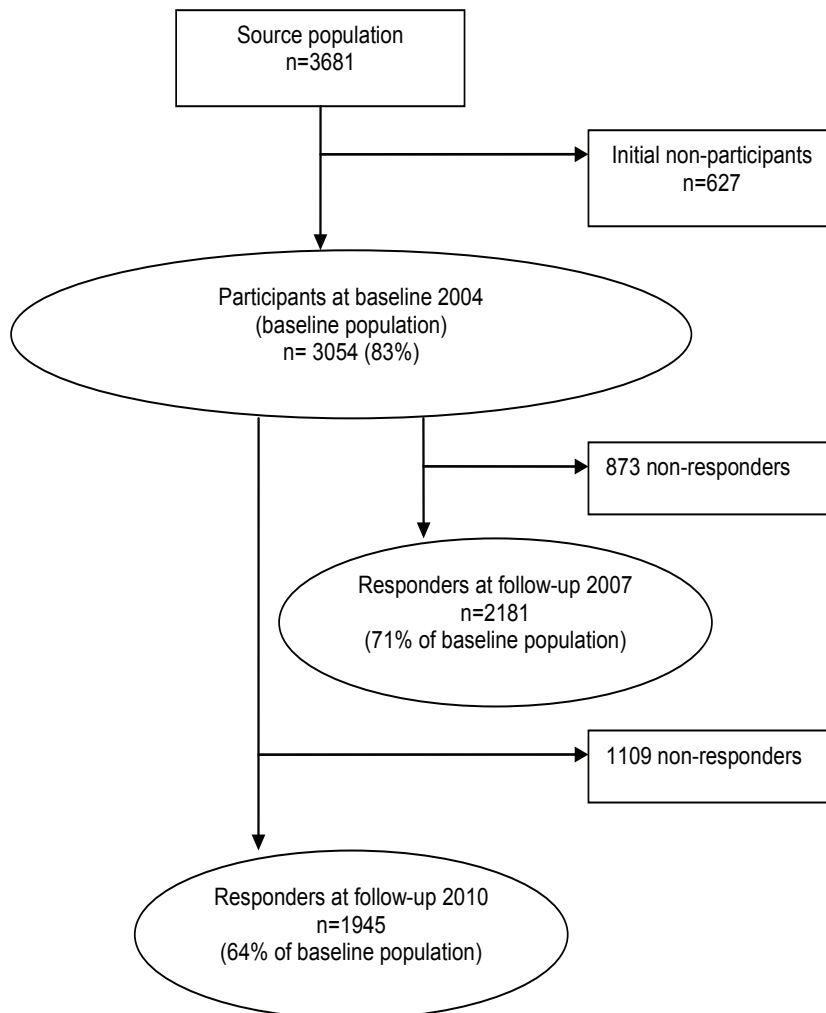
This section will summarise the main findings of the individual studies. Additional results and more detailed presentations are available in the appended papers.

Participation and non-response

Since we have baseline questionnaire information but no CPR information on six of the 3687 individuals originally defining the source population, it was not possible to link these participants to any register material with regard to either information about themselves or their parents. This means that essential information was missing, and therefore it was eventually decided not to count these six persons in the source or baseline population. Since this decision was made after publishing of the first article, the numbers defining the source and baseline populations in paper I are slightly different from the numbers in papers II and III.

During the follow-up period of approximately 6 years, some of the potential participants refused to answer one or more questionnaires, some said no to participate in research activities, and others moved abroad or died. An overview of the distribution of participants and non-participants at baseline and responders and non-responders at follow-ups in 2007 and 2010 is presented in Figure 5.

Figure 5. Distribution of participants and non-participants at baseline and follow-ups



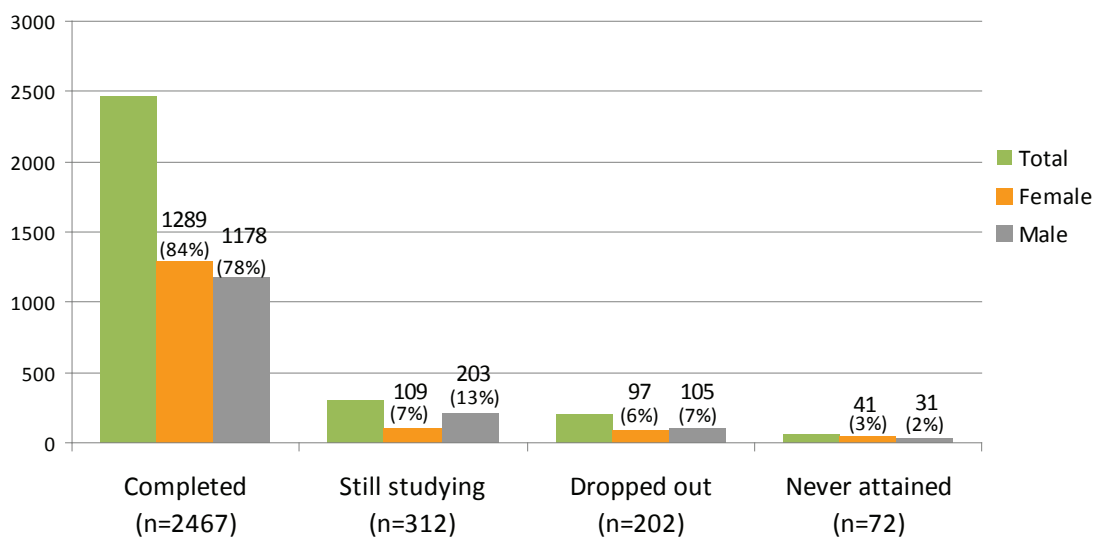
Participants at baseline did not differ much from the source population except that the participants had slightly better school abilities and came more often from homes with two adults or from homes with a higher income and educational level. This selection pattern became more pronounced at the first follow-up, but was not further strengthened at the second follow-up and led to prevalence ratios ranging from 1.13 to 0.78 across all three collection points (paper II, Table 1).

Study I

Among the 3053 young people included in Study I, 2467 (80.8%) had completed a secondary education, 312 (10.2%) were still attending a secondary education, 202 (6.6%) had dropped out and never attended another secondary education, and 72 (2.4%) had never attended a secondary education by the age of 20/21.

The distribution of educational attainment by gender is illustrated in Figure 6. Among females 84% had completed a secondary education compared to 78% of the males.

Figure 6. Educational attainment, total and in females and males



Of the females 68% chose upper secondary school in contrast to 48% of the males (Figure 7).

Figure 7. Gender distribution in relation to educational track

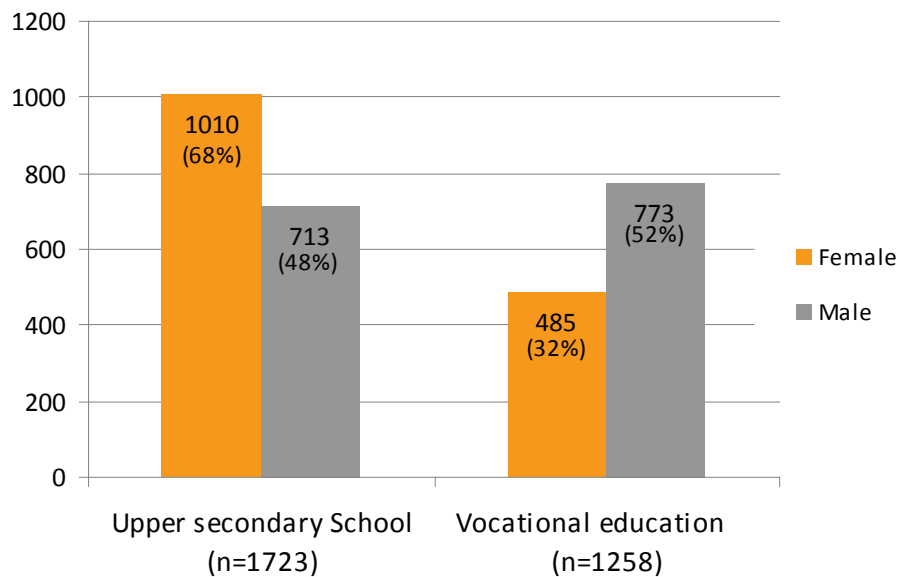


Table 5 presents the fully adjusted ORs between individual as well as family risk factors and educational attainment. Especially low grades when completing compulsory school were strong risk factors of not having completed a secondary education by age 20/21. Of the vulnerability measures, low sense of meaningfulness showed association with dropping out and never attending a secondary education. Low general health status was likewise associated with dropping out or never attending a secondary education, and overweight with never attending a secondary education. Low family income as well as low parental education, in general, decreased chances of completing a secondary education.

Table 5. Individual and family risk factor for educational attainment after compulsory school

	n	%	Completed (n=2134) Base	Still studying (n=236) OR* 95%-CI	Dropped out (n=146) OR* 95%-CI	Never attained (n=32) OR* 95%-CI
Individual risk factors						
Grades - oral Danish	2889					
8 or above	2102	72.8		1.0	1.0	1.0
7 or below	787	27.2		1.7 1.2;2.3	2.1 1.5;3.1	2.0 0.9;4.2
Grades - written math	2874					
8 or above	1962	68.3		1.0	1.0	1.0
7 or below	912	31.7		2.4 1.8;3.3	2.5 1.7;3.6	2.5 1.1;5.5
Self-esteem	2973					
Normal/high	2236	75.2		1.0	1.0	1.0
Low	737	24.8		1.6 1.1;2.2	1.3 0.8;1.9	1.5 0.6;3.6
Sense of meaningfulness	3022					
Normal/high	2438	80.7		1.0	1.0	1.0
Low	584	19.3		1.4 0.98;2.0	1.8 1.2;2.6	1.8 0.7;4.5
General health status	3033					
High	2904	95.8		1.0	1.0	1.0
Low	129	4.3		1.2 0.6;2.4	2.2 1.1;4.2	2.7 0.8;9.3
Depressive symptoms	2999					
No	1958	65.3		1.0	1.0	1.0
Yes	1041	34.7		0.9 0.7;1.3	1.1 0.7;1.6	0.7 0.3;1.6
Body mass index	2878					
Low weight	273	9.5		0.8 0.5;1.3	0.7 0.4;1.4	1.3 0.4;4.1
Normal weight	2301	80.0		1.0	1.0	1.0
Overweight	304	10.6		0.9 0.6;1.4	1.3 0.8;2.1	3.5 1.4;8.6
Family risk factors						
Household income	3052					
Highest	1017	33.3		1.0	1.0	1.0
Middel	1018	33.4		1.2 0.8;1.8	1.3 0.8;2.2	2.4 0.8;7.3
Lowest	1017	33.3		1.6 1.1;2.5	2.2 1.3;3.6	3.7 1.2;11.8
Highest household education (years)	3001					
>15 years	170	5.7		1.0	1.0	1.0
13-15 years	924	30.8		1.3 0.6;2.8	1.8 0.5;6.0	1.6 0.2;12.8
10-12 years	1548	51.6		1.3 0.6;2.8	1.6 0.5;5.3	0.5 0.1;4.5
<10 years	359	12.0		1.4 0.6;3.3	2.6 0.8;9.2	1.3 0.1;11.7
Family type	3053					
Two adults	2652	86.9		1.0	1.0	1.0
One adult/not at home	401	13.1		1.1 0.7;1.8	1.1 0.6;1.8	0.95 0.3;2.8

*Adjusted for gender, age when completing 9th grade and all individual and family risk factors.

Values are odds ratios base on mlogit calculations.

When divided into the two educational tracks, upper secondary school and vocational education, some minor differences were seen, and the most interesting results in relation to drop-out of secondary education are presented in Table 6.

Table 6. Individual risk factors for drop-out of secondary education in different educational tracks

	Total		Upper secondary school		Vocational education	
	OR*	95%-CI	OR*	95%-CI	OR*	95%-CI
Grades, oral Danish						
8 or above	1.0		1.0		1.0	
7 or below	2.1	1.5 ; 3.1	2.3	1.1 ; 4.6	1.6	0.98 ; 2.5
Grades, written math						
8 or above	1.0		1.0		1.0	
7 or below	2.5	1.7 ; 3.6	2.4	1.2 ; 4.7	1.9	1.1 ; 3.0
Sense of meaningfulness						
normal/high	1.0		1.0		1.0	
low	1.8	1.2 ; 2.6	1.1	0.5 ; 2.5	2.0	1.2 ; 3.3
General health status						
high	1.0		1.0		1.0	
low	2.2	1.1 ; 4.2	2.1	0.6 ; 7.8	1.9	0.8 ; 4.3

* Adjusted for gender, age when completing 9th grade and all individual and family risk factors. Values are odds ratios base on mlogit calculations.

Low grades in math and Danish showed a stronger association with drop-out from upper secondary school compared to vocational education, whereas a low sense of meaningfulness was associated with a 2-fold risk of dropping out of vocational education but was not associated with dropping out of upper secondary school. General health status showed a strong association with dropping out from both educational tracks. The associations between individual or family risk factors and educational attainment in the two educational tracks are described in more detail in paper I, Table II.

Study II

Initially non-participation

Comparing the ORs for educational attainment between the baseline population and the source population on register-based risk factors, the relative risk estimates showed no or minor differences between the two populations. We found no under- or overestimations exceeding 22%, and none of the RORs showed a statistically significant bias, since all CIs included the value one. The ORs, RORs, and 95%-CIs of educational attainment in relation to

initial non-participation are presented in paper II, Table 2.

Loss to follow-up

The examination of loss to follow-up only demonstrated modest differences on relative risk estimates when the follow-up populations were compared with the baseline population (Table 7).

Table 7. Relative odds ratios (ROR) examining the impact of loss to follow-up on odds ratios for educational attainment

	Relative Odds Ratios (ROR) [*]							
	Follow-up in 2007				Follow-up in 2010			
	Still studying		Dropping out		Still studying		Dropping out	
	ROR [†]	95%-CI	ROR [†]	95%-CI	ROR [†]	95%-CI	ROR [†]	95%-CI
Register-based risk factors								
Grades - oral Danish								
8 or above								
7 or below	1.11	0.6 ; 2.05	1.36	0.22 ; 8.54	1.18	0.53 ; 2.64	0.88	0.35 ; 2.20
Grades - written math								
8 or above								
7 or below	1.02	0.53 ; 1.97	1.21	0.18 ; 8.29	1.15	0.42 ; 3.14	1.00	0.24 ; 4.12
Drug use								
no								
yes	0.97	0.50 ; 1.89	0.89	0.41 ; 1.93	1.06	0.46 ; 2.45	1.59	0.42 ; 5.98
Household income								
highest								
middel	0.98	0.73 ; 1.32	0.96	0.53 ; 1.75	0.92	0.66 ; 1.28	0.99	0.48 ; 2.04
lowest	0.92	0.63 ; 1.34	0.88	0.30 ; 2.57	1.01	0.54 ; 1.91	1.15	0.16 ; 8.23
Highest household education								
>12 years								
10-12 years	1.00	0.76 ; 1.32	1.04	0.55 ; 1.99	1.05	0.71 ; 1.55	1.02	0.54 ; 1.91
<10 years	0.77	0.58 ; 1.02	1.26	0.10 ; 15.4	0.77	0.51 ; 1.16	1.20	0.12 ; 12.6
Family type								
two adults								
one adult	0.94	0.62 ; 1.43	0.80	0.39 ; 1.67	1.05	0.58 ; 1.93	1.18	0.33 ; 4.19
Questionnaire-based risk factors								
Self-esteem								
normal/ high								
low	0.92	0.65 ; 1.31	1.14	0.54 ; 2.40	1.09	0.60 ; 1.99	1.18	0.52 ; 2.68
Sense of meaningfulness								
normal/high								
low	1.02	0.70 ; 1.47	1.16	0.46 ; 2.94	0.84	0.63 ; 1.13	0.96	0.47 ; 1.97
General health status								
high								
low	1.55	0.36 ; 6.72	1.01	0.19 ; 5.26	1.09	0.33 ; 3.59	0.95	0.18 ; 5.15
Depressive symptoms								
no								
yes	1.06	0.82 ; 1.37	1.21	0.65 ; 2.26	1.07	0.78 ; 1.47	1.10	0.63 ; 1.91
Body mass index								
low weight	0.94	0.75 ; 1.19	1.02	0.62 ; 1.67	1.49	0.83 ; 2.66	1.11	0.58 ; 2.12
normal weight								
overweight	1.10	0.76 ; 1.57	0.88	0.46 ; 1.69	1.15	0.71 ; 1.86	1.62	0.47 ; 5.52

*Relative Odds Ratios, comparing OR's for participants at baseline in 2004 with OR's of participants at follow-up in 2007 or 2010, respectively.

[†]Adjusted for gender and age when completing 9th grade.

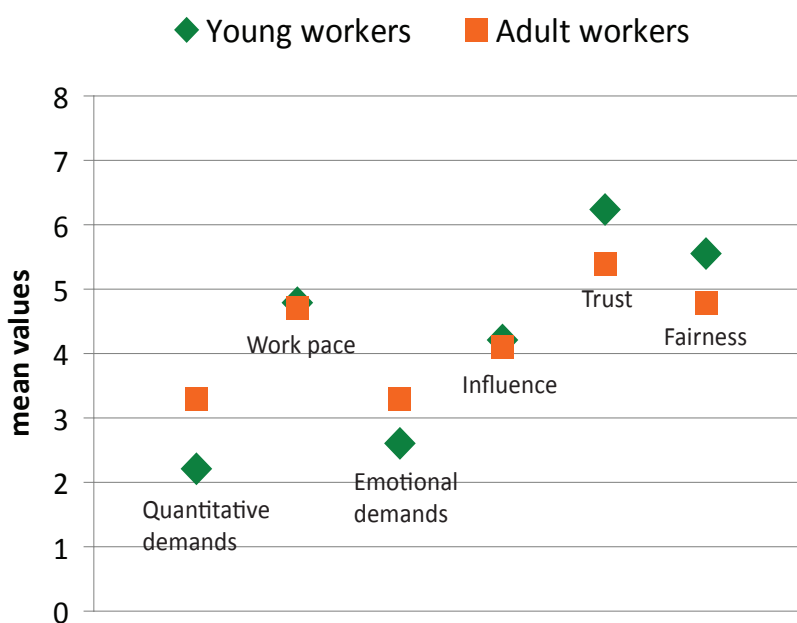
For six RORs (three at each follow-up), under- or overestimation exceeded 23%, but they were all based on small numbers and CIs were wide. The rest of the RORs did not reveal any under- or overestimation exceeding 23%, and at no point in time did the selection lead to statistically significant bias (Table 7).

In order to take into account the initial non-participation when examining loss to follow-up, a supplementary analysis was conducted comparing the follow-up populations with the source population on register variables only. It showed increasing bias for some RORs, which changed from under- or overestimation below 23% in the main analysis to under- or overestimation of 24–29%, and all but one of the CIs were not statistically significant. The results of this supplementary analysis are available in paper II, Supplementary Table 1.

Study III

Among the 679 young people with primary work affiliation or in an apprenticeship at age 20/21, the experienced psychosocial work environment was overall good. The young workers experienced less quantitative demands, less emotional demands, and higher trust and fairness at the workplace compared to a population of Danish working adults (128) (Figure 8).

Figure 8. Mean values of psychosocial work environment



For quantitative demands, work pace, and emotional demands at work, low values were considered positive, whereas high values of influence, trust, and fairness at the work place were considered positive.

On the other hand, young workers seem to experience a more demanding physical work environment than their adult colleagues (130), especially in relation to hard physical work (Figure 9).

Figure 9. Mean values of physical work environment

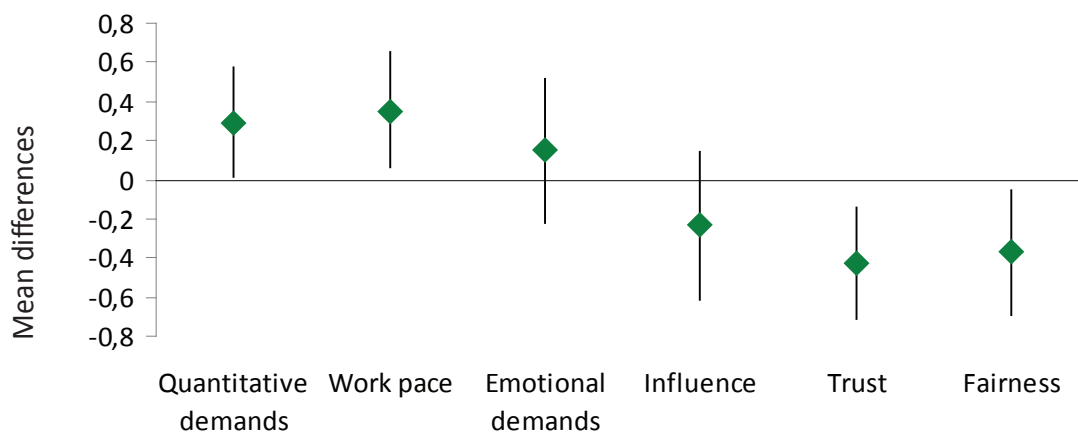


For repetitive movements and hard physical work, low values were considered positive. A more detailed presentation of the mean scores in the different exposure subgroups is available in paper III, Table 1.

Risk factors of poor psychosocial work environment

Those with low self-esteem had statistically significantly higher mean scores of quantitative demands and work pace, and statistically significantly lower scores of trust and fairness at work compared to those with normal/high self-esteem (Figure 10).

Figure 10. Mean differences of psychosocial work environment among those with low self-esteem and normal/high self-esteem (fully adjusted)



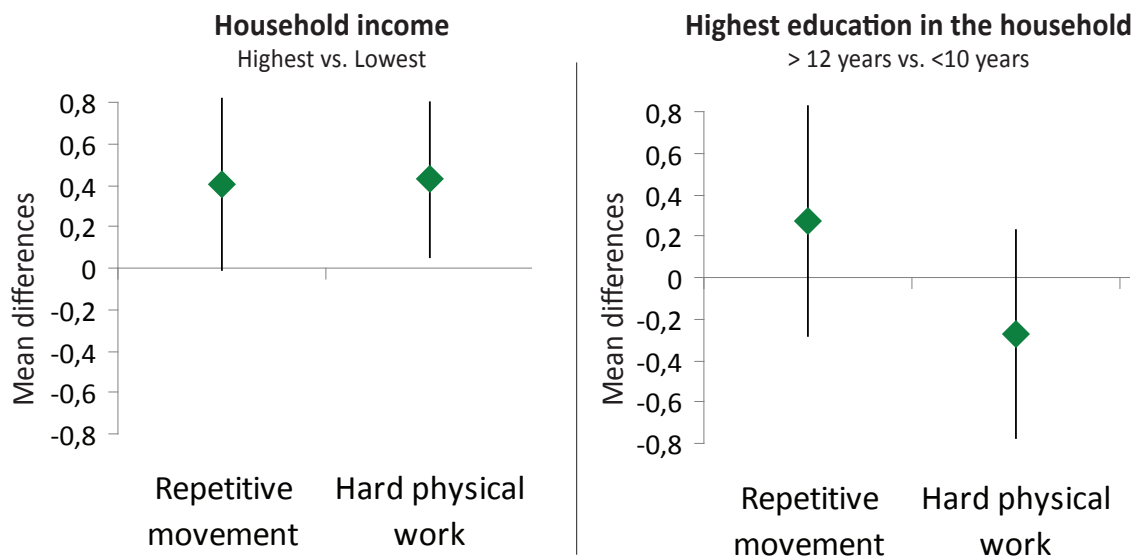
Among females and those reporting low self-esteem both at age 14/15 and age 17/18, low self-esteem was increasingly associated with experiencing low influence at work at age 20/21. Additional gender differences are presented in paper III, Supplementary Table 1.

Young people from low/middle socioeconomic status families experienced less emotional demands at work than those from high socioeconomic status families. Especially low/middle parental education was associated with low emotional demands (paper III, Table 2).

Risk factors of poor physical work environment

Figure 11 presents the mean differences of physical work environment between those from the lowest and the highest socioeconomic groups. Young people from low income families reported more repetitive movements and hard physical work compared to young people from high income families. Young people with parents with a low level of education experienced more repetitive movements than those with highly educated parents.

Figure 11. Mean differences of physical work environment among those from low socioeconomic status families and high socioeconomic status families (fully adjusted)



A more detailed presentation of the mean differences of the psychosocial and physical work environment outcomes in relation to the eight risk factors is available in paper III, Tables 2 and 3.

6. Discussion

In the following, the key findings in Study I and Study III are discussed in the light of other studies followed by a generalised section with discussion of methodological considerations across the studies. In this section, the key findings in Study II will be incorporated into the selection bias discussion.

Main findings

Educational attainment

As illustrated in Figure 6, females are a bit more likely to complete a secondary education than males, which is in line with the tendency in almost all OECD countries (23). In our study, some of the explanation for this gender difference could be that more young males than females chose vocational education, which in general lasts a bit longer than upper secondary school, and therefore males are more frequently still studying by the age of 20/21 (Figure 6 and 7).

Both individual and family risk factors were associated with the chance of completing a secondary education, also after mutually adjustments had been performed. Since the preliminary stratified analyses showed some differences in relation to educational track, the results were presented separately. Only small differences were shown for gender, why we chose to adjust for gender in the final analyses.

The strong association between poor school performance and poor educational attainment found in our study has been confirmed by others (66,67), including a study which showed test results of 9th grade students in math and reading to be associated with educational attainment 5 years later (68). The results of our study indicate that good school performance is especially important in preventing drop-out from upper secondary school.

An association between sense of meaningfulness and dropping out of vocational education but not dropping out of upper secondary school was shown. Only limited studies have investigated SOC in relation to educational attainment (69,70), and to our knowledge it is the first time a variation in pattern due to educational track has been identified. The reason for this is not quite clear. A larger data material is needed to further explore the relation between sense of meaningfulness and drop-out from vocational education.

Low self-esteem was less associated with completing secondary education compared to sense of meaningfulness, but both measures pointed in the same direction. Few studies have examined low self-esteem as a risk factor for poor educational attainment, and the results are conflicting. A longitudinal study by Mahaffy did not find self-esteem to be associated with educational attainment when aspects of social context and individual level factors were taken into account (71), whereas other longitudinal studies found that self-esteem in late childhood and adolescence did affect adult educational attainment (72,73).

No general conclusion on the association between health measures and educational attainment is justified since the results were not consistent. General health status was strongly associated with both drop-out and never attending a secondary education, which is in line with previous studies that have demonstrated an association between general health and timely high school graduation, drop-out from high school, and years of completed schooling among young people (75,76,78).

The same clear pattern was not seen in relation to BMI, which was strongly associated with never attending a secondary education but not with educational achievement otherwise. Previous results regarding BMI and educational attainment have likewise been conflicting, with some studies showing an association between adolescent obesity and educational attainment (79,80,147). A study by De Ridder et al. demonstrates that both self-rated health and BMI are strongly related to school drop-out (75), whereas a study by Viner et al. did not demonstrate any association between childhood obesity and educational attainment at age 30 (81). It is relevant to mention that opposed to our study, the study by De Ridder et al. categorised those who never attended a secondary education as drop-outs. Because of lack of power, we decided to categorise underweight, normal weight, and overweight as suggested by Cole et al. (146), but it would be interesting to explore the association between obesity and educational attainment among adolescents further since there is some indication of an exposure-response pattern (75).

No association between depressive symptoms and completing of secondary education was demonstrated in the present study. Previous studies investigating this association have not been unequivocal. One study showed an association between depressive symptoms in late

childhood and failure to complete high school (83), and another study found adolescent depressive symptoms to be associated with decreased years of schooling, increased probability of dropping out of high school, and decreased probability of college enrolment (82). Other studies have not shown as convincing associations (85,86,148), e.g. depression at age 14–16 was not associated with educational achievement at age 16–21 after adjustment for social, familiar, and individual factors, and the study concluded that an existing association was due to confounding (85).

As mentioned earlier, the association between parental socioeconomic status and educational attainment found in the present study is in accord with the findings of others (17,66,67,87,88), whereas the lack of an association between living with only one parent and educational achievement does not agree with previous findings (90,91), including a study which found adolescents from one-parent families to be less likely to graduate from high school (90). Contrary, a study from Finland found only a moderate association between single parent families and educational achievement (89). The reason for the different results could be due to variation in welfare systems in the USA and the northern part of Europe and consequently different social and economic living conditions of single parents. A correlation analysis between living with one parent and household income showed a coefficient of 0.47 (Appendix B), and adjusting for household income demonstrated the single largest negative impact on the association between family type and educational attainment in our study. The fact that two of the studies did not adjust for income means that they may have captured the effect of parental income instead of family type (89,90).

In Study II we chose to supplement the analyses with exposure information on use of prescription medication. The primary focus in paper II was to address possible selection problems, but it is relevant to mention that drug use showed strong associations with never attending a secondary education (OR=5.15 in the baseline population). This strong association remained after adjusting for all other risk factors included in the study (OR=6.2) (results not shown). The association between drug use and educational attainment was not elaborated in Study II, but it would be interesting to explore further in a larger data material.

Work environment

The psychosocial work environment of young workers was on average good compared to the Danish general working population, but they experienced more demanding physical work than adults. One explanation for this negative distortion of physical demands at work, which has also been found in younger ages (61), could be that young workers do not yet have the same degree of experience and social position as older workers and in that way

are selected to perform the hardest job functions.

None of the family or individual risk factors showed any strong association with experienced work environment, and all the mean differences were below a minimal important difference of 0.5 SD (42). Although Pejtersen et al. recommended minimal important differences of 0.3 SD in the quantitative demands scales and 0.2 SD in the influence scales, we chose to stick to the commonly accepted minimal important difference of 0.5 SD for all the used scales (42).

Although the results of this study are in favour of the work environment among young people, the importance of vulnerability, especially low self-esteem in late childhood is relevant to discuss. Overall, low self-esteem at age 14/15 showed the strongest associations with reporting of a poor psychosocial work environment at age 20/21, and in relation to experiencing low influence at work, the strongest associations were seen among females and those reporting low self-esteem both at age 14/15 and age 17/18.

Even though low self-esteem has been found to be associated with low job performance and low job satisfaction among adults (97,98) and a Danish study has reported an association between self-esteem and later cognitive stress symptoms (149), studies investigating childhood self-esteem as a potential risk factor of experienced psychosocial work environment among young workers are lacking.

The reason why low self-esteem seems to be an important risk factor for poor psychosocial work environment could be that those with low self-esteem are selected into jobs with a poor work environment due to their low self-esteem. Another explanation could be negative affectivity (150), where low self-esteem could influence the way the individual perceives the work environment. Of the two possible explanations, we think the first is most likely because self-esteem showed stronger associations with measures of demands, trust, and fairness than with influence.

Except for being associated with low influence at work, especially among females, sense of meaningfulness was not strongly associated with a poor psychosocial work environment. This finding is in line with a study by Togari et al., which did not find any association between SOC and the experienced psychosocial work environment 2 years later in a population of 20- to 40-year-old workers (96).

No clear pattern was observed between school performance or health measures and work environment except that low general health status showed some diverging results as it was strongly associated with high quantitative demands and increased repetitive movements;

however, those with a low general health status reported less amount of hard physical work compared to those with high general health status.

The strong relation between low socioeconomic status and poor psychosocial work environment demonstrated among adult workers (100,101) was weaker in this study than the relation between low socioeconomic status and poor physical work environment, which has also been demonstrated previously (58,101). Actually, low socioeconomic status was found to be associated with experiencing low emotional demands at work. This reverse tendency has been demonstrated previously (100,101). A Danish study by Kristensen et al. found high emotional demands among high socioeconomic groups particular in groups working with clients, patients, inmates, or children (100). Although emotional demands have been identified as an independent risk factor with regard to mental health and sickness absence (151-153), the strength and direction of the association seem to depend heavily on the resources of the individual worker. Demands that are too high for one person might very well be suitable or too low for another (100). It is therefore not clear whether the higher levels of emotionally job demands found in the higher socioeconomic groups should necessarily be considered as potentially harmful unless combined with low job control (32).

Methodological considerations

Selection bias

Selection bias may result from procedures used to select the study population and from factors that influence study participation (104). A priori, we were worried about selection due to initial non-participation and loss to follow-up in the study. Due to the thorough data collection during school time at the participants' schools and the possibility to mail questionnaires to those not at school on the day of collection or those attending school a year too early or too late, the response rate of the first round of questionnaires was as high as 83%. Unfortunately, the high response rate at baseline declined at follow-ups (65% in 2007 and 58% in 2010, Table 3), which could potentially have introduced selection bias.

As mentioned earlier, the concern about selection bias is especially serious if the decision to take part in the study is related to the outcome. Due to the prospective design and the fact that the participants in the Vestliv study knew nothing about their educational or occupational outcome when they took the decision on participation at baseline, we do not consider this to be a problem of great size. On the other hand, it cannot be ruled out that

the decision on participation could have been influenced by factors which were indirectly associated with the outcomes.

Study I

In Study I, 80.8% of the responders had completed a secondary education during follow-up compared to only 59% of the non-responders. This means that those who were still studying had dropped out or never attended a secondary education were underrepresented in our study.

Study II

In accordance with other studies (105-107,109,110,112,113), Study II showed that baseline participants more often came from homes with two adults or with higher income and educational level than the general population of young people. The baseline participants also tended to have better school abilities than the general population of young people. Measures of health and well-being were not found to be associated with participation in this study, which is in line with the findings in some studies (111,154,155) but opposite others that found high mental distress (108,110), low general health status (108,114,156), and high BMI (108) to be related to initial non-participation and loss to follow-up. The reason for these inconsistent results are not clear, but they could be due to the fact that young people in general suffer from less severe morbidity than older generations, meaning that health problems would have a smaller impact on their ability to participate.

Initial non-participation as well as loss to follow-up only showed small differences on the relative risk estimates (RORs), and at no point in time did the selection lead to statistically significant bias. Previous studies based on adult cohorts that used RORs to calculate relative risk estimates have not found any considerable selection bias in relation to the initial non-participation (121,122) or loss to follow-up (120). Some of the relative risk estimates showed wide confidence intervals, which limited our ability to detect important differences among source, baseline, and follow-up populations. The chosen associations are only a small subset of all the associations that will be investigated on basis of the Vestliv cohort, and it is possible that other associations may have a larger bias due to initially non-participation and loss to follow-up. It is important to emphasise that while other researchers can benefit from applying the presented method of estimating selection bias, the results cannot be generalised to other research areas.

Study III

In Study III those experiencing a poor work environment may have been underrepresented. The young people with poorest work environment could, because of high strain at work, already have lost connection with the labour market and in that way be underrepresented

in the study population. This could potentially lead to underestimations of associations in the study (104).

A comparison of the distribution of four register variables between the participants and the potential participants, meaning those with information on work environment but no questionnaire information from baseline, indicated that the participants performed better in school and came from families of higher socioeconomic status. On the other hand, only small differences were seen between the risk estimates in the two populations, and it did not lead to any important changes in the findings.

The fact that those with low general health status reported less hard physical work compared to those with high general health status could be a result of a healthy-worker effect, meaning that those with poorer health are selected to less strenuous jobs because of health reasons. It has been discussed whether this bias is a selection bias or due to confounding (104), but eventually it could lead to underestimations of the associations in the study.

Information bias

Information bias occurs when there is systematic error in the information from or about the study participants. Information bias can be either differential or non-differential and may be a consequence of measurement error, i.e. if the exposure, outcome, or confounders are subject to misclassification. Differential misclassification means that the error occurs more frequently in one group than in the other(s), whereas non-differential misclassification causes the same error in all study groups. Differential misclassification can either exaggerate or underestimate associations, while non-differential misclassification tends to produce estimates that are biased towards the null (157).

In this study, information bias most likely occurred as a result of self-reported information. Register information can also induce information bias since the data quality depends largely on the purpose of the register, the data collection method, and the coverage, but the bias will most likely be non-differential in nature. In general, it is considered a strength, when both register- and questionnaire-based data are used because this minimises the risk of common method variance, which can lead to differential misclassification and risk of overestimating the associations (158,159). In the following, possible sources and reasons for misclassification of exposure or outcome are discussed along with elaborations on whether they are differential or non-differential.

A general consideration was to what degree the exposure variables were correlated. However, a correlation matrix in general showed low to moderate correlations between exposure variables, apart from a correlation of 0.47 between household income and family type (See Appendix B).

Misclassification of exposure

Register data

Due to high validity of the Danish Civil Registration System as well as the register information on education and income, none or limited information bias was expected in relation to variables measuring school grades, highest education, or income in the household as well as family type, and any potential bias was considered non-differential. Since information about sale of prescription medication must be reported in Denmark and we used information from two complete years, the risk of misclassification of this variable is also considered minor and non-differential.

Questionnaire data

In order to gain comprehensibility of the estimates, we chose to dichotomise all self-reported exposures. The CES-DC scale measuring depressive symptoms, which have been found to be the most valid as a measure of depression for girls and for children aged 12–18 years (143), was dichotomised at a cut-off of 3 and above, as suggested by Fendrich et al. (143), and a Cronbach's alpha of 0.63 was computed. The dichotomisation of the scales measuring self-rated health status, self-esteem, and sense of meaningfulness were not validated, which means that potential misclassification due to dichotomisation could be a possibility but was considered most likely to be non-differential. As a way of addressing the potential problems with dichotomisation, sensitivity analyses were performed in Study I and Study III that included the exposure variables as continuous or in finer categories as well as changing cut-off points. This did not change the overall conclusions either in relation to educational attainment or work environment outcomes.

As a measure of general health status, we used the one item from the SF-36 (141) which is found to be strongly associated with both mortality and morbidity (140,141) indicating that this global question has good validity. Due to the population of overall healthy young workers, the response categories of this item resulted in a ceiling effect. As a consequence, we decided to dichotomise the responses. Misclassification is considered unlikely or at least non-differential.

The use of abbreviated scales to measure self-esteem and sense of meaningfulness could

have introduced information bias. The 6-item subset from the well-known self-esteem scale developed by Rosenberg (160) has previously been tested valid by Turner et al., and a Cronbach's alpha of 0.82 found in this study is very similar to their alpha of 0.78 (138).

The four questions about sense of meaningfulness from the "Orientation to life questionnaire" (SOC-13) constitute one of three sub-scales used to measure SOC (133), but since the scale was developed to measure the construct as a global orientation, the decision to use only one of the sub-scales could have affected the validity of the variable. In studies using the complete SOC-13 scale, Cronbach's alphas between 0.74 and 0.91 have been detected (133), whereas the Cronbach's alpha of the meaningfulness sub-scale was only 0.53 in a study in an old population (161), which is a bit lower than the 0.62 found in our population of young workers. The potential misclassification introduced by the use of abbreviated scales is most likely non-differential. For more information about the wording and validity of the scales used, see Appendix A.

The calculation of BMI was based on self-reported height and weight. Self-reported weight among adolescents is likely to be under-reported, with overweight and obese participants showing greater bias and variability in self-reported weight than normal/underweight participants (162). This could potentially have led to differential misclassification both in relation to educational attainment and work environment, but since mainly overweight and obese participants tend to be misclassified as normal weight and not the opposite, it would most likely have biased the estimates towards unity.

Misclassification of outcome

In Study I and Study II, the prospective design and the use of information from the education register (125), when collecting and defining the outcome "educational attainment" make the risk of differential misclassification of this outcome unlikely.

In Study III, the use of a self-reported work environment measures could possibly have introduced information bias. The main disadvantage of using self-administered questionnaires to gather information about psychosocial working conditions is that self-administered questionnaires can be influenced by factors other than the work environment itself. If the exposed perceived the work environment to be different from the non-exposed due to their exposure and thereby tended to generally report more negatively on all aspects of work environment than the non-exposed, misclassification could have occurred. This potential problem with negative affectivity was, as mentioned earlier, a concern in relation to low self-esteem, which overall showed the strongest associations with poor psychosocial

work environment. It could be that low self-esteem influenced the way the individual perceived the work environment, meaning those who reported low self-esteem automatically reported negatively on all aspects of work environment as well. This problem could potentially lead to differential misclassification, with overestimation of the association between low self-esteem and poor psychosocial work environment.

The lack of information about former work experience, on how long the participants had been in present employment or apprenticeship, and on the number of working hours per week could also have introduced misclassification, but it was considered to be non-differential.

Follow-up time

The primary analyses in this thesis were based on questionnaire information from baseline in 2004 and follow-up in 2010. This resulted in a follow-up period of approximately 6 years. It is possible that changes in exposure status of the participants may have happened during the follow-up period, which could potentially have affected the associations under study. However, in Study III, an attempt was made to obtain information about what happened between the two collections, by including information on four of the questionnaire-based risk factors from follow-up in 2007, in a supplementary analysis. Based on these results it seemed that the reporting of low self-esteem both in 2004 and 2007 increased the risk of experiencing poor psychosocial work environment in 2010 (results not shown), but the tendency was not consistent through all the measures of psychosocial work environment. These results indicate that the true effect of some of the exposures on selected work environment measures probably has been underestimated.

It could also be discussed whether 6 years follow-up time is long enough to investigate educational attainment or work environment as outcome. However, early signs of failure to thrive both in the educational system as well as on the labour market (or both in combination as in apprenticeship) could potentially have great consequences in relation to later marginalisation and exclusion from the labour market, and for this reason we find it relevant to get information about the early transition from the educational system to work life.

A stronger attempt of integrating as much longitudinal information as possible both from registers as well as questionnaires will be made in the future, and hopefully it will be supplemented with a fourth collection round when the participants are 24/25 years old in 2014/2015.

Statistical issues

The presented studies used prospectively collected data from a large youth cohort. The large size of the cohort and the almost complete information on register information allowed us to investigate our research questions in great detail. On the other hand, we experienced limited statistical power with regard to the investigation of more detailed subanalyses in relation to gender and educational track. Likewise, the numbers in some of the categories of the exposure variables, e.g. general health status, were small, resulting in rather imprecise estimates. In order to address this problem, sensitivity analyses were performed, and changes in scales or cut-off points did not show considerable changes in the results. We are aware that some of our findings lack statistical precision, and therefore the risk of chance findings has to be considered. A solution to this problem could be to collaborate with other youth cohorts in the future in order to gain larger data sets.

In Study II, we used ROR estimates with 95%-CIs to estimate the degree of initial non-participation and loss to follow-up. This method has been tested in a Danish simulation study and shown to give valid CIs for RORs when the expected bias related to the selection is modest (121). Multiple imputation techniques is another increasingly used method of addressing problems with missing data in order to avoid selection bias (118,119). The idea behind imputation methods is to create several imputed data sets in which missing observations are replaced with random values from a statistical model based on distributions in the observed dataset and underlying assumptions on the nature of the missing data (119,163,164). In order to deal with missing data in the Vestliv cohort, the plan is to supplement future analyses with multiple imputation methods.

In order to use as much data material as possible and to avoid further selection bias due to exclusion, different numbers of participants in the risk factor categories were accepted in the analyses of all three studies. In Study III, an additional complete case analysis using only the 578 participants with complete information on all risk factors and outcomes showed slight differences from the partly adjusted and fully adjusted estimates, but no alteration of the overall conclusions.

Confounding and effect modification

By definition, a confounder must be associated with both the exposure and the outcome and should not be a part of the causal pathway between exposure and outcome. Effect modification is defined as a situation where the effect of an exposure on an outcome depends on the levels of another variable. The variable across which the effect measure varies

is called an effect modifier (157).

When studying risk factors of an outcome instead of focusing on causality, adjustment of both confounders and other risk factors is relevant. In our studies, stratification and adjustment were used in multivariate regression analyses. Mutually adjustments of the exposure variables were performed in Study I and Study III in order to explain as much of the direct association between each risk factor and the outcome of interest (educational attainment and work environment, respectively). It is a possibility that some of the exposures could be intermediates (mediators) of the association between other exposures and the outcome of interest. For instance, in Study I the strong effect of family risk factors on educational attainment, especially parental education, was attenuated when personal risk factors were included in the models, and it could be argued that school grades may be intermediates of the association between educational status of the parents and educational attainment of the young people. As mentioned in the main findings section, it likewise seems that household income mediates the association between family type and educational attainment.

In Study I, stratification on gender did not show clear signs of effect modification in relation to educational attainment, and therefore it was chosen to adjust for gender in Study I and Study II. However, in Study III gender showed signs of being an effect modifier in relation to some of the risk factors of poor work environment, and therefore it was chosen not to adjust for gender but present the results all together and for each gender separately. In Study I and Study II, age when completing 9th grade was considered a potential confounder and was adjusted for. In Study III information about whether the young workers were employees or in an apprenticeship was likewise considered a potential confounder and adjusted for.

Causality

Since the studies in this thesis investigated risk factors of educational attainment and experienced work environment, the focus was not on causality, and caution about causal inference is warranted. It is most likely that other factors related to school environment, teachers' recommendations, and parents' educational aspirations for their children are also relevant to include when trying to understand the causes for not completing a secondary education. In addition, other aspects of physical and psychosocial work environment as well as individual characteristics like coping strategy or personality could be interesting to include in future research on the relation between individual and background characteristics and experienced work environment. Structural and contextual factors such as labour market conditions and actual circumstances in the workplace could also have an impact on the experienced work environment among young workers.

Generalisability

Young people represent a very heterogeneous group, which makes generalising difficult (165). In Study I, those still attending a secondary education at the age of 20/21 was a complex group, both containing some studying without delay as well as some who will never complete a secondary education.

In Study III, the study population was based on young people having primary affiliation to the labour market or attending a vocational education with an apprenticeship at age 20/21. This means that the young people who were attending a tertiary education in the university or other institution at age 20/21 were not represented, and the study population therefore likely consisted of fewer persons who will end up completing a tertiary education compared to adult cohorts.

Another threat to the generalisability of Study III is the possibility that the number of young people who perform physical demanding jobs is overestimated due to the occupational structure in the rural region from where the young people were sampled.

For these different reasons, caution must prevail with regard to generalising the results of this study to all Danish young people.

7. Conclusion

In this thesis, we studied the associations between individual and family risk factors in late childhood and educational attainment as well as experienced work environment among young people at the age 20/21.

The study on completion of secondary education confirmed a social gradient in educational attainment. Furthermore, the results indicated that factors related to low school performance, low health status, and high vulnerability compromise the opportunity for young people to complete secondary education, despite socioeconomic background. Especially, low sense of meaningfulness was a strong risk factor of dropping out of vocational education, and overweight showed a strong association with never attending a secondary education. Depressive symptoms or living with one parent did not show any strong association with completing a secondary education.

The study investigating risk factors of poor work environment demonstrated an overall good psychosocial work environment among 20/21-year-olds compared to adult workers, whereas the physical work environment of young workers needs improvement. None of the individual or family risk factors showed strong associations with poor experienced psychosocial or physical work environment, but it seemed that young people with low self-esteem may need special attention to prevent them from being selected into psychosocially demanding job functions later in life. Low parental socioeconomic status was the strongest risk factors for poor physical work environment.

We also investigated the impact of initial non-participation and loss to follow-up on the validity of descriptive measures and selected estimates of relative risk. Although certain characteristics were related to initially participation and especially to participation at follow-ups, it did not have any large impact on the relative risk estimates of educational attainment. These findings are related to specific associations in a population of young people and cannot be generalised to other research areas. Nevertheless, the results are reassuring with regard to obtaining valid risk estimates in future analyses of the Vestliv Cohort.

8. Perspectives and future research

This PhD project investigates what determines educational attainment and experienced work environment in young people. On the basis of the conclusions, it is recommended that the high-risk groups be recognised and targeted at an early stage in order to ensure a successful transition from school to work life. Hopefully, it will help preventing young people from having their future opportunities substantially reduced.

As stated earlier the aim of this PhD project was not to explore health as an outcome per se but to investigate risk factors of educational and work life outcome, which eventually can lead to development of health problems. Although no directly transferable The Reserve Capacity Model by Gallo & Matthews (Figure 1) illustrates the complex associations between socioeconomic status, vulnerability (Reserve Capacity), emotions, experiences, and poor health outcomes (7).

The fact that vulnerability measures like low sense of meaningfulness and low self-esteem were found to be important risk factors for later adverse educational and work related outcomes is supported by the model. It stresses the importance of such psychosocial resources (Reserve Capacity) on cognitive-emotional factors as well as on behavioural and physiological pathways, eventually leading to poor health outcomes.

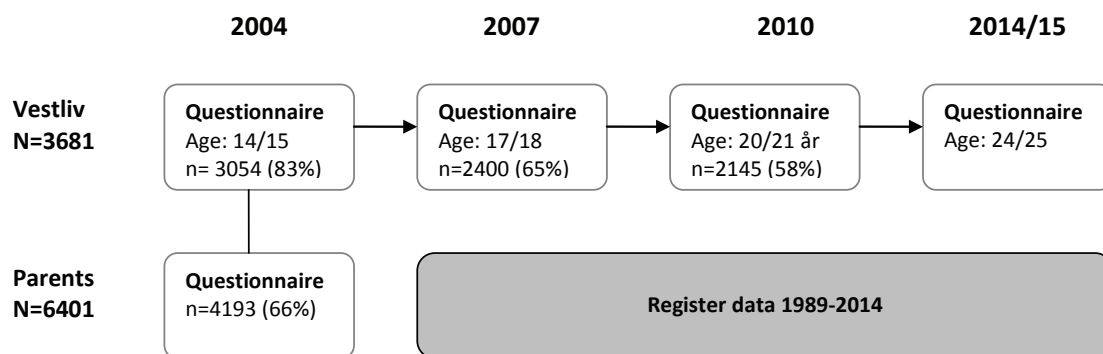
Regardless of the contribution from this PhD project there still is a gap in our knowledge about the mechanisms affecting the transition from school to work life. Especially evidence linking individual or family factors and work life outcomes of young people is scarce.

Future research on Vestliv will increase the focus on the life course perspective with investigations on the relations between mental or physical health and later work life outcome across generations. Longitudinal studies with the purpose of identifying family or personal resources, which prevent negative social heritage in the interaction between mental or physical health and work life outcome in early adulthood will be performed.

8. Perspectives and future research

Register and questionnaire information on the young people and their parents will be used and hopefully a new collection round will be conducted in 2015, supplementing the existing register and questionnaire information with information from the young people at the age of 24/25 (Figure 12).

Figure 12. Previous and future data collections on the Vestliv Cohort



With more knowledge on this topic, facilitation of personal and family resources at an early stage may potentially reduce the number of young people with poor prospects for later work life outcome.

9. English summary

Background

The transition from school to work life is a critical period in young people's lives, and educational achievements as well as start at work are important determinants of later development of inequality in both health and social status. In Denmark, around 9% to 15% do not complete a secondary education, and almost half of those who start a vocational education drop out. A good work environment at the start of a job career is necessary to inspire towards the finishing of a vocational education, to reduce risk of later work-related health problems, and to prevent new employees from losing connection with the labour market.

Aim

The aim was to provide further insight into the influence of late childhood individual and family risk factors on educational attainment and experienced work environment among Danish 20/21 year olds in the transition from school to work life. This PhD project also includes a methodological study that investigates potential selection problems in the Vestliv Cohort.

Materials and methods

Questionnaire information from a cohort of 3681 young people born in 1989 (Vestliv) was collected at ages 14/15, 17/18, and 20/21. In addition, data from several registers were used. The outcome educational attainment at age 20/21, used in Study I and Study II was based on register information, whereas the eight work environment outcomes in Study III were based on questionnaire information at age 20/21. Exposure information was divided into the four domains: school performance, vulnerability, health, and family background, and consisted of 11 individual and family risk factors, all together. Multinomial logistic regression and multiple linear regression models were used to estimate associations between risk factors and educational attainment or work environment.

Additionally, the pattern of participation and the impact of initial non-participation as well as loss to follow-up on relative risk estimates for educational attainment were estimated by computing prevalence ratios (PR) and relative odds ratios (ROR) between the source, baseline, and follow-up populations.

Results

Study I: Among the 3053 young people with baseline and outcome information, 80.8% had completed a secondary education at age 20/21. Low grades and low general health status were strong risk factors for not completing a secondary education. Low sense of meaningfulness and overweight were associated with never attending a secondary education. Low sense of meaningfulness was associated with increased risk of dropping out of vocational education but not dropping out of upper secondary education.

Study II: At baseline participants had slightly better school abilities and came more often from homes with two adults and higher income and educational levels compared to the source population. This selection pattern became more pronounced at the first follow-up, but was not further strengthened at the second follow-up. Neither initial non-participation or loss to follow-up demonstrated any statistically significant selection bias.

Study III: Among the 679 young people with primary work affiliation or in an apprenticeship, the experienced psychosocial work environment was more positive compared to their adult colleagues, whereas the physical work environment was more demanding. Overall, no strong associations between any of the risk factors and reporting of psychosocial and physical work environment were shown. Low self-esteem at age 14/15 showed the strongest associations with experiencing a poor psychosocial work environment at age 20/21. Low parental socioeconomic status was associated with poor physical work environment.

Conclusion

The results of these studies stress the importance of integrating different individual and family background aspects when trying to understand what compromises the opportunity for young people to complete secondary education and to have a positive start in work life. The findings of a low sense of meaningfulness as being a risk factor of dropping out from vocational education and low self-esteem being associated with reporting of poor psychosocial work environment among 20/21 year olds support the importance of increasing focus on vulnerable young people in the transition from school to work life.

The results shown in Study II are reassuring with regard to obtaining valid risk estimates in future analyses of the Vestliv Cohort.

10. Dansk resumé

Baggrund

Overgangen fra skole til arbejdsliv er en kritisk fase i unge menneskers liv, hvor såvel uddannelsesgennemførelse som start på arbejde er vigtige determinanter for senere udvikling af ulighed i helbred og social status. I Danmark gennemfører 9% til 15% aldrig en ungdomsuddannelse og næsten halvdelen af de som starter på en erhvervsuddannelse dropper ud. Et godt arbejdsmiljø ved jobstart er nødvendigt for at facilitere til gennemførelse af erhvervsuddannelse, reducere risikoen for udvikling af arbejds-relaterede helbredsproblemer og forebygge, at nye ansatte mister tilknytningen til arbejdsmarkedet.

Formål

Formålet var at producere yderligere viden om betydningen af individuelle og familiemæssige risikofaktorer i sen barndom for uddannelsesgennemførelse og oplevet arbejdsmiljø blandt danske unge 20/21 årige i overgangen fra skole til arbejdsliv. Dette ph.d. projekt omfatter desuden et metodestudie med formålet at estimere potentielle selektionsproblemer i Vestliv kohorten.

Materiale og metode

Spørgeskemainformation fra en kohorte af 3681 unge, født i 1989 (Vestliv) blev indsamlet ved 14/15, 17/18 og 20/21 års alderen. Desuden blev der anvendt information fra adskilte registre. Udfaldet uddannelsesgennemførelse ved 20/21 års alderen, som blev anvendt i Studie I og Studie II, var baseret på registeroplysninger mens de otte arbejdsmiljø udfald i Studie III var baseret på spørgeskemainformation ved 20/21 års alderen. Eksponeringsoplysningerne blev inddelt i de fire domæner: skole evner, sårbarhed, helbred og familiebaggrund, og bestod i alt af 11 individuelle og familiebaggrunds risikofaktorer. Multinomial logistisk regression og multipel lineær regressions modeller blev anvendt til at estimere sammenhænge mellem risikofaktorer og uddannelsesgennemførelse samt arbejdsmiljø.

Endvidere blev karakteristika for deltagelse samt betydningen af ikke-deltagelse ved baseline og follow-ups for de relative risikoestimer for uddannelses gennemførelse estimeret ved at beregne prævalens ratioer (PR) og relative odds ratioer (ROR) mellem kilde-, baseline- og follow-up populationer.

Resultater

Studie I: Af de 3053 unge med informationer fra baseline og information om udfald havde 80,8% gennemført en ungdomsuddannelse ved 20/21 års alderen. Lave karakterer samt lav generel helbreds status var stærke risikofaktorer for ikke at gennemføre en ungdomsuddannelse. Lav følelse af meningsfuldhed og overvægt var sammenhængende med aldrig at påbegynde en ungdomsuddannelse. Lav følelse af meningsfuldhed var sammenhængende med øget risiko for at droppe ud af en erhvervsuddannelse, men ikke med at droppe ud af gymnasiet.

Studie II: Deltagerne ved baseline havde lidt bedre karakterer i skolen og kom oftere fra hjem med to voksne, højere indkomst og uddannelsesniveau sammenlignet med kildepopulationen. Dette selektionsmønster blev mere udtalt ved første follow-up, men blev ikke yderligere forstærket ved anden follow-up. Hverken ikke-deltagelse ved baseline eller follow-ups førte til statistisk signifikant selektions bias.

Studie III: Det psykosociale arbejdsmiljø blandt de 679 unge med primær arbejdsmarkedskontakt eller læreplads var bedre sammenlignet med deres ældre kollegers, mens det fysiske arbejdsmiljø var mere belastende. Overordnet var der ingen stærk sammenhæng mellem nogen af risikofaktorerne og rapporteringen af psykosocialt eller fysisk arbejdsmiljø. Lav selvtillid ved 14/15 års alderen var stærkest associeret med dårligt psykosocialt arbejdsmiljø ved 20/21 års alderen. Lav socioøkonomisk status hos forældrene var sammenhængende med dårligt fysisk arbejdsmiljø.

Konklusion

Resultaterne fra disse studier viser vigtigheden af at integrere forskellige individuelle og familiebaggrunds aspekter, når vi vil forstå, hvad der mindsker unges mulighed for at gennemføre en ungdomsuddannelse og få en positiv start på arbejdslivet. At lav følelse af meningsfuldhed er en risikofaktor for at droppe ud af erhvervsuddannelse, og at lav selvtillid er sammenhængende med rapportering af dårligt psykosocialt arbejdsmiljø blandt 20/21 årige viser vigtigheden af et øget fokus på sårbare unge i overgangen fra skole til arbejdsliv. Resultaterne fra Studie II er lovende i forhold til muligheden for at udregne valide risikoestimer i fremtidige analyser baseret på Vestliv kohorten.

11. Appendices

Appendix A. Wording and description of the questionnaire variables

Variable name*	Year	Question	Answer categories	Chronbach alfa** (scales)
Sense of meaningfulness	2004 and 2007	a) Hvad synes du om de ting, du gør i hverdagen?	“meget spændende, spændende, OK, kedelige, meget kedelige”	0.62
		Om din hverdag: b) Hvor tit gør du ting, som du selv synes er meningsfulde? c) Hvor ofte føler du, at du er ligeglad med det, der sker omkring dig? d) Hvor tit har du følelsen af, at det du foretager dig er uden mening?	“meget ofte, ofte, af og til, sjældent, aldrig”	
Self-esteem	2004 and 2007	Hvor enig eller uenig er du i hvert af de følgende udsagn? a) Jeg synes, at jeg har en del gode egenskaber b) Jeg synes, at jeg er mindst lige så meget værd som andre c) Jeg kan gøre ting lige så godt som de fleste andre d) Jeg har et positivt syn på mig selv e) Alt i alt er jeg tilfreds med mig selv f) Alt i alt er jeg tilbøjelig til at føle mig som en fiasko	“meget enig, enig, uenig, meget uenig”	0.82
General health status	2004 and 2007	Hvordan synes du dit helbred er alt i alt?	“fremragende, vældig godt, godt, mindre godt, dårligt”	One item
Depressive symptoms	2004 and 2007	I løbet af den sidste uge, hvor meget har du haft følgende følelser? a) Jeg var glad i den sidste uge b) Jeg følte at kammerater ikke var venlige og ikke havde lyst til at være sammen med mig c) Jeg følte mig trist d) Det var hårdt at komme i gang i denne uge	“slet ikke, lidt, nogle gange, en hel del”	0.63
Body mass index	2004	Hvad er din højde i cm? Hvad er din vægt i kilo?		

11. Appendices

Quantitative demands	2010	Kommer du bagud med dit arbejde? Har du tid nok til dine arbejdsopgaver?	“altid, ofte, sommetider, sjældent, aldrig/næsten aldrig”	0.56
Work pace	2010	Er det nødvendigt at arbejde meget hurtigt? Er arbejdstempoet højt gennem hele arbejdsdagen?	“altid, ofte, sommetider, sjældent, aldrig/næsten aldrig”	0.67
Emotional demands	2010	Bringer dit arbejde dig i følelsesmæssige belastende situationer? Skal du tage stilling til andre menneskers personlige problemer i dit arbejde?	“altid, ofte, sommetider, sjældent, aldrig/næsten aldrig”	0.54
Influence	2010	Har du stor indflydelse på beslutninger om dit arbejde? Har du indflydelse på mængden af dit arbejde?	“altid, ofte, sommetider, sjældent, aldrig/næsten aldrig”	0.54
Trust	2010	Stoler ledelsen på, at medarbejderne gør et godt stykke arbejde? Kan man stole på de udmeldinger, der kommer fra ledelsen?	I meget høj grad, I høj grad, Delvist, I ringe grad, I meget ringe grad	0.74
Fairness	2010	Bliver konflikter løst på en retfærdig måde? Bliver arbejdsopgaverne fordelt på en retfærdig måde?	I meget høj grad, I høj grad, Delvist, I ringe grad, I meget ringe	0.73
Repetitive movement	2010	Hvor ofte skal du - som en del af dit arbejde: ...gøre den samme bevægelse i lange perioder? ...udføre samme arbejdsopgave med arme, hænder eller fingre mange gange i minuttet?	sjældent/aldrig, sommertider, ofte, (næsten) altid	0.81
Hard physical work	2010	Hvor ofte skal du - som en del af dit arbejde - ...lave fysisk hårdt arbejde? ...bruge din maksimale fysiske styrke?	sjældent/aldrig, sommertider, ofte, (næsten) altid	0.82

*Measures of sense of meaningfulness, self-esteem, general health status and depressive symptoms were asked the same way at follow-up in 2007 as at baseline in 2004.

**The Chronbach alfa calculations are based on all available answers from 2004 or follow-up in 2010

Appendix B. Correlation matrix between exposure variables used in studies I, II and III

(obs=2548)

	Danish	Math	GHS*	BMI	SOC(me)**	Depressive	Self-esteem	Income	Edu	Family type	Drug use
Danish	1.0000										
Math	0.4384	1.0000									
GHS*	-0.0131	-0.0552	1.0000								
BMI	-0.0238	-0.0436	0.0792	1.0000							
SOC(me)**	0.1228	0.0977	-0.1331	-0.0386	1.0000						
Depressive	0.0078	-0.0617	0.2056	0.0519	-0.3631	1.0000					
Self-esteem	0.0869	0.1731	-0.1822	-0.0383	0.4022	-0.3930	1.0000				
Income	0.1449	0.1988	-0.0609	-0.0237	0.1029	-0.0750	0.0736	1.0000			
Edu	-0.2077	-0.2153	0.0765	0.0764	-0.0734	0.0004	-0.0947	-0.3244	1.0000		
Family type	-0.0219	-0.1128	0.0633	-0.0024	-0.0321	0.0626	-0.0377	-0.4737	0.1302	1.0000	
Drug use	-0.0031	-0.0317	0.0524	0.0107	-0.0375	0.1033	-0.1324	-0.0101	0.0217	-0.0032	1.0000

* GHS = General health status

** SOC(me) = Sense of meaningfulness

12. References

- (1) Wilkinson R, Marmot M. Social determinants of health: the solid facts. 2nd ed. Geneva: World Health Organization; 2003.
- (2) Diderichsen F, Andersen I, Manuel C. Health Inequality-determinants and policies [Ulighed i sundhed-årsager og indsatser]. Sundhedsstyrelsen 2011.
- (3) Graham H, Power C. Childhood disadvantage and health inequalities: a framework for policy based on lifecourse research. *Child Care Health Dev* 2004;30(6):671-678.
- (4) Freudenberg N, Ruglis J. Reframing school dropout as a public health issue. *Prev Chronic Dis* 2007;4(4):A107.
- (5) Due P, Krolner R, Rasmussen M, Andersen A, Trab Damsgaard M, Graham H, et al. Pathways and mechanisms in adolescence contribute to adult health inequalities. *Scand J Public Health* 2011;39(6 Suppl):62-78.
- (6) Kuh D, Ben-Shlomo Y, Lynch J, Hallqvist J, Power C. Life course epidemiology. *J Epidemiol Community Health* 2003;57(10):778-783.
- (7) Gallo LC, Matthews KA. Understanding the association between socioeconomic status and physical health: do negative emotions play a role? *Psychol Bull* 2003;129(1):10-51.
- (8) Gallo LC, Bogart LM, Vranceanu AM, Matthews KA. Socioeconomic status, resources, psychological experiences, and emotional responses: a test of the reserve capacity model. *J Pers Soc Psychol* 2005;88(2):386-399.
- (9) Viner RM, Ozer EM, Denny S, Marmot M, Resnick M, Fatusi A, et al. Adolescence and the social determinants of health. *Lancet* 2012;379(9826):1641-1652.
- (10) Diderichsen F, Andersen I, Manuel C, Working Group of Danish Review on Social Determinants of Health, Andersen AM, Bach E, et al. Health Inequality--determinants and policies. Summary. *Scand J Public Health* 2012;40(8 Suppl):6-8.
- (11) Marmot M. Fair Society, Healthy Lives. University College London 2010.

- (12) The Ministry of children and education [Undervisningsministeriet]. Educational guide [Uddannelsesguiden]. Available at: <http://www.ug.dk/>. Accessed April/27, 2014.
- (13) Statistics Denmark. Denmark in numbers [Danmark I tal 2013]. Statistics Denmark 2013.
- (14) Council of globalisation [Globaliseringsrådet]. Globalisation and the Danish labour market [Globalisering og det danske arbejdsmarked]. Council of globalisation 2005:1-27.
- (15) OECD. Education at a glance 2013:OECD indicators. OECD Publishing 2013:74-75.
- (16) Bronnum-Hansen H, Baadsgaard M. Widening social inequality in life expectancy in Denmark. A register-based study on social composition and mortality trends for the Danish population. BMC Public Health 2012;12:994-2458-12-994.
- (17) Reisel L. Two paths to inequality in educational outcomes: Family background and educational selection in the United States and Norway. Sociology of Education 2011;84(4):261-280.
- (18) OECD. Jobs for youth: Denmark. OECD Publishing 2010:65.
- (19) The Ministry of children and education [Undervisningsministeriet]. Figures that talk 2009. [Tal, der taler 2009]. The ministry of children and education 2010;1:58-72.
- (20) Grytnes R. Making the right choice. Inquiries into the reasoning behind young people's decisions about education. Young 2011;19(3):333-351.
- (21) The Government [Regeringen]. One Denmark, which stands united. [Et Danmark, der står sammen]. The Government 2011:19-20.
- (22) Statistics Denmark [Danmarks Statistik]. Upper secondary education. Available at: www.dst.dk/da/Statistik/emner/befolkningens-uddannelsesniveau/ungdomsuddannelser.aspx. Accessed February/03, 2014.
- (23) OECD. Education at a glance 2013: OECD indicators. OECD Publishing 2013:42-43.
- (24) Andersen D. 4 years after primary school [4 år efter grundskolen]. AKF 2005.
- (25) Didrichsen F, Andersen I, Manuel C. Health Inequality-determinants and policies [Ulighed i sundhed-årsager og indsatser]. Sundhedsstyrelsen 2011:51-52.
- (26) Jørgensen CH. Drop-out from vocational educations [Frafald fra erhvervsuddannelserne]. 1st ed. Frederiksberg: Roskilde universitetsforlag; 2011.

-
- (27) The Ministry of children and education [Undervisningsministeriet]. Drop-out from vocational educations is increasing. [Frafaldet på erhvervsskolerne er stigende]. Available at: <http://www.uvm.dk/Service/Statistik/~UVM-DK/Content/News/Udd/Erhvervs/2013/Sep/130904-Frafaldet-paa-erhvervsskolerne-er-stigende>.
- (28) De Ridder KA, Pape K, Cuypers K, Johnsen R, Holmen TL, Westin S, et al. High school dropout and long-term sickness and disability in young adulthood: a prospective propensity score stratified cohort study (the Young-HUNT study). *BMC Public Health* 2013;13:941-2458-13-941.
- (29) Labriola M, Lund T, Bennedsen G, Pedersen AHM, Sagoo SN, Hansen CD, et al. Factors influencing initiation, completion or drop-out from secondary education [Faktorer af betydning for påbegyndelse, gennemførelse eller frafald fra en ungdomsuddannelse]. The national labour market authority [Arbejdsmarkedsstyrelsen] 2012:1-104.
- (30) Hansen ON, Netterstrøm B. Psychosocial work environment factors and stress [Psykosociale arbejdsmiljøfaktorer og stress]. In: Autrup H, Bonde JP, Rasmussen K, Sigsgaard T, editors. *Environmental and occupational medicine [Miljø og arbejdsmedicin]*. 2nd ed. Copenhagen: FADL; 2003. p. 339-361.
- (31) Parker S, Wall T. *Job design and work design*. California: SAGE publications; 1998.
- (32) Karasek R. Job demands, job decision latitude, and mental strain: implications for job redesign. *Administrative Science Quarterly* 1979;24(2):285-310.
- (33) Karasek R, Theorell T. *Healthy work. Stress, productivity, and the reconstruction of working life*. New York: Basic Books; 1990.
- (34) Siegrist J. Adverse health effects of high-effort/low-reward conditions. *J Occup Health Psychol* 1996;1(1):27-41.
- (35) Bakker AB, Demerouti E. The Job Demands-Resources model: state of the art. *Journal of Managerial Psychology* 2006;22(2):309-328.
- (36) Karasek R, Brisson C, Kawakami N, Houtman I, Bongers P, Amick B. The Job Content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics. *J Occup Health Psychol* 1998;3(4):322-355.
- (37) Siegrist J, Starke D, Chandola T, Godin I, Marmot M, Niedhammer I, et al. The measurement of effort-reward imbalance at work: European comparisons. *Soc Sci Med* 2004;58(8):1483-1499.

- (38) Kristensen TS, Hannerz H, Hogh A, Borg V. The Copenhagen Psychosocial Questionnaire--a tool for the assessment and improvement of the psychosocial work environment. *Scand J Work Environ Health* 2005;31(6):438-449.
- (39) Bjorner JB, Pejtersen JH. Evaluating construct validity of the second version of the Copenhagen Psychosocial Questionnaire through analysis of differential item functioning and differential item effect. *Scand J Public Health* 2010;38(3 Suppl):90-105.
- (40) Thorsen SV, Bjorner JB. Reliability of the Copenhagen Psychosocial Questionnaire. *Scand J Public Health* 2010;38(3 Suppl):25-32.
- (41) Kristensen TS. A questionnaire is more than a questionnaire. *Scand J Public Health* 2010;38(3 Suppl):149-155.
- (42) Pejtersen JH, Kristensen TS, Borg V, Bjorner JB. The second version of the Copenhagen Psychosocial Questionnaire. *Scand J Public Health* 2010;38(3 Suppl):8-24.
- (43) Moncada S, Llorens C, Navarro A, Kristensen TS. ISTAS21 COPSOQ: Spanish version of the Copenhagen Psychosocial Questionnaire [ISTAS21 COPSOQ: versio'n en lengua castellana del cuestionario psicosocial de Copenhague]. *Arch Preven Riesgos Laboral* 2005;8(1):18-29.
- (44) Nubling M, Stossel U, Hasselhorn HM, Michaelis M, Hofmann F. Measuring psychological stress and strain at work - Evaluation of the COPSOQ Questionnaire in Germany. *Psychosoc Med* 2006;3:Doc05.
- (45) Bonde JP. Psychosocial factors at work and risk of depression: a systematic review of the epidemiological evidence. *Occup Environ Med* 2008;65(7):438-445.
- (46) Kolstad HA, Hansen AM, Kaergaard A, Thomsen JF, Kaerlev L, Mikkelsen S, et al. Job strain and the risk of depression: is reporting biased? *Am J Epidemiol* 2011;173(1):94-102.
- (47) Borg V, Nexø MA, Kolte IV, Andersen MF. White book about mental health, sickness absence and return to work [Hvidbog om mentalt helbred, sygefravær og tilbagevenden til arbejde]. National research centre for the working environment 2010.
- (48) Theorell T, Hammarstrom A, Gustafsson PE, Magnusson Hanson L, Janlert U, Westerglund H. Job strain and depressive symptoms in men and women: a prospective study of the working population in Sweden. *J Epidemiol Community Health* 2014;68(1):78-82.
- (49) Rugulies R, Aust B, Madsen IE, Burr H, Siegrist J, Bultmann U. Adverse psychosocial working conditions and risk of severe depressive symptoms. Do effects differ by occupational grade? *Eur J Public Health* 2013;23(3):415-420.

-
- (50) M. B. Grynderup. Psychosocial working conditions, physiological stress and the risk of depression [PhD dissertation]. Aarhus: Health, Aarhus University; 2013.
- (51) Melchior M, Caspi A, Milne BJ, Danese A, Poulton R, Moffitt TE. Work stress precipitates depression and anxiety in young, working women and men. *Psychol Med* 2007;37(8):1119-1129.
- (52) Laberge M, Ledoux E. Occupational health and safety issues affecting young workers: a literature review. *Work* 2011;39(3):215-232.
- (53) Andersen JH, Kaergaard A, Mikkelsen S, Jensen UF, Frost P, Bonde JP, et al. Risk factors in the onset of neck/shoulder pain in a prospective study of workers in industrial and service companies. *Occup Environ Med* 2003;60(9):649-654.
- (54) National Research Council and Institute of Medicine. Musculoskeletal disorders and the workplace. Low Back and Upper Extremities Panel on Musculoskeletal Disorders and the Workplace Commission on Behavioral and Social Sciences and Education. Washington DC: National Academy Press; 2001.
- (55) Ariens GA, van Mechelen W, Bongers PM, Bouter LM, van der Wal G. Physical risk factors for neck pain. *Scand J Work Environ Health* 2000;26(1):7-19.
- (56) Hanvold TN, Waersted M, Mengshoel AM, Bjertness E, Twisk J, Veiersted KB. A longitudinal study on risk factors for neck and shoulder pain among young adults in the transition from technical school to working life. *Scand J Work Environ Health* 2014;doi:10.5271/sjweh.3437.
- (57) Rahkonen O, Laaksonen M, Martikainen P, Roos E, Lahelma E. Job control, job demands, or social class? The impact of working conditions on the relation between social class and health. *J Epidemiol Community Health* 2006;60(1):50-54.
- (58) Bauer GF, Huber CA, Jenny GJ, Muller F, Hammig O. Socioeconomic status, working conditions and self-rated health in Switzerland: explaining the gradient in men and women. *Int J Public Health* 2009;54(1):23-30.
- (59) Christensen KB, Fèveile H, Labriola M, Lund T. The impact of psychosocial work environment factors on the risk of disability pension in Denmark. *Eur J Public Health* 2008;18(3):235-237.
- (60) Kines P, Framke E, Salmi E, Bengtson E. Young workers' occupational safety and health risks in the Nordic countries. *Nordic Council of Ministers* 2013:1-67.
- (61) Rasmussen K, Hansen CD, Nielsen KJ, Andersen JH. Incidence of work injuries amongst Danish adolescents and their association with work environment factors. *Am J Ind Med* 2011;54(2):143-152.

- (62) Jakobsen P, Bach E. Work environment and health in Denmark 2012-resumé and results [Arbejdsmiljø og helbred i Danmark 2012-resumé og resultater]. National Research Centre for the Working Environment 2013:1-162.
- (63) COWI. Apprentices and trainees psychological work environment [Lærlinge og elevs psykiske arbejdsmiljø]. COWI 2009.
- (64) British Medical Association. Adolescent health. Board of Science and Education 2003.
- (65) Lund T, Andersen JH, Winding TN, Biering K, Labriola M. Negative life events in childhood as risk indicators of labour market participation in young adulthood: a prospective birth cohort study. *PLoS One* 2013;8(9):e75860.
- (66) Kristensen P, Gravseth HM, Bjerkedal T. Educational attainment of Norwegian men: influence of parental and early individual characteristics. *J Biosoc Sci* 2009;41(6):799-814.
- (67) Jæger MM, Holm A. Which background factors matter more in intergenerational educational attainment: Social class, cultural capital or cognitive ability? A random effects approach. *Centre for Applied Microeconometrics* 2003:1-28.
- (68) Marjoribanks K. Family Background, Academic Achievement, and Educational Aspirations as Predictors of Australian Young Adults' Educational Attainment. *Psychol Rep* 2005;96(3):751-754.
- (69) Madarasova Geckova A, Tavel P, van Dijk JP, Abel T, Reijneveld SA. Factors associated with educational aspirations among adolescents: cues to counteract socioeconomic differences? *BMC Public Health* 2010;10:154.
- (70) Kristensson P, Ohlund LS. Swedish upper secondary school pupils' sense of coherence, coping resources and aggressiveness in relation to educational track and performance. *Scand J Caring Sci* 2005;19(1):77-84.
- (71) Mahaffy KA. Girls' low self esteem: How is it related to later socioeconomic achievements? *Gender Soc* 2004;18(3):309-327.
- (72) De Araujo P, Lagos S. Self-esteem, education, and wages revisited. *Journal of Economic Psychology* 2013;34:120-132.
- (73) Waddell GR. Labor-market consequences of poor attitude and low self-esteem in youth. *Economic Inquiry* 2006;44:69-97.
- (74) De Ridder KA, Pape K, Johnsen R, Westin S, Holmen TL, Bjørngaard JH. School dropout: a major public health challenge: a 10-year prospective study on medical and non-medical social insurance benefits in young adulthood, the Young-HUNT 1 Study (Norway). *J Epidemiol Community Health* 2012;66:995-1000.

-
- (75) De Ridder KA, Pape K, Johnsen R, Holmen TL, Westin S, Bjorngaard JH. Adolescent health and high school dropout: a prospective cohort study of 9000 Norwegian adolescents (the young-HUNT). *PLoS One* 2013;8(9):e74954.
- (76) Jackson MI. Understanding links between adolescent health and educational attainment. *Demography* 2009;46(4):671-694.
- (77) Haas SA, Fosse NE. Health and the educational attainment of adolescents: evidence from the NLSY97. *J Health Soc Behav* 2008;49(2):178-192.
- (78) Le F, Diez Roux A, Morgenstern H. Effects of child and adolescent health on educational progress. *Soc Sci Med* 2013;76(1):57-66.
- (79) Fowler-Brown AG, Ngo LH, Phillips RS, Wee CC. Adolescent obesity and future college degree attainment. *Obesity (Silver Spring)* 2010;18(6):1235-1241.
- (80) Karnehed N, Rasmussen F, Hemmingsson T, Tynelius P. Obesity and attained education: cohort study of more than 700,000 Swedish men. *Obesity (Silver Spring)* 2006;14(8):1421-1428.
- (81) Viner RM, Cole TJ. Adult socioeconomic, educational, social, and psychological outcomes of childhood obesity: a national birth cohort study. *BMJ* 2005;330(7504):1354.
- (82) Fletcher JM. Adolescent depression and educational attainment: results using sibling fixed effects. *Health Econ* 2010;19(7):855-871.
- (83) Needham BL. Adolescent depressive symptomatology and young adult educational attainment: an examination of gender differences. *J Adolesc Health* 2009;45(2):179-186.
- (84) Van Ameringen M, Mancini C, Farvolden P. The impact of anxiety disorders on educational achievement. *J Anxiety Disord* 2003;17(5):561-571.
- (85) Fergusson DM, Woodward LJ. Mental health, educational, and social role outcomes of adolescents with depression. *Arch Gen Psychiatry* 2002;59(3):225-231.
- (86) Breslau J, Miller E, Joanie Chung WJ, Schweitzer JB. Childhood and adolescent onset psychiatric disorders, substance use, and failure to graduate high school on time. *J Psychiatr Res* 2011;45(3):295-301.
- (87) Dubow EF, Boxer P, Huesmann LR. Long-term Effects of Parents' Education on Children's Educational and Occupational Success: Mediation by Family Interactions, Child Aggression, and Teenage Aspirations. *Merrill Palmer Q (Wayne State Univ Press)* 2009;55(3):224-249.
- (88) Albrecht CM, Albrecht DE. Social status, adolescent behavior, and educational attainment. *Sociological Spectrum* 2011;31(1):114-137.

- (89) Riala K, Isohanni I, Jokelainen J, Jones PB, Isohanni M. The relationship between childhood family background and educational performance, with special reference to single-parent families: A longitudinal study. *Social Psychology of Education* 2003;6(4):349-365.
- (90) Wojtkiewicz RA. Simplicity and complexity in the effects of parental structure on high school graduation. *Demography* 1993;30(4):701-717.
- (91) Song C, Benin M, Glick J. Dropping out of high school: The effects of family structure and family transitions. *Journal of Divorce & Remarriage* 2012;53(1):18-33.
- (92) Elovainio M, Kivimaki M, Ek E, Vahtera J, Honkonen T, Taanila A, et al. The effect of pre-employment factors on job control, job strain and psychological distress: a 31-year longitudinal study. *Soc Sci Med* 2007;65(2):187-199.
- (93) Fitzgerald ST, Brown KM, Sonnega JR, Ewart CK. Early antecedents of adult work stress: social-emotional competence and anger in adolescence. *J Behav Med* 2005;28(3):223-230.
- (94) Hintsanen M, Kivimaki M, Hintsala T, Theorell T, Elovainio M, Raitakari OT, et al. A prospective cohort study of deficient maternal nurturing attitudes predicting adulthood work stress independent of adulthood hostility and depressive symptoms. *Stress* 2010;13(5):425-434.
- (95) Modin B, Ostberg V, Toivanen S, Sundell K. Psychosocial working conditions, school sense of coherence and subjective health complaints. A multilevel analysis of ninth grade pupils in the Stockholm area. *J Adolesc* 2011;34(1):129-139.
- (96) Togari T, Yamazaki Y. A causal relationship between sense of coherence and psycho-social work environment: from one-year follow-up data among Japanese young adult workers. *Global Health Promotion* 2012;19(1):32-42.
- (97) Wu CH, Griffin MA. Longitudinal relationships between core self-evaluations and job satisfaction. *J Appl Psychol* 2012;97(2):331-342.
- (98) Judge TA, Bono JE. Relationship of core self-evaluations traits--self-esteem, generalized self-efficacy, locus of control, and emotional stability--with job satisfaction and job performance: a meta-analysis. *J Appl Psychol* 2001;86(1):80-92.
- (99) Yang X, Telama R, Hirvensalo M, Hintsanen M, Hintsala T, Pulkki-Raback L, et al. Sustained involvement in youth sports activities predicts reduced chronic job strain in early midlife. *J Occup Environ Med* 2010;52(12):1154-1159.
- (100) Kristensen TS, Borg V, Hannerz H. Socioeconomic status and psychosocial work environment: results from a Danish national study. *Scand J Public Health Suppl* 2002;59:41-48.

-
- (101) Borg V, Kristensen TS. Social class and self-rated health: can the gradient be explained by differences in life style or work environment? *Soc Sci Med* 2000;51(7):1019-1030.
- (102) Westerlund H, Gustafsson PE, Theorell T, Janlert U, Hammarstrom A. Social adversity in adolescence increases the physiological vulnerability to job strain in adulthood: a prospective population-based study. *PLoS One* 2012;7(4):e35967.
- (103) Wulff C, Bergman LR, Sverke M. General mental ability and satisfaction with school and work: A longitudinal study from ages 13 to 48. *Journal of Applied Developmental Psychology* 2009;30:398-408.
- (104) Rothman K, Greenland S, Lash T. Validity in Epidemiologic Studies. In: Rothman K, Greenland S, Lash T, editors. *Modern Epidemiology*. 3rd ed. Philadelphia (PA): Lippincott Williams & Williams; 2008. p. 128-150.
- (105) Bergman P, Ahlberg G, Forsell Y, Lundberg I. Non-participation in the second wave of the PART study on mental disorder and its effects on risk estimates. *Int J Soc Psychiatry* 2010;56(2):119-132.
- (106) Goldberg M, Chastang JF, Leclerc A, Zins M, Bonenfant S, Bugel I, et al. Socioeconomic, demographic, occupational, and health factors associated with participation in a long-term epidemiologic survey: a prospective study of the French GAZEL cohort and its target population. *Am J Epidemiol* 2001;154(4):373-384.
- (107) Jacobsen TN, Nohr EA, Frydenberg M. Selection by socioeconomic factors into the Danish National Birth Cohort. *Eur J Epidemiol* 2010;25(5):349-355.
- (108) Torvik FA, Rognmo K, Tambs K. Alcohol use and mental distress as predictors of non-response in a general population health survey: the HUNT study. *Soc Psychiatry Psychiatr Epidemiol* 2012;47(5):805-816.
- (109) Carter KN, Imlach-Gunasekara F, McKenzie SK, Blakely T. Differential loss of participants does not necessarily cause selection bias. *Aust N Z J Public Health* 2012;36(3):218-222.
- (110) Lundberg I, Damstrom Thakker K, Hallstrom T, Forsell Y. Determinants of non-participation, and the effects of non-participation on potential cause-effect relationships, in the PART study on mental disorders. *Soc Psychiatry Psychiatr Epidemiol* 2005;40(6):475-483.
- (111) Korkeila K, Suominen S, Ahvenainen J, Ojanlatva A, Rautava P, Helenius H, et al. Non-response and related factors in a nation-wide health survey. *Eur J Epidemiol* 2001;17(11):991-999.

- (112) Powers J, Loxton D. The impact of attrition in an 11-year prospective longitudinal study of younger women. *Ann Epidemiol* 2010;20(4):318-321.
- (113) Littman AJ, Boyko EJ, Jacobson IG, Horton J, Gackstetter GD, Smith B, et al. Assessing nonresponse bias at follow-up in a large prospective cohort of relatively young and mobile military service members. *BMC Med Res Methodol* 2010;10:99.
- (114) Van Loon AJ, Tijhuis M, Picavet HS, Surtees PG, Ormel J. Survey non-response in the Netherlands: effects on prevalence estimates and associations. *Ann Epidemiol* 2003;13(2):105-110.
- (115) Bambs CE, Kip KE, Mulukutla SR, Aiyer AN, Johnson C, McDowell LA, et al. Sociodemographic, clinical, and psychological factors associated with attrition in a prospective study of cardiovascular prevention: the Heart Strategies Concentrating on Risk Evaluation study. *Ann Epidemiol* 2013;23(6):328-333.
- (116) Alonso A, Segui-Gomez M, de Irala J, Sanchez-Villegas A, Beunza JJ, Martinez-Gonzalez MA. Predictors of follow-up and assessment of selection bias from dropouts using inverse probability weighting in a cohort of university graduates. *Eur J Epidemiol* 2006;21(5):351-358.
- (117) Cunradi CB, Moore R, Killoran M, Ames G. Survey nonresponse bias among young adults: the role of alcohol, tobacco, and drugs. *Subst Use Misuse* 2005;40(2):171-185.
- (118) Donders AR, van der Heijden GJ, Stijnen T, Moons KG. Review: a gentle introduction to imputation of missing values. *J Clin Epidemiol* 2006;59(10):1087-1091.
- (119) van der Heijden GJ, Donders AR, Stijnen T, Moons KG. Imputation of missing values is superior to complete case analysis and the missing-indicator method in multivariable diagnostic research: a clinical example. *J Clin Epidemiol* 2006;59(10):1102-1109.
- (120) Greene N, Greenland S, Olsen J, Nohr EA. Estimating bias from loss to follow-up in the Danish National Birth Cohort. *Epidemiology* 2011;22(6):815-822.
- (121) Nohr EA, Frydenberg M, Henriksen TB, Olsen J. Does low participation in cohort studies induce bias? *Epidemiology* 2006;17(4):413-418.
- (122) Kaerlev L, Kolstad HA, Hansen AM, Thomsen JF, Kaergaard A, Rugulies R, et al. Are risk estimates biased in follow-up studies of psychosocial factors with low base-line participation? *BMC Public Health* 2011;11:539.
- (123) Pedersen CB. The Danish Civil Registration System. *Scand J Public Health* 2011;39(7 Suppl):22-25.

-
- (124) Baadsgaard M, Quitzau J. Danish registers on personal income and transfer payments. *Scand J Public Health* 2011;39(7 Suppl):103-105.
- (125) Jensen VM, Rasmussen AW. Danish Education Registers. *Scand J Public Health* 2011;39(7 Suppl):91-94.
- (126) WHO Collaborating Centre for Drug Statistics Methodology. Guidelines for ATC classification and DDD assignment 2013. Available at: www.whocc.no/filearchive/publications/1_2013guidelines.pdf. Accessed February/21, 2013.
- (127) Statistics Denmark [Danmarks Statistik]. Handbook of data in the medicinedatabase [Håndbog til data i Lægemedeldatabasen]. Statistics Denmark 2010:1-90.
- (128) National Research Centre for the Working Environment. Instruction of the short questionnaire on psychosocial work environment. Available at: <http://www.arbejdsmiljoforskning.dk/da/publikationer/spoergeskemaer/psykisk-arbejdsmiljoe>. Accessed August/20, 2013.
- (129) Hildebrandt VH, Bongers PM, van Dijk FJ, Kemper HC, Dul J. Dutch Musculoskeletal Questionnaire: description and basic qualities. *Ergonomics* 2001;44(12):1038-1055.
- (130) Hansen CD, Andersen JH. Sick at work--a risk factor for long-term sickness absence at a later date? *J Epidemiol Community Health* 2009;63(5):397-402.
- (131) Antonovsky A. Unravelling the mystery of health. San Francisco: Josey Bass Publishers; 1987.
- (132) Eriksson M, Lindstrom B. Validity of Antonovsky's sense of coherence scale: a systematic review. *J Epidemiol Community Health* 2005;59(6):460-466.
- (133) Antonovsky A. The structure and properties of the sense of coherence scale. *Soc Sci Med* 1993;36(6):725-733.
- (134) Torsheim T, Aaroe LE, Wold B. Sense of coherence and school-related stress as predictors of subjective health complaints in early adolescence: interactive, indirect or direct relationships? *Soc Sci Med* 2001;53(5):603-614.
- (135) Torsheim T, Wold B. Health behaviour in school-aged children. Research protocol for the 1997-98 Survey. University of Edinburg 1998.
- (136) Rasmussen M, Due P, Holstein BE. Health Behaviour in School-aged Children (HBSC) [Skolebørnsundersøgelsen 1998. Sundhed, sundhedsvaner og sociale forhold]. Copenhagen 2000.

- (137) Rosenberg M. *Society and the adolescent self-image*. Princeton, NJ: Princeton University Press.; 1965.
- (138) Turner RJ, Lloyd DA, Roszell P. Personal resources and the social distribution of depression. *Am J Community Psychol* 1999;27(5):643-672.
- (139) Idler EL, Kasl SV. Self-ratings of health: do they also predict change in functional ability? *J Gerontol B Psychol Sci Soc Sci* 1995;50(6):S344-53.
- (140) Kaplan GA, Goldberg DE, Everson SA, Cohen RD, Salonen R, Tuomilehto J, et al. Perceived health status and morbidity and mortality: evidence from the Kuopio ischaemic heart disease risk factor study. *Int J Epidemiol* 1996;25(2):259-265.
- (141) Idler EL, Benyamini Y. Self-rated health and mortality: a review of twenty-seven community studies. *J Health Soc Behav* 1997;38(1):21-37.
- (142) Ware JE, Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care* 1992;30(6):473-483.
- (143) Fendrich M, Weissman MM, Warner V. Screening for depressive disorder in children and adolescents: validating the Center for Epidemiologic Studies Depression Scale for Children. *Am J Epidemiol* 1990;131(3):538-551.
- (144) Benn RT. Some mathematical properties of weight-for-height indices used as measures of adiposity. *Br J Prev Soc Med* 1971;25(1):42-50.
- (145) World Health Organisation Technical Report Services. *Obesity: preventing and managing the global epidemic*. Report of a WHO Consultation. WHO 2000.
- (146) Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ* 2000;320(7244):1240-1243.
- (147) Laitinen J, Power C, Ek E, Sovio U, Jarvelin MR. Unemployment and obesity among young adults in a northern Finland 1966 birth cohort. *Int J Obes Relat Metab Disord* 2002;26(10):1329-1338.
- (148) McLeod JD, Uemura R, Rohrman S. Adolescent mental health, behavior problems, and academic achievement. *J Health Soc Behav* 2012;53(4):482-497.
- (149) Albertsen K, Rugulies R, Garde AH, Burr H. The effect of the work environment and performance-based self-esteem on cognitive stress symptoms among Danish knowledge workers. *Scand J Public Health* 2010;38(3 Suppl):81-89.
- (150) Watson D, Clark LA. Negative affectivity: the disposition to experience aversive emotional states. *Psychol Bull* 1984;96(3):465-490.

-
- (151) Burr H, Albertsen K, Rugulies R, Hannerz H. Do dimensions from the Copenhagen Psychosocial Questionnaire predict vitality and mental health over and above the job strain and effort-reward imbalance models? *Scand J Public Health* 2010;38(3 Suppl):59-68.
- (152) Rugulies R, Aust B, Pejtersen JH. Do psychosocial work environment factors measured with scales from the Copenhagen Psychosocial Questionnaire predict register-based sickness absence of 3 weeks or more in Denmark? *Scand J Public Health* 2010;38(3 Suppl):42-50.
- (153) Lund T, Labriola M, Christensen KB, Bultmann U, Villadsen E, Burr H. Psychosocial work environment exposures as risk factors for long-term sickness absence among Danish employees: results from DWECS/DREAM. *J Occup Environ Med* 2005;47(11):1141-1147.
- (154) Gustavson K, von Soest T, Karevold E, Roysamb E. Attrition and generalizability in longitudinal studies: findings from a 15-year population-based study and a Monte Carlo simulation study. *BMC Public Health* 2012;12:918.
- (155) Ekholm O, Gundgaard J, Rasmussen NK, Hansen EH. The effect of health, socio-economic position, and mode of data collection on non-response in health interview surveys. *Scand J Public Health* 2010;38(7):699-706.
- (156) Goldberg M, Chastang JF, Zins M, Niedhammer I, Leclerc A. Health problems were the strongest predictors of attrition during follow-up of the GAZEL cohort. *J Clin Epidemiol* 2006;59(11):1213-1221.
- (157) Rothman. *Epidemiology-An introduction*. 2nd ed. New York: Oxford University Press; 2012.
- (158) Spector PE. Method variance as an artifact in self-reported affect and perceptions of work: myth or significant problem? *J Appl Psychol* 1987;72:438-443.
- (159) Williams LJ, Cote JA, Buckley MR. Lack of method variance in self-reported affect and perceptions at work: Reality or artefact? *J Appl Psychol* 1989 Jun;74(3):462-468.
- (160) Rosenberg M, Turner RH. *Social Psychology: Sociological Perspectives*. 1st ed. New York: Basic Books; 1979.
- (161) Naaldenberg J, Tobi H, van den Esker F, Vaandrager L. Psychometric properties of the OLQ-13 scale to measure Sense of Coherence in a community-dwelling older population. *Health Qual Life Outcomes* 2011;9:37-7525-9-37.
- (162) Elgar FJ, Roberts C, Tudor-Smith C, Moore L. Validity of self-reported height and weight and predictors of bias in adolescents. *J Adolesc Health* 2005;37(5):371-375.

12. References

- (163) Sterne JA, White IR, Carlin JB, Spratt M, Royston P, Kenward MG, et al. Multiple imputation for missing data in epidemiological and clinical research: potential and pitfalls. *BMJ* 2009;338:b2393.
- (164) White IR, Royston P, Wood AM. Multiple imputation using chained equations: Issues and guidance for practice. *Stat Med* 2011;30(4):377-399.
- (165) Nielsen ML, Dyreborg D, Kines P, Nielsen KJ, Rasmussen K. Exploring and Expanding the Category of 'Young Workers' According to Situated Ways of Doing Risk and Safety—a Case Study in the Retail Industry. *Nordic journal of working life studies* 2013;3:219-243.







ORIGINAL ARTICLE

Personal predictors of educational attainment after compulsory school: Influence of measures of vulnerability, health, and school performance

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Abstract

Aims: Getting a secondary education is essential in preventing future inequalities in health and socioeconomic status. We investigated to what degree personal predictors like low school performance, high vulnerability, and poor health status are associated with not completing a secondary education in a Danish youth cohort. **Methods:** This prospective study used data from a questionnaire in 2004 and register data in 2010. The study population consisted of 3053 adolescents born in 1989. Information on educational attainment from Statistics Denmark was divided into four categories: completed, still studying, dropped out, or never attained a secondary education. Data was analysed using multinomial logistic regression. **Results:** Low grades when completing compulsory school predicted not having completed a secondary education by age 20/21 (odds ratios (OR) between 1.7 and 2.5). Low sense of coherence in childhood was associated with dropping out from a vocational education (OR 2.0). Low general health status was associated with dropping out (OR 2.2) or never attaining a secondary education (OR 2.7) and overweight was associated with never attaining a secondary education (OR 3.5). **Conclusions:** **The study confirms the social gradient in educational attainment. Furthermore, the results indicate that factors related to the individual in terms of low school performance, low health status, and high vulnerability predict future success in the educational system. It is recommended that these high-risk groups are recognised and targeted when designing guidance and supervision programmes for youth at secondary education.**

Key Words: educational attainment, health, school performance, vulnerability, young people

Background

Social inequality in health and the strong linkage between decreasing educational level and poor health has been the subject of a number of studies [1–3]. Data suggests that this undesirable inequality in health is established already in childhood and adolescence [3–5]. The path through the educational system is a key issue for understanding how childhood conditions can lead to future inequalities in health [6]. It has particular relevance for youth, since young people may still have the potential for avoiding negative consequences of low educational attainment for poor health and low socioeconomic status later in life. In an international perspective, education improves

job prospects in general and the likelihood of remaining employed in times of economic hardship [7].

The literature indicates that young people's attainment of education is affected by different factors. The most frequently examined factor is socioeconomic status measured as parental education, income, and growing up in single-parent families, which all have been shown to be related to educational attainment [8–10]. Additionally, school performance and health problems during childhood and adolescence are associated with educational attainment [10,11]. Some health measures, such as depressive symptoms and poor general health, seem to have a negative influence

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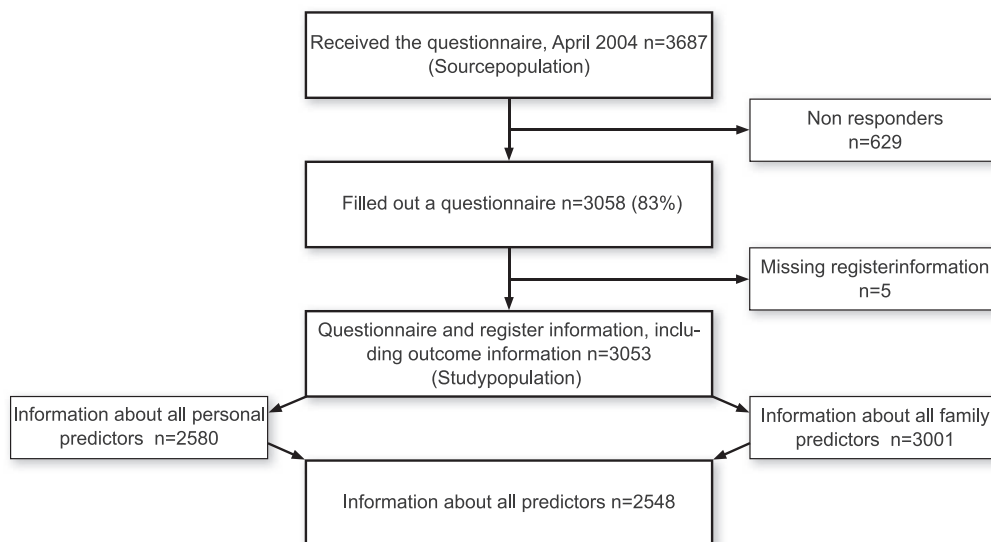


Figure 1. Distribution of the study participants

on chances of completing an education [11–13], whereas results from previous work are conflicting regarding factors such as obesity [14,15]. Few studies have addressed the association between vulnerability in childhood and educational attainment, but high sense of coherence (SOC) was found to increase school achievement among young people [16,17].

A major transition in the Danish education system is the one from compulsory school to secondary education. After compulsory school, the first major differentiation of a cohort of young people takes place between those who complete a secondary education (in Denmark approximately 77%) and those who stop their educational career [18]. With the known linkage between decreasing educational level and social inequality in health in mind [1–3], more knowledge about the influence of personal aspects on the chance of completing a secondary education is needed in order to improve the support of vulnerable young people.

Aims

Data from a large prospective cohort of Danish young people was used to investigate to what degree low school grades, increased vulnerability, and health problems can explain differences in educational attainment after compulsory school.

Materials and methods

Study population

The source population for the present study consisted of all individuals born in 1989 living in the

county of Ringkjøbing, Denmark in early April 2004, altogether 3687 adolescents, for whom addresses, gender, and age when completing 9th grade were identified by help from The Central Office of Civil Registration [19] and from public schools. Information for the present study was derived from a questionnaire and from registers. Questionnaire information was collected at baseline in 2004 when the participants were 14/15 years old and took place during school hours at the respondents' schools. Those not at school at the day of collection received the questionnaire by mail. All together 3058 adolescents filled out the questionnaire (response rate 83%). Register information was missing for five participants resulting in a final study population consisting of 3053 individuals. Complete information on both personal and family predictors was available for 2548 participants (Figure 1).

To gather information on family predictors, respondents were linked to their parents or guardians by using their personal identification number (CPR number), which is given to every inhabitant in Denmark at birth (or upon entry for immigrants) [19]. The study and the data linkage procedures were approved by the Danish Data Protection Agency.

Outcome

Education beyond compulsory school (secondary education) consists primarily of a high school academic track of three years, (in this study called "upper secondary school") and vocational education. Vocational

education, which lasts between 2 and 4 years, is typically a mixture of theoretical courses at branch specific schools and practical training in apprenticeships. The outcome of the present study was educational attainment after compulsory school in October 2010 when the participants were 20/21 years old which allowed a follow up of 6.5 years. Data on secondary education was derived from Statistics Denmark [20].

The participants were categorised into one of the following four categories: (1) Completed: consisting of participants who had completed a secondary education; (2) Still studying: consisting of those who were still attaining a secondary education; (3) Dropped out: if they had dropped out of their last secondary education and never attained another, and (4) Never attained: if they had never attained a secondary education. A distinction was made between “upper secondary school” and “vocational education”.

Exposure variables

The main exposures were the personal predictors, which were categorised into three domains: “school performance”, “vulnerability”, and “health”. Information about exposures, except final grades in maths and Danish, was derived from the questionnaire at baseline. Information about final grades was based on register information from Statistics Denmark [20].

School performance. In Denmark, all children are required to receive education for at least 9 years. The oral Danish and written maths exam grades after compulsory school (9th grade) were used. Before September 2007, grades were given using the so-called 13-point scale (00, 03, 5, 6, 7, 8, 9, 10, 11, 13). A dichotomous variable indicating “high grades” (8–13 equivalent to B+ and above) and “low grades” (00–7) was generated. In the period 2004–2007, 90% and 91% of the participants completed exams in written maths and oral Danish, respectively.

Health. Self-rated health was used as a general indicator of health, as it is a strong predictor of both mortality and morbidity [21,22]. It was measured using a single item from SF-36 [22]. By adding a cut point after the two highest categories, the variable was dichotomised into “high” and “low” general health status.

Depressive symptoms were measured using the four-item validated version of The Center for Epidemiologic Studies Depression Scale for Children [23]. Higher CES-DC scores indicate increasing levels of depression. The recommended cut-off at 3 and above was used to dichotomise the responses into

two categories: “depressive symptoms” and “no depressive symptoms” [23].

Information about body mass index (BMI) was categorised, as suggested by Cole et al. [24], into low weight, normal weight, and overweight for 15-year-old children. BMI cut-off points were for low weight <17 kg/m² for both boys and girls, for normal weight 17–23.29 kg/m² for boys and 17–23.94 kg/m² for girls, and for overweight >23.29 kg/m² for boys and >23.94 kg/m² for girls [24].

Vulnerability. Vulnerability covers the way individuals think about themselves and their situation. Vulnerability was measured by using two scales measuring self-esteem and sense of coherence.

Sense of coherence is a theoretical construct, which is used to measure the degree to which a person finds the world comprehensible, manageable, and meaningful. Meaningfulness, according to Antonovsky [25], is a belief that things in life are interesting and a source of satisfaction, that things are really worth it and that there is good reason or purpose to care about what happens in life. From the “Sense of coherence – revised short version for children”, four items about meaningfulness out of a total of 13 were used [26,27]. The items were: (1) What do you think of the things you do every day? (2) How often do you do things you find meaningful? (3) How often do you have the feeling that you don’t really care about what goes on around you? and (4) How often do you have the feeling that there is little meaning in the things you do in your daily life?. Response alternatives were “Very exciting, exciting, all right, boring, very boring” in the first question and “Very often, often, sometimes, seldom, never” in the last three questions with a score between 1 and 5. Data was categorised with cut-off point at the 25% percentile as normal/high SOC score (SOC score >12) and low SOC score (SOC score ≤12).

Self-esteem was measured by using six items from Rosenberg’s 10 items self-esteem scale [28]. Data was dichotomised into normal/high self-esteem and low self-esteem by applying a cut-off point at the 25% percentile corresponding to a self-esteem score >17.

Socioeconomic status. To measure socioeconomic status, the following information was used: highest attained education, income, and family type at the end of 2003. Yearly household income was recoded into tertiles corresponding to lowest (<64,540 EUR), middle (64,540–82,402 EUR), and highest (>82,402 EUR) [29]. Highest attained education in the household was recoded into four categories: < 10 years, 10–12 years, 13–15 years, >15 years [20]. If the

participants' parents were divorced, information stemmed from the household where the participants' address was listed. Register-based information was used to dichotomise family type into "living with one parent or not living with parents" or "living with two parents" [19].

Statistical methods

A correlation analysis between exposure variables was initially performed and no correlation exceeded 0.48.

We estimated crude and adjusted odds ratios for subtypes of educational attainment (four categories) according to personal and family predictors using multinomial logistic regression ($n=3053$). Those who had completed a secondary education were used as reference. The adjusted analyses were carried out in two steps. First, personal predictors were mutually adjusted for all other personal predictors and vice versa for family predictors. Secondly, all predictors were mutually adjusted.

We then examined the two types of educational tracks, upper secondary school and vocational education, separately. The participants who never attained a secondary education were excluded so the outcome variable now consisted of three categories ($n=2981$). In this analysis, we mutually adjusted for all other predictors.

The exposure variables were first included in the analysis as continuous or in finer categories. Since it did not change the main results, several variables were dichotomised to gain power and comprehensibility of the estimates.

Gender and age when completing 9th grade were included in all models. p -values <0.05 were considered statistically significant, and results are presented with 95% confidence intervals. STATA statistical package (version 12.0; Stata, College Station, TX, USA) was used for all analyses.

Results

At follow up, 2467 (80.8%) had completed a secondary education, 312 (10.2%) were still attaining a secondary education, 202 (6.6%) had dropped out and never attained another secondary education, and 72 (2.4%) had never attained a secondary education.

Personal predictors

School performance. Young people with low grades in oral Danish when completing compulsory school were more likely to still be studying, to have dropped out, or to never have attained a secondary education

compared to those with high grades (ORs between 1.7 and 2.1). For those with low maths grades, these associations were even stronger (ORs between 2.4 and 2.5; Table I).

Vulnerability. Individuals with low self-esteem or low sense of coherence were at increased risk of being still studying, dropping out, or never attaining a secondary education (ORs between 1.3 and 1.8). The strongest associations were seen for low sense of coherence and the risk of dropping out (OR 1.8, 95% CI 1.2–2.6) or never attaining a secondary education (OR 1.8, 95% CI 0.7–4.5; Table I).

Health. Low general health status was associated with dropping out or never attaining a secondary education (OR 2.2 and OR 2.7, respectively). Overweight was associated with never attaining a secondary education (OR 3.5). Low weight and depressive symptoms were not associated with educational attainment (Table I).

Family predictors

Young people from households within the lowest income group were more likely to still be studying, to have dropped out, or to never have attained a secondary education (ORs between 1.6 and 3.7). The same patterns were seen when no parent within the household had education above compulsory school. Living with one parent or without parents was not associated with educational attainment (Table I).

Educational tracks. Young people with low grades in oral Danish or written maths were at increased risk of being still studying or to have dropped out from upper secondary school (ORs between 2.3 and 2.9). These associations were somewhat weaker for vocational education (ORs between 1.0 and 1.9).

Low self-esteem was a predictor of still being studying in upper secondary school (OR 1.9) while sense of coherence was associated with being still studying and with dropping out of vocational education (OR 1.5 and OR 2.0, respectively; Table II).

Young people with low general health status had approximately a 2-fold greater risk of dropping out of both upper secondary school and vocational education compared to those with high general health status. No clear associations were found between depressive symptoms or body mass index and the risk of dropping out or still being studying for the two educational tracks (Table II).

Confidence intervals of the family predictors were wide and the estimates imprecise, but a tendency in relation to educational attainment was seen. Young

Table I. Personal and family predictors for educational attainment after compulsory school.

	n	%	Completed (n=2467)				Still studying (n=312)				Dropped out (n=202)				Never attained (n=72)			
			Base	OR crude	OR adjusted	95% CI adjusted	OR crude	OR adjusted	95% CI adjusted	OR crude	OR adjusted	95% CI adjusted	OR crude	OR adjusted	95% CI adjusted	OR crude	OR adjusted	95% CI adjusted
Personal predictors																		
Grades: oral Danish	2889																	
8 or above	2102	72.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
7 or below	787	27.2	2.5	1.8	1.4-2.5	1.7	1.2-2.3	3.3	2.4	1.6-3.4	2.1	1.5-3.1	2.6	1.5	0.7-3.2	2.0	0.9-4.2	
Grades: written maths	2874																	
8 or above	1962	68.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
7 or below	912	31.7	3.2	2.4	1.8-3.3	2.4	1.8-3.3	3.9	2.6	1.8-3.8	2.5	1.7-3.6	4.0	3.1	1.6-6.3	2.5	1.1-5.5	
Self-esteem	2973																	
Normal/high	2236	75.2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Low	737	24.8	2.0	1.6	1.1-2.2	1.6	1.1-2.2	1.7	1.3	0.8-1.9	1.3	0.8-1.9	2.9	1.3	0.6-2.8	1.5	0.6-3.6	
Sense of coherence	3022																	
Normal/high	2438	80.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Low	584	19.3	1.7	1.4	0.99-2.0	1.4	0.98-2.0	2.1	1.8	1.2-2.7	1.8	1.2-2.6	2.2	1.9	0.8-4.1	1.8	0.7-4.5	
General health status	3033																	
High	2904	95.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Low	129	4.3	1.8	1.2	0.6-2.5	1.2	0.6-2.4	2.6	2.2	1.1-4.2	2.2	1.1-4.2	4.2	2.4	0.8-7.9	2.7	0.8-9.3	
Depressive symptoms	2999																	
No	1958	65.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Yes	1041	34.7	1.2	0.9	0.7-1.3	0.9	0.7-1.3	1.4	1.1	0.8-1.6	1.1	0.7-1.6	1.6	0.9	0.4-1.8	0.7	0.3-1.6	
Body mass index	2878																	
Low weight	273	9.5	0.9	0.8	0.5-1.3	0.8	0.5-1.3	0.8	0.7	0.4-1.4	0.7	0.4-1.4	0.97	1.1	0.4-3.2	1.3	0.4-4.1	
Normal weight	2301	80.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overweight	304	10.6	1.0	0.9	0.6-1.4	0.9	0.6-1.4	1.4	1.4	0.9-2.3	1.3	0.8-2.1	2.1	2.6	1.1-6.0	3.5	1.4-8.6	
Family predictors																		
Income	3052																	
Highest	1017	33.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Middle	1018	33.4	1.5	1.4	0.98-1.9	1.2	0.8-1.8	1.5	1.3	0.9-2.0	1.3	0.8-2.2	1.4	1.7	0.7-3.8	2.4	0.8-7.3	
Lowest	1017	33.3	2.3	1.9	1.3-2.7	1.6	1.1-2.5	3.6	2.6	1.7-4.0	2.2	1.3-3.6	3.8	3.6	1.6-8.0	3.7	1.2-11.8	

(Continued)

Personal predictors of educational attainment after compulsory school

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Table I. (Continued)

	n	%	Completed (n=2467)			Still studying (n=312)			Dropped out (n=202)			Never attained (n=72)			
			Base	OR crude	OR adjusted	95% CI crude	95% CI adjusted	OR crude	OR adjusted	95% CI crude	95% CI adjusted	OR crude	OR adjusted	95% CI crude	95% CI adjusted
Highest education	3001														
>15 years	170	5.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
13-15 years	924	30.8	1.4	1.3	0.6-2.5	1.3	0.6-2.8	3.0	2.6	0.8-8.4	1.8	0.5-6.0	3.5	2.8	0.4-21.7
10-12 years	1548	51.6	2.1	1.6	0.8-3.2	1.3	0.6-2.8	4.0	3.0	0.9-9.7	1.6	0.5-5.3	3.0	1.9	0.2-15.0
<10 years	359	12.0	3.0	2.1	1.0-4.3	1.4	0.6-3.3	1.0	5.9	1.8-19.8	2.6	0.8-9.2	8.3	4.2	0.5-34.8
Family type	3053														
Two adults	2652	86.9	1.0	1.0	0.7-1.6	1.1	0.7-1.8	2.4	1.0	0.7-1.6	1.1	0.6-1.8	2.5	0.8	0.4-1.7
One adult/not at home	401	13.1	1.7	1.1	0.7-1.6	1.1	0.7-1.8	2.4	1.0	0.7-1.6	1.1	0.6-1.8	2.5	0.8	0.4-1.7

Values are odds ratios based on mlogit calculations. All the analyses are adjusted for gender and age when completing 9th grade.
 Crude sample: Participants who completed the questionnaire at baseline in 2004 and with outcome information (n=3053 where 2467 completed, 312 were still studying, 202 dropped out and 72 never attained).
 Adjusted 1 sample (personal predictors): adjusted for other personal predictors (n=2580 where 2152 completed, 240 were still studying, 150 dropped out and 38 never attained a secondary education).
 Adjusted 1 sample (family predictors): adjusted for other family predictors (n=3001 where 2442 completed, 305 were still studying, 194 dropped out and 60 never attained a secondary education).
 Adjusted 2 sample: adjusted for all personal and family predictors (n=2548 where 2134 completed, 236 were still studying, 146 dropped out and 32 never attained).

Table II. Personal and family predictors for educational attainment after compulsory school in different educational tracks.

	Upper secondary school					Vocational education							
	n	% Completed (n=1623)	Still studying (n=45)		Dropped out (n=55)		n	% Completed (n=844)	Still studying (n=267)		Dropped out (n=147)		
			OR crude	OR adjusted	OR crude	OR adjusted			OR crude	OR adjusted	OR crude	OR adjusted	
Personal predictors													
Grades: oral Danish	1680						1161						
8 or above	1443	85.9	1.0	1.0	1.0	632	54.4	1.0	1.0	1.0	1.0		
7 or below	237	14.1	2.8	2.5	1.2-5.2	3.4	2.3	1.1-4.6	1.2	1.0	0.7-1.5	1.7	1.6
Grades: written maths	1678						115						0.98-2.5
8 or above	1365	81.4	1.0	1.0	1.0	1.0	579	50.4	1.0	1.0	1.0	1.0	1.0
7 or below	313	18.7	3.8	2.9	1.4-6.0	3.3	2.4	1.2-4.7	1.5	1.4	0.97-2.0	2.3	1.9
Self-esteem	1695						1210						1.1-3.0
Normal/high	1313	77.5	1.0	1.0	1.0	1.0	884	73.1	1.0	1.0	1.0	1.0	1.0
Low	382	22.5	2.6	1.9	0.8-4.2	1.1	1.2	0.6-2.6	1.6	1.4	0.9-2.0	1.7	1.3
Sense of coherence	1710						1247						0.8-2.1
Normal/high	1431	83.7	1.0	1.0	1.0	1.0	963	77.2	1.0	1.0	1.0	1.0	1.0
Low	279	16.3	1.9	1.0	0.4-2.4	1.8	1.1	0.5-2.5	1.5	1.5	1.0-2.2	1.9	2.0
General health status	1716						1247						1.2-3.3
High	1656	96.5	1.0	1.0	1.0	1.0	1186	95.1	1.0	1.0	1.0	1.0	1.0
Low	60	3.5	3.5	1.1	0.1-8.7	1.8	2.1	0.6-7.8	1.1	0.96	0.4-2.2	2.3	1.9
Depressive symptoms	1703						1226						0.8-4.3
No	1132	66.5	1.0	1.0	1.0	1.0	789	64.4	1.0	1.0	1.0	1.0	1.0
Yes	571	33.5	1.3	0.8	0.4-1.6	1.0	0.9	0.4-1.7	1.1	0.98	0.7-1.4	1.5	1.2
Body mass index	1644						1171						0.8-1.9
Low weight	149	9.1	0.95	0.8	0.3-2.5	0.6	0.4	0.1-1.6	0.8	0.7	0.4-1.2	0.8	0.9
Normal weight	1357	82.5	1.0	1.0	1.0	1.0	898	76.7	1.0	1.0	1.0	1.0	1.0
Overweight	138	8.4	0.6	0.6	0.1-2.7	1.3	1.1	0.4-3.0	0.7	0.7	0.4-1.2	1.1	1.1
Family predictors													0.6-2.1
Income	1723						1258						
Highest	705	40.9	1.0	1.0	1.0	1.0	300	23.9	1.0	1.0	1.0	1.0	1.0
Middle	566	32.9	1.3	1.3	0.5-3.4	0.8	0.8	0.3-1.7	1.0	1.0	0.7-1.6	1.6	1.8
Lowest	452	26.2	4.2	3.5	1.4-9.1	2.5	1.8	0.8-4.1	1.1	1.0	0.6-1.7	2.7	2.3
Highest education	1709						1232						1.2-4.7
>15 years	143	8.4	1.0	1.0	1.0	1.0	26	2.1	1.0	1.0	1.0	1.0	1.0
13-15 years	655	38.3	1.7	0.9	0.2-4.3	2.1	1.5	0.3-6.8	0.8	1.0	0.4-2.9	2.9	2.2
10-12 years	797	46.6	2.0	0.96	0.2-4.5	2.4	1.4	0.3-6.6	0.6	0.6	0.2-1.7	2.4	1.4

(Continued)

Table II. (Continued)

	Upper secondary school					Vocational education										
	n	% Completed (n=1623)	Still studying (n=45)		Dropped out (n=55)		n	% Completed (n=844)	Still studying (n=267)		Dropped out (n=147)					
			OR crude	OR adjusted	OR crude	OR adjusted			OR crude	OR adjusted	OR crude	OR adjusted				
<10 years	114	6.7	3.2	1.3	0.2-7.8	5.7	2.7	0.5-14.9	230	18.7	0.7	0.6	0.2-1.8	4.6	2.1	0.3-17.0
Family type	1723								1258							
Two adults	1537	89.2	1.0	1.0	1.0	1.0	1.0	1062	84.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0
One adult/not at home	186	10.8	1.8	0.8	0.3-2.2	1.9	1.0	0.4-2.6	196	15.6	1.4	1.5	0.8-2.5	2.1	1.2	0.6-2.2

Values are odds ratios based on multivariate calculations. All analyses are adjusted for gender and age when completing 9th grade. Crude sample (n=2981); participants who completed the questionnaire at baseline in 2004 and with outcome information (upper secondary school n=1723, where 1623 completed, 45 were still studying and 55 dropped out; vocational education n=1258 where 844 completed, 267 were still studying and 147 dropped out). Adjusted 1 sample (n=2516): adjusted for all personal and family predictors. Upper secondary school n=1537, where 1453 completed, 38 were still studying and 46 dropped out; vocational education n=979 where 681 completed, 198 were still studying and 100 dropped out).

people from households with low income had a 3.5-fold higher risk of still being studying in upper secondary school, and approximately a 2-fold greater risk of dropping out of both upper secondary school and vocational education compared to young people from households with high income. Same trend was seen for young people with low educated parents (Table II).

Discussion

This 6.5-year prospective study showed that low grades when completing compulsory school predicted not having completed a secondary education by age 20/21. Furthermore, low sense of coherence in childhood was associated with dropping out from vocational education. Low general health status was associated with dropping out or never attaining a secondary education, and overweight was associated with never attaining a secondary education. Low family income and low parental education also decreased chances of having completed a secondary education while no association was found for not living with two parents at age 14/15.

Previous studies have described school performance to be positively related to educational attainment [9,10]. The present study indicates that school performance in terms of grades in oral Danish and written maths are essential for the transition from compulsory school into secondary education.

Our findings on general health status are in accordance with the results from a study of de Ridder et al. [13], who found a strong association between poor self-rated health, high school drop-out, and the risk of receiving medical and non-medical benefits in young adulthood. We found overweight to be a predictor of never attaining a secondary education but not educational achievement otherwise. Fowler-Brown et al. [15] found that obesity during adolescence was associated with lower likelihood of attaining a college degree and Karnehed et al. [14] found that men who had a BMI ≥25 kg/m² at age 18 were less likely to complete 15 years of school, compared to those with BMI <25 kg/m² at age 18 [14]. In the present study, depressive symptoms were not associated with completing a secondary education, which is not consistent with results from the study of Fletcher [12], who found that adolescent depressive symptoms decrease years of schooling completed, increase the probability of dropping out of high school, and decrease the probability of college enrolment. That study used the CES-D depression score instead of the CES-DC, which was used in our study and is a derived and validated score for children and adolescents [23]. A sensitivity analysis of the

CES-DC was conducted but this did not change the results. It is not clear if the different findings in relation to depressive symptoms in this study and the study of Fletcher are due to the use of different scales but we found the CES-DC most relevant for this study.

Few studies have focused on sense of coherence in relation to educational attainment. A cross-sectional study by Madarasova Geckova et al. [17] found that respondents perceiving the world as more manageable, meaningful and comprehensible were more likely to plan further education and a study by Kristensson et al. [16] found that sense of coherence correlated significantly positively with many of the primary and upper secondary marks. In the present study, we used the four items about meaningfulness from the sense of coherence scale and found it to be strongly associated with dropping out from vocational education. Why sense of coherence is related to dropping out of vocational education but not dropping out of upper secondary education is unclear. This study showed low self-esteem to be less associated to completing secondary education compared to sense of coherence, but both measures pointed in the same direction. A study by Mahaffy [30] didn't find self-esteem to be associated with educational attainment when aspects of social context and individual level factors were taken into account. The use of selected items instead of the complete questionnaires when measuring sense of coherence and self-esteem is a limitation of this study, although the item selection was done on the basis on other studies and validated subscales. A Cronbach alpha on 0.82 revealed a high internal consistency of the six selected items.

The association between parental socioeconomic status and educational attainment found in the present study is in accord with the findings of others [9,10]. However, the lack of association between living with one parent and educational achievement does not agree with the study by Wojtkiewicz [8], who found adolescents from one-parent families to be less likely to graduate from high school [8]. The different results could be due to variation in welfare systems in USA and Denmark and consequently different social and economic living conditions of single parents.

The strong effect of family predictors, especially parental education, was attenuated when personal predictors were included in the models. This was especially true for secondary school completion, where school grades may be a mediator of the educational status of the parents (results not shown).

When defining our outcome variable, a follow-up time of 6.5 years was used. This might be somewhat short especially in relation to those still studying at

vocational education. This category will contain a minor group of subjects who are being still studying without delay, since a few types of vocational education last up to 5 years. This means that they are more comparable to those who completed a secondary education than those dropping out or never attaining a secondary education.

An analysis stratified by gender was performed and since no essential differences were found between boys and girls we chose to adjust for gender in the final analyses.

In the present cohort, 80.8% completed a secondary education during follow up which is a relatively large number compared to the fact that 77% of all Danish young people at age 25 in year 2010 had completed a secondary education [18]. A comparison of parental socioeconomic status and educational attainment between the 629 non-responders and the 3053 participants showed that the participants came from better socioeconomic background than the non-responders and only 59% of the non-responders had completed a secondary education by follow up. This means that those who dropped out or never attained a secondary education were underrepresented in our study. It is uncertain if this selection has induced bias related to the ORs. If the young people participating in this study and not having completed a secondary education are representative of all young people not completing a secondary education, then the ORs were not affected.

This is a large prospective study with a high response rate and almost complete follow-up information from the registers. The study benefits from investigating risk factors from several personal and family factors within the same study. Although the study reveals associations, caution about causal inference is warranted. It is most likely that other factors related to school environment, teachers' recommendations and parents' educational aspirations for their children are also relevant to include when trying to understand the causes for not completing a secondary education. Nevertheless, the associations that remained after mutually adjustments bear witness to the importance of personal as well as socioeconomic factors.

This study points out some of the predictors of dropping out or never attaining a secondary education and shows some differences related to educational track. Dropping out or never attaining a secondary education could be the first step into a marginalisation, which could potential lead to an exclusion from the labour market, already in young adulthood.

In conclusion, this study confirms the social gradient in educational attainment. Furthermore, the

results indicate that, in spite of equal access to education, factors related to the individual in terms of school performance, health, and vulnerability in adolescence predict future success in the educational system, regardless of socioeconomic status. It is recommended that these high-risk groups are recognised and targeted when designing guidance and supervision programmes for youth at secondary education.

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Conflict of interest

The author declares that there is no conflict of interest.

References

- [1] Krokstad S, Kunst AE and Westin S. Trends in health inequalities by educational level in a Norwegian total population study. *J Epidemiol Community Health* 2002;56: 375–80.
- [2] Ernstsen L, Bjerkeset O and Krokstad S. Educational inequalities in ischaemic heart disease mortality in 44,000 Norwegian women and men: the influence of psychosocial and behavioural factors. The HUNT Study. *Scand J Public Health* 2010;38:678–85.
- [3] Viner RM, Ozer EM, Denny S, et al. Adolescence and the social determinants of health. *Lancet* 2012;379:1641–52.
- [4] Friestad C and Klepp KI. Socioeconomic status and health behaviour patterns through adolescence: results from a prospective cohort study in Norway. *Eur J Public Health* 2006;16:41–7.
- [5] Christiansen M, Hansen CD, Glasscock D, et al. Social inequality and health in adolescents. *Ugeskr Laeger* 2010;172:857–63.
- [6] Due P, Krolner R, Rasmussen M, et al. Pathways and mechanisms in adolescence contribute to adult health inequalities. *Scand J Public Health* 2011;39(6 Suppl):62–78.
- [7] Frieden TR and Centers for Disease Control and Prevention (CDC). Forward: CDC Health Disparities and Inequalities Report – United States, 2011. *MMWR Surveill Summ* 2011;60 Suppl:1–2.
- [8] Wojtkiewicz RA. Simplicity and complexity in the effects of parental structure on high school graduation. *Demography* 1993;30:701–17.
- [9] Kristensen P, Gravseth HM and Bjerkedal T. Educational attainment of Norwegian men: influence of parental and early individual characteristics. *J Biosoc Sci* 2009;41:799–814.
- [10] Jæger MM and Holm A. Which background factors matter more in intergenerational educational attainment: social class, cultural capital or cognitive ability? A random effects approach. *Centre for Applied Microeconometrics* 2003:1–28.
- [11] Jackson MI. Understanding links between adolescent health and educational attainment. *Demography* 2009;46:671–94.
- [12] Fletcher JM. Adolescent depression and educational attainment: results using sibling fixed effects. *Health Econ* 2010;19:855–71.
- [13] De Ridder KA, Pape K, Johnsen R, et al. School dropout: a major public health challenge: a 10-year prospective study on medical and non-medical social insurance benefits in young adulthood, the Young-HUNT 1 Study (Norway). *J Epidemiol Community Health* 2012;66:995–1000.
- [14] Karnehed N, Rasmussen F, Hemmingsson T, et al. Obesity and attained education: cohort study of more than 700,000 Swedish men. *Obesity (Silver Spring)* 2006;14:1421–8.
- [15] Fowler-Brown AG, Ngo LH, Phillips RS, et al. Adolescent obesity and future college degree attainment. *Obesity (Silver Spring)* 2010;18:1235–41.
- [16] Kristensson P and Ohlund LS. Swedish upper secondary school pupils' sense of coherence, coping resources and aggressiveness in relation to educational track and performance. *Scand J Caring Sci* 2005;19:77–84.
- [17] Madarasova Geckova A, Tavel P, van Dijk JP, et al. Factors associated with educational aspirations among adolescents: cues to counteract socioeconomic differences? *BMC Public Health* 2010;10:154.
- [18] Statistics Denmark. *Education among 25–35 year old in 2010 [25-og 35-åriges uddannelse 2010]*. Available at: www.dst.dk/nytudg/18012 (2012, accessed 4 December 2012).
- [19] Pedersen CB. The Danish Civil Registration System. *Scand J Public Health* 2011;39(7 Suppl):22–5.
- [20] Jensen VM and Rasmussen AW. Danish Education Registers. *Scand J Public Health* 2011;39(7 Suppl):91–4.
- [21] Kaplan GA, Goldberg DE, Everson SA, et al. Perceived health status and morbidity and mortality: evidence from the Kuopio ischaemic heart disease risk factor study. *Int J Epidemiol* 1996;25:259–65.
- [22] Idler EL and Benyamini Y. Self-rated health and mortality: a review of twenty-seven community studies. *J Health Soc Behav* 1997;38:21–37.
- [23] Fendrich M, Weissman MM and Warner V. Screening for depressive disorder in children and adolescents: validating the Center for Epidemiologic Studies Depression Scale for Children. *Am J Epidemiol* 1990;131:538–51.
- [24] Cole TJ, Bellizzi MC, Flegal KM, et al. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ* 2000;320:1240–3.
- [25] Antonovsky A. *Unravelling the mystery of health*. San Francisco: Josey Bass Publishers, 1987. p.19.
- [26] Torsheim T, Aaroe LE and Wold B. Sense of coherence and school-related stress as predictors of subjective health complaints in early adolescence: interactive, indirect or direct relationships? *Soc Sci Med* 2001;53:603–14.
- [27] Eriksson M and Lindstrom B. Validity of Antonovsky's sense of coherence scale: a systematic review. *J Epidemiol Community Health* 2005;59:460–6.
- [28] Turner RJ, Lloyd DA and Roszell P. Personal resources and the social distribution of depression. *Am J Community Psychol* 1999;27:643–72.
- [29] Baadsgaard M and Quitzau J. Danish registers on personal income and transfer payments. *Scand J Public Health* 2011;39(7 Suppl):103–5.
- [30] Mahaffy KA. Girls' low self esteem: How is it related to later socioeconomic achievements? *Gender Soc* 2004;18(3):309–27.





Initial non-participation and loss to follow-up in a Danish youth cohort: implications for relative risk estimates

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ABSTRACT

Background Initial non-participation and loss to follow-up in the Danish youth cohort Vestliv could introduce selection bias of the measured risk estimates.

Objective To investigate the impact of initial non-participation and loss to follow-up on the validity of descriptive measures and selected estimates of relative risk.

Methods Of the 3681 young people defining the source population, 83% answered a questionnaire at baseline in 2004. At follow-up waves in 2007 and 2010, the response rates were 71% and 64%, respectively. Relative ORs (RORs) were used to examine the impact of initial non-participation and loss to follow-up on the association between socioeconomic or personal risk factors at age 14/15 and educational attainment at age 20/21. RORs were calculated as OR (baseline population)/OR (source population) or OR (follow-up population)/OR (baseline population).

Results The participants had slightly better school abilities and came more often from homes with two adults, higher income or higher educational level. These differences increased at subsequent follow-ups. The effect of initial non-participation on the ORs was modest with most RORs being close to one. Loss to follow-up led to larger variations in the RORs ranging from 0.77 to 1.62 although for most estimates, the bias was minor. None of the measured RORs were statistically different from one indicating no significant bias.

Conclusions Although certain characteristics were related to those who initially chose to participate and especially to those who participated at follow-ups, it did not have any large influence on the relative risk estimates measured in the study.

INTRODUCTION

Selective response in a cohort study can be a serious threat to the validity of the study and may potentially lead to selection bias. Selection problems can be related to initial non-participation, missing data or loss to follow-up.¹ Findings have shown that participants and non-participants differ in many ways, typically with participants belonging to higher socioeconomic strata and having better health status.^{2–5} Young age itself has also been found to be associated with non-participation.^{2 6 7} In cohort studies of adolescents and young adults, certain characteristics such as tobacco and alcohol use, male gender and high body mass index (BMI) were more frequent among non-participants.^{6 8–10}

Although certain characteristics may be related to those who decide to participate in a cohort study, it does not necessarily introduce any important

selection bias for the associations under study.^{11 12} Compared with initial non-participation, loss to follow-up is in general considered a much greater threat to the validity of the internal comparisons since it may be related to both exposure and outcome.^{6 8 13}

Recently, a study on socioeconomic and personal predictors of educational attainment was conducted in the Danish youth cohort Vestliv. This study investigated to what degree low school performance, low sense of meaningfulness, low self-esteem and poor health status at age 14/15 were associated with completing a secondary education after compulsory school (age 20/21).¹⁴ The cohort was established in 2004 with a participation rate of 83% at baseline and with two follow-ups in 2007 and 2010 where participation rates were 65% and 58%, respectively. Of the participants at baseline, 71% responded at follow-up in 2007 and 64% at follow-up in 2010. These selections may have affected both the constitution of the available study sample and the validity of the internal comparisons.

The aims of the present study were to investigate if participants at baseline differed from the source population and if participants at follow-ups differed from the baseline population. Furthermore, we wanted to examine if (1) initial non-participation in 2004 and (2) loss to follow-up in 2007 and 2010 affected the associations between socioeconomic or personal risk factors and educational attainment.

METHODS

The source population of the prospective cohort study Vestliv consisted of all individuals born in 1989 and living in the county of Ringkjoebing, Denmark in early April 2004, altogether 3681 adolescents. Recruitment took place at the schools within the county where a baseline questionnaire was filled out during school hours in 2004 when the participants were 14/15 years old. Those not at school on the day of collection received the questionnaire by mail. Of the potential 3681 responders, 3054 (83%) chose to participate. A follow-up was conducted in 2007 when the young people were 17/18 years old, using both emailed and postal questionnaires. A second follow-up was carried out in 2010 when the young people were 20/21 years old, using only emailed questionnaires. Of the 3054 individuals defining the initial study population (called baseline population in the following), 2181 (71%) participated in the first follow-up in 2007 and 1945 (64%) in the second follow-up in 2010 (figure 1).

Register information about the source population was retrieved from Statistics Denmark by using the

Research report

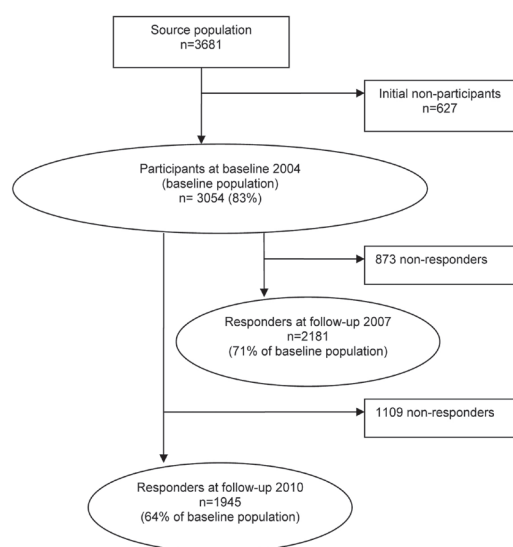


Figure 1 Distribution of participants and non-participants at baseline and responders and non-responders at follow-ups in 2007 and 2010.

personal identification number from the Central Person Register (CPR number), which is given to every inhabitant in Denmark at birth or upon entry for immigrants. To obtain information about family conditions, the young people were linked to their parents or guardians also using the CPR number.¹⁵ The study was approved by the Danish Data Protection Agency.

The outcome was a registered information about educational attainment after compulsory school measured in year 2010 when the participants were 20/21 years old.¹⁶ In Denmark, compulsory school ends after ninth grade, typically at the age of 16 years. The participants were categorised into one of the following four categories: (1) 'Completed' consisting of participants who had completed a secondary education; (2) 'Still studying' consisting of those who were still attaining a secondary education; (3) 'Dropped out' if they had dropped out of their last secondary education and never attained another and (4) 'Never attained' if they had never attained a secondary education.

The following exposure variables from 2004 (age 14/15) were derived from the registers. Yearly household income was recoded in tertiles corresponding to lowest (<64 540 EUR), middle (64 540–82 402 EUR) and highest tertile (>82 402 EUR).¹⁷ Highest education in the household was categorised into three categories <10, 10–12 and >12 years.¹⁶ Family type was dichotomised into 'living with one adult or not living with adults' or 'living with two adults'.¹⁵ Register-based information on the oral Danish and written math examination grades when finalising ninth grade were used, and a dichotomous variable indicating 'high grades' (8–13 equivalent to B+ and above) and 'low grades' (00–7 equivalent to B and below) was generated.¹⁶ Drug use was based on information about prescription medication for pain and nervous symptoms in the period 2005–2006 using the standardised international Anatomical Therapeutic Chemical (ATC) classification system.¹⁸ Four ATC classifications were included (painkilling drugs (N02), drugs for anxiety and sleep disturbance (N05B and N05C) and drugs against depression (N06A)) and combined into one variable defined as 'no drug use' or 'drug use'.

The following exposure variables were based on questionnaire information from 2004 (age 14/15). Depressive symptoms were measured using the four-item validated version of 'The Center for Epidemiologic Studies Depression Scale for Children' and the responses were dichotomised into 'depressive symptoms' and 'no depressive symptoms' at the recommended cut-off at 3.¹⁹ General health status was measured using a single item from SF-36 and the variable was dichotomised into 'high' and 'low' general health status by adding a cut point after the two highest categories.²⁰ BMI was categorised into low weight (BMI < 17 kg/m² for both boys and girls), normal weight (17–23.29 kg/m² for boys and 17–23.94 kg/m² for girls) and overweight (BMI > 23.29 kg/m² for boys and BMI > 23.94 kg/m² for girls), using thresholds for 15-year-old children.²¹ The four items about meaningfulness from the 'Sense of coherence-revised short version for children' (13 items) were used to categorise data with cut-off point at the 25% centile as normal/high and low scores.²² Self-esteem was measured by using six items from Rosenberg's 10 items self-esteem scale and also categorised into normal/high and low self-esteem by applying a cut-off point at the 25% centile.²³

Statistical analysis

First, the pattern of participation was examined by calculating prevalences (P) of register-based risk factors in the source population and the baseline population and comparing them by estimating prevalence ratios PR = (P_{Baseline population}/P_{Source population}).⁴ The same was carried out for the follow-ups in 2007 and 2010 where prevalences of register-based and questionnaire-based risk factors for responders were compared with those for the baseline population.

Second, multinomial logistic regression was used to estimate ORs for associations between different risk factors and educational attainment in the source population, the baseline population and the follow-up populations in 2007 and 2010. Individuals who had completed a secondary education were used as reference group. Gender and age when completing ninth grade were included in all models. To examine the impact of the initial non-participation, we computed relative ORs (ROR) as the ratio of the OR for the baseline population and the OR in the source population (ROR = OR_{Baseline population}/OR_{Source population}). Similarly, loss to follow-up was examined by computing RORs as the ratio of the OR for the follow-up populations in 2007 or 2010 and the OR of the baseline population (ROR = OR_{Follow-up population}/OR_{Baseline population}).¹¹ In the loss to follow-up analyses, the outcome category 'never attained' contained too few participants to be able to calculate valid ROR estimates and therefore the category was excluded from these analyses. To calculate 95% CI of the PR and the ROR estimates, the following approximate formula was applied: $se(\hat{\theta}_{Sub} - \hat{\theta}_{Tot}) = \sqrt{se(\hat{\theta}_{Sub})^2 - se(\hat{\theta}_{Tot})^2}$,¹¹ where $\hat{\theta}_{Tot}$ is the estimate of the total sample and $\hat{\theta}_{Sub}$ is the estimate in a subsample. This formula has been used in previous studies^{4 11 12} and has in a Danish simulation study shown to give valid CIs for RORs when the expected bias related to the selection is modest.¹¹ STATA statistical package (V12.0; Stata, College Station, Texas, USA) was used for all analyses.

Sensitivity analyses were performed with exposure variables included as continuous values or with alternative categorisations. These analyses did not reveal RORs that differed from those found in the main analysis; neither did they provide higher statistical power.

Table 1 Participation at baseline and response at follow-ups in 2007 and 2010 according to socioeconomic and personal risk factors

Source population (N=3681)	Baseline 2004 (N=3054)			Follow-up 2007 (N=2181)			Follow-up 2010 (N=1945)			
	Prevalence	Participation*	Prevalence ratio†	Prevalence	Response*	Prevalence ratio†	Prevalence	Response*	Prevalence ratio†	
	n Per cent	Per cent	Estimate 95% CI	n Per cent	Per cent	Estimate 95% CI	n Per cent	Per cent	Estimate 95% CI	
All	3681	3054	100	83	2181	100	71	1945	100	64
<i>Register-based risk factors</i>										
Grades—oral Danish	3340	2889		86	2086		72	1865		65
8 or above	2358	2102	73	89	1596	77	76	1424	76	68
7 or below	982	787	27	80	490	23	62	441	24	56
Grades—written math	3327	2874		86	2078		72	1857		65
8 or above	2176	1962	68	90	1520	73	77	1385	75	71
7 or below	1151	912	32	79	558	27	61	472	25	52
Drug use	3681	3054		83	2181		71	1945		64
No	3500	2905	95	83	2080	95	72	1838	95	63
Yes	181	149	4.9	82	101	4.6	68	107	5.5	72
Household income	3678	3053		83	2180		71	1945		64
Highest	1138	1017	33	89	1017	36	77	692	36	68
Middle	1177	1018	33	86	1018	35	74	693	36	68
Lowest	1363	1018	33	75	639	29	63	560	29	55
Highest household education (years)	3582	3001		84	2153		72	1927		64
>12	1219	1094	36	90	833	39	76	753	39	69
10–12	1867	1548	52	83	1113	52	72	973	50	63
<10	496	359	12	72	207	10	58	201	10	56
Family type	3681	3054		83	2181		71	1945		64
Two adults	3130	2652	87	85	1957	90	74	1744	90	66
One adult	551	402	13	73	224	10	56	201	10	50
<i>Questionnaire-based risk factors</i>										
Self-esteem	2974				2126		71	1901		64
Normal/high	2237	75		—	1614	76	72	1410	74	63
Low	737	25		—	512	24	69	491	26	67
Sense of meaningfulness	3023				2164		72	1933		64
Normal/high	2439	81		—	1768	82	72	1578	82	65
Low	584	19		—	396	18	68	355	18	61
General health status	3034				2168		71	1932		64
High	2905	96		—	2086	96	72	1859	96	64
Low	129	4.3		—	82	3.8	64	73	3.8	57
Depressive symptoms	3000				2152		72	1924		64
No	1959	65		—	1408	65	72	1271	66	65

Continued

Table 1 Continued

	Source population (N=3681)		Baseline 2004 (N=3054)		Follow-up 2007 (N=2181)				Follow-up 2010 (N=1945)						
	n	Per cent	Prevalence	Per cent	Prevalence	Per cent	Participation*	Prevalence ratio†		Prevalence	Per cent	Response*	Per cent	Prevalence ratio§	
								Estimate	95% CI					Estimate	95% CI
Yes	-	-	-	-	744	35	-	-	1.00	0.97 to 1.03	653	34	63	0.98	0.94 to 1.02
Body mass index	-	-	1041	35	2067	72	-	-	1.01	0.94 to 1.08	1831	64	64	0.93	0.85 to 1.03
Low weight	-	-	273	9.5	198	9.6	-	-	1.01	1.00 to 1.02	1481	81	64	1.01	1.00 to 1.03
Normal weight	-	-	2301	80	1669	81	-	-	0.91	0.85 to 0.99	188	10	62	0.97	0.89 to 1.06
Overweight	-	-	305	11	200	9.7	-	-	-	-	-	-	-	-	-

*Different participation rates/response rates caused by missing register information.

†Prevalence ratio=prevalence in the baseline population/prevalence in the source population.

‡Prevalence ratio=prevalence in the 2007 follow-up population/prevalence in the baseline population.

§Prevalence ratio=prevalence in the 2010 follow-up population/prevalence in the baseline population.

The significant prevalence ratios are written in bold.

RESULTS

Table 1 shows participation rates at baseline, response rates at follow-ups and the distribution of risk factors in the source, baseline and follow-up populations. Participants at baseline did not differ much from the source population except that adolescents from families in the highest income and educational group, those brought up by two adult and those with high grades in math and Danish were slightly over-represented. At follow-up in 2007, these over-representations increased. The lowest response rates in specific groups were 56–63% and the highest 76–77% as compared with the general participation rate of 71%. This led to prevalence ratios ranging from 1.08 to 0.78 indicating only modest over-representation and under-representation. The pattern of response at follow-up in 2010 was identical to the pattern in 2007. None of the risk factors measured in the baseline questionnaire were related to the loss to follow-up (table 1).

Impact of initial non-participation on relative estimates

Table 2 displays ORs and RORs for educational attainment measured in the baseline population and the source population. For most associations, we found no or minor differences in the ORs for the two populations leading to RORs close to one. Only for the associations between ‘low income’ or ‘living with one adult’ and ‘never attained a secondary education’, underestimation or overestimation of about 20% were observed, but the CIs of the RORs were wide, and all included the value 1.

Impact of loss to follow-up on relative estimates

The bias estimates related to the loss to follow-up in 2007 and 2010 are displayed in table 3. Compared with the baseline population, stronger associations were observed for the participants in the 2007 follow-up for ‘low general health status’ and ‘still studying’ (ROR 1.55) and for ‘low grades in oral Danish’ or ‘low household education’ and ‘dropping out’ (RORs 1.36 and 1.26), however all with CIs including the value 1. The rest of the RORs did not reveal any underestimation or overestimation exceeding 23%, and most RORs were close to 1.

Among participants in the 2010 follow-up, we observed stronger associations between ‘low weight’ and ‘still studying’ (ROR 1.49) and between ‘drug use’ or ‘overweight’ and ‘dropping out’ (RORs 1.59 and 1.62) as compared with the baseline population. None of the remaining RORs, revealed underestimation or overestimation exceeding 23%, and most RORs were close to 1. Again, CIs were wide showing no statistically significant bias.

A supplementary analysis comparing the follow-up populations with the source population was conducted for register variables. It revealed increasing bias for some RORs related to grades, drug use and low household education, which changed from underestimation or overestimation below 23% in the main analysis to underestimation or overestimation of 24–29%. All but one of the CIs was not statistically significant (see online supplementary table S1).

DISCUSSION

In this Danish cohort of young people, the initial participation only involved minor selection on socioeconomic and personal risk factors. The participants had slightly better school abilities and came more often from homes with two adults or with higher income and educational level. This selection pattern became more pronounced at the first follow-up, but was not further strengthened at the second follow-up.

The impact of the initial participation on relative risk estimates for educational attainment was modest with no indication

Table 2 Relative ORs (ROR) examining the impact of initial non-participation on ORs for educational attainment

	ORs for educational attainment											
	Source population (n=3668)*			Participants at baseline (n=3053)†			RORs‡					
	Still studying (n=418) OR¶	Dropping out (n=286) OR¶	Never attained (n=129) OR¶	Still studying (n=312) OR¶	Dropping out (n=202) OR¶	Never attained (n=72) OR¶	Still studying ROR¶	Dropping out ROR¶	Never attained ROR¶	Still studying 95% CI	Dropping out 95% CI	Never attained 95% CI
<i>Register-based risk factors</i>												
<i>Grades—oral Danish</i>												
8 or above	Ref	Ref	Ref	Ref	Ref	Ref	1.08	0.75 to 1.55	0.92	0.70 to 1.22	0.87	0.60 to 1.26
7 or below	2.34	3.56	3.03	2.53	3.28	2.62						
<i>Grades—written math</i>												
8 or above	Ref	Ref	Ref	Ref	Ref	Ref	0.99	0.70 to 1.40	0.94	0.68 to 1.31	1.03	0.26 to 4.09
7 or below	3.24	4.19	3.85	3.22	3.95	3.98						
<i>Drug use</i>												
No	Ref	Ref	Ref	Ref	Ref	Ref	1.16	0.64 to 2.08	0.84	0.67 to 1.05	1.13	0.08 to 16.5
Yes	1.69	1.44	4.55	1.96	1.21	5.15						
<i>Household income</i>												
Highest	Ref	Ref	Ref	Ref	Ref	Ref	0.98	0.81 to 1.18	1.03	0.74 to 1.42	0.96	0.54 to 1.71
Middle	1.52	1.46	1.49	1.49	1.50	1.43						
Lowest	2.28	3.46	4.62	2.27	3.56	3.76	1.00	0.73 to 1.37	1.03	0.50 to 2.11	0.81	0.62 to 1.07
<i>Highest household education (years)</i>												
>12	Ref	Ref	Ref	Ref	Ref	Ref	1.09	0.86 to 1.39	0.98	0.78 to 1.24	—	—
10–12	1.39	1.53	1.50	1.52	1.50	0.98						
<10	2.26	3.59	3.00	2.23	3.77	2.69	0.99	0.63 to 1.54	1.05	0.42 to 2.60	0.90	0.37 to 2.16
<i>Family type</i>												
Two adults	Ref	Ref	Ref	Ref	Ref	Ref	1.01	0.75 to 1.35	1.10	0.65 to 1.86	0.78	0.42 to 1.44
One adult	1.66	2.15	3.16	1.67	2.36	2.46						

*Includes 2835 participants who had completed a secondary education (reference group). Information about age when completing ninth grade was missing for 13 persons.
 †Includes 2467 participants who had completed a secondary education (reference group). Information about age when completing ninth grade was missing for one person.
 ‡ROR=OR in the baseline population/OR in the source population.
 §Not possible to calculate an ROR with CIs for 'parental education 10–12 years' and 'never attained'.
 ¶Adjusted for gender and age when completing ninth grade.
 ††The significant ORs and RORs are written in bold.

Table 3 Relative ORs (ROR) examining the impact of loss to follow-up on ORs for educational attainment

	ORs for educational attainment													
	Participants at baseline (n=2981)*			Participants at follow-up in 2007 (n=2146)†			Participants at follow-up in 2010 (n=1915)‡			Relative ORs (ROR)§				
	Still studying (n=312) OR¶	Dropping out (n=202) OR¶	Still studying (n=199) OR¶	Dropping out (n=87) OR¶	Still studying (n=167) OR¶	Dropping out (n=85) OR¶	Still studying (n=167) OR¶	Dropping out (n=85) OR¶	Still studying (n=167) OR¶	Dropping out (n=85) OR¶	Still studying (n=167) OR¶	Dropping out (n=85) OR¶		
<i>Register-based risk factors</i>														
<i>Grades—oral Danish</i>														
8 or above	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref		
7 or below	2.52	3.28	2.79	4.47	2.97	2.88	1.11	0.60 to 2.05	1.36	0.22 to 8.54	1.18	0.53 to 2.64	0.88	0.35 to 2.20
<i>Grades—written math</i>														
8 or above	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
7 or below	3.22	3.95	3.30	4.79	3.72	3.94	1.02	0.53 to 1.97	1.21	0.18 to 8.29	1.15	0.42 to 3.14	1.00	0.24 to 4.12
<i>Drug use</i>														
No	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.92	1.21	1.87	1.08	2.03	1.92	0.97	0.50 to 1.89	0.89	0.41 to 1.93	1.06	0.46 to 2.45	1.59	0.42 to 5.98
<i>Household income</i>														
Highest	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Middle	1.48	1.50	1.46	1.44	1.37	1.49	0.98	0.73 to 1.32	0.96	0.53 to 1.75	0.92	0.66 to 1.28	0.99	0.48 to 2.04
Lowest	2.25	3.55	2.08	3.13	2.28	4.10	0.92	0.63 to 1.34	0.88	0.30 to 2.57	1.01	0.54 to 1.91	1.15	0.16 to 8.23
<i>Highest household education (years)</i>														
>12	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
10–12	1.51	1.50	1.51	1.57	1.59	1.53	1.00	0.76 to 1.32	1.04	0.55 to 1.99	1.05	0.71 to 1.55	1.02	0.54 to 1.91
<10	2.20	3.77	1.69	4.74	1.69	4.54	0.77	0.58 to 1.02	1.26	0.10 to 15.4	0.77	0.51 to 1.16	1.20	0.12 to 12.6
<i>Family type</i>														
Two adults	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
One adult	1.64	2.36	1.55	1.90	1.73	2.80	0.94	0.62 to 1.43	0.80	0.39 to 1.67	1.05	0.58 to 1.93	1.18	0.33 to 4.19
<i>Questionnaire-based risk factors</i>														
<i>Self-esteem</i>														
Normal/high	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Low	2.01	1.73	1.85	1.97	2.18	2.05	0.92	0.65 to 1.31	1.14	0.54 to 2.40	1.09	0.60 to 1.99	1.18	0.52 to 2.68
<i>Sense of meaningfulness</i>														
Normal/high	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Low	1.71	2.10	1.73	2.44	1.44	2.02	1.02	0.70 to 1.47	1.16	0.46 to 2.94	0.84	0.63 to 1.13	0.96	0.47 to 1.97

General health status																		
High	Ref	2.63	Ref	2.68	Ref	2.65	Ref	1.88	Ref	2.50	1.55	0.36 to 6.72	1.01	0.19 to 5.26	1.09	0.33 to 3.59	0.95	0.18 to 5.15
Low	1.73																	
Depressive symptoms																		
No	Ref	1.40	Ref	1.28	Ref	1.70	Ref	1.30	Ref	1.53	1.06	0.82 to 1.37	1.21	0.65 to 2.26	1.07	0.78 to 1.47	1.10	0.63 to 1.91
Yes	1.21																	
Body mass index																		
Low weight	0.88	0.82	Ref	0.83	Ref	0.83	Ref	1.31	Ref	0.91	0.94	0.75 to 1.19	1.02	0.62 to 1.67	1.49	0.83 to 2.66	1.11	0.58 to 2.12
Normal weight	Ref	1.42	Ref	1.03	Ref	1.25	Ref	1.08	Ref	2.29	1.10	0.76 to 1.57	0.88	0.46 to 1.69	1.15	0.71 to 1.86	1.62	0.47 to 5.52
Overweight	0.94																	

* Includes 2467 participants who had completed a secondary education (reference group). Information about age when completing ninth grade was missing for one person.
† Includes 1860 participants who had completed a secondary education (reference group).
‡ Includes 1663 participants who had completed a secondary education (reference group).
§ RORs, comparing ORs for participants at baseline in 2004 with ORs of participants at follow-up in 2007 or 2010, respectively.
¶ Adjusted for gender and age when completing ninth grade.
The significant ORs and RORs are written in bold.

of underestimation or overestimation exceeding 22%, and most estimates were similar in the source and baseline population. Also the examination of loss to follow-up showed in general only small differences on relative risk estimates when comparing the follow-up populations with the baseline population. For six relative risk estimates (three at each follow-up), we observed underestimation or overestimation exceeding 23%, but they were all based on small numbers and CIs were wide. At no point in time did the selection lead to statistically significant bias. These findings are in accord with previous studies based on adult cohorts that also calculated relative risk estimates and did not find any considerable selection bias, neither in relation to the initial non-participation,^{11 12} nor in relation to the loss to follow-up.¹³

It is well known that socioeconomic measures are strong predictors of non-participation both initially and at follow-up among adult populations.^{2-4 7 24 25} This study shows that adolescents to some degree follow the response pattern of their parents, as low household income and low parental education were associated with both initial non-participation and loss to follow-up. This is also consistent with the results from two young adult cohorts where people were mainly in their 20s when recruited.^{8 26}

At the follow-ups, we found health and well-being of the participants to be almost identical to that of the baseline population. Previous studies have found high mental distress,^{5 24} low general health status^{5 27 28} and high BMI⁵ to be related to initial non-participation and loss to follow-up whereas others did not.^{25 29 30} It remains unclear why the present study could not replicate these response patterns, but one explanation may be that young people have less severe morbidity in general which may have a relatively smaller impact on their ability to participate. Also, they may be more willing to tell about their, relatively minor, health problems as compared with an adult population.

The Vestliv cohort consists of a large sample of young Danes with a high initial participation rate of 83%. Register information was almost complete for the source population, and studies have shown these data to have a high validity.¹⁵⁻¹⁷ Additionally, we had high completeness of the questionnaire that was included in the study. The Vestliv cohort has multiple research aspects with the overall focus of studying inequality in a lifecourse perspective. Inspired by a recent study,¹⁴ we investigated exposures related to educational attainment after compulsory school. These are, however, only a small subset of all the relative risk estimates that might be studied in the Vestliv cohort study, and larger bias could be observed for other associations. It is also important to emphasise that while other researchers can benefit from applying the presented method of estimating selection bias, the results cannot be generalised to other research areas.

In this study, we used ROR estimates with 95% CIs to estimate the degree of initial non-participation and loss to follow-up. If large bias had been found, it would have been possible to use inverse probability weighting, but this method requests some kind of information about the missing variables, which can be difficult to achieve.³¹ Multiple imputation techniques is another way of addressing problems with missing data in order to avoid selection bias and is becoming increasingly used in epidemiological studies.^{32 33}

Although certain characteristics were related to those who participated initially and especially to those who responded at follow-ups, our study showed that it did not have any large influence on the relative risk estimates in the study, as contrasts sustained within the study population. For some of the bias

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estimates, CIs were wide limiting our ability in detecting important differences in the relative risk estimates among source, base-line and follow-up populations. Our results are context specific, and it would be useful to obtain data from other populations as well. In combination, this could provide useful information for ongoing and future epidemiological studies involving young people. For forthcoming analyses in this cohort, we find the results from this study reassuring for obtaining valid risk estimates.

What is already known on this subject

- ▶ Previous studies of adult cohorts have found low socioeconomic status and poor health to increase non-participation and loss to follow-up.
- ▶ This study examines if certain characteristics were related to participation initially and at follow-ups in a cohort of young people and if any important selection bias of the associations under study was introduced.

What this study adds

- ▶ Initial non-participation was minor and did not have important impact on the validity of the measured relative risk estimates.
- ▶ Loss to follow-up was associated with more pronounced selection patterns, but no statistically significant effects on the relative risk estimates were observed.

Contributors JHA initiated the study. TNW designed and performed the analyses, and wrote the main paper. EAN helped designing the study and analysing the data. All authors interpreted the results and their implications and commented on the manuscript at all stages.

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REFERENCES

- 1 Rothman K, Greenland S, Lash T. Validity in Epidemiologic Studies. In: Rothman K, Greenland S, Lash T, eds. *Modern Epidemiology*. 3rd ed. Philadelphia, PA: Lippincott Williams & Williams; 2008:128–150.
- 2 Bergman P, Ahlberg G, Forsell Y, et al. Non-participation in the second wave of the PART study on mental disorder and its effects on risk estimates. *Int J Soc Psychiatry* 2010;56:119–32.
- 3 Goldberg M, Chastang JF, Leclerc A, et al. Socioeconomic, demographic, occupational, and health factors associated with participation in a long-term epidemiologic survey: a prospective study of the French GAZEL cohort and its target population. *Am J Epidemiol* 2001;154:373–84.
- 4 Jacobsen TN, Nohr EA, Frydenberg M. Selection by socioeconomic factors into the Danish National Birth Cohort. *Eur J Epidemiol* 2010;25:349–55.
- 5 Torvik FA, Rognmo K, Tams K. Alcohol use and mental distress as predictors of non-response in a general population health survey: the HUNT study. *Soc Psychiatr Epidemiol* 2012;47:805–16.
- 6 Alonso A, Segui-Gomez M, de Irala J, et al. Predictors of follow-up and assessment of selection bias from dropouts using inverse probability weighting in a cohort of university graduates. *Eur J Epidemiol* 2006;21:351–8.
- 7 Carter KN, Imlach-Gunasekara F, McKenzie SK, et al. Differential loss of participants does not necessarily cause selection bias. *Aust N Z J Public Health* 2012;36:218–22.
- 8 Powers J, Loxton D. The impact of attrition in an 11-year prospective longitudinal study of younger women. *Ann Epidemiol* 2010;20:318–21.
- 9 Morrison TC, Wahlgren DR, Hovell MF, et al. Tracking and follow-up of 16,915 adolescents: minimizing attrition bias. *Control Clin Trials* 1997;18:383–96.
- 10 Cunradi CB, Moore R, Killoran M, et al. Survey nonresponse bias among young adults: the role of alcohol, tobacco, and drugs. *Subst Use Misuse* 2005;40:171–85.
- 11 Nohr EA, Frydenberg M, Henriksen TB, et al. Does low participation in cohort studies induce bias? *Epidemiology* 2006;17:413–18.
- 12 Kaerlev L, Kolstad HA, Hansen AM, et al. Are risk estimates biased in follow-up studies of psychosocial factors with low base-line participation? *BMC Public Health* 2011;11:539.
- 13 Greene N, Greenland S, Olsen J, et al. Estimating bias from loss to follow-up in the Danish National Birth Cohort. *Epidemiology* 2011;22:815–22.
- 14 Winding TN, Nohr EA, Labriola M, et al. Personal predictors of educational attainment after compulsory school: influence of measures of vulnerability, health, and school performance. *Scand J Public Health* 2013;41:92–101.
- 15 Pedersen CB. The Danish Civil Registration System. *Scand J Public Health* 2011;39:22–5.
- 16 Jensen VM, Rasmussen AW. Danish Education Registers. *Scand J Public Health* 2011;39:91–4.
- 17 Baadsgaard M, Quitzau J. Danish registers on personal income and transfer payments. *Scand J Public Health* 2011;39:103–5.
- 18 WHO Collaborating Centre for Drug Statistics Methodology. Guidelines for ATC classification and DDD assignment 2013, 2012. http://www.whocc.no/filearchive/publications/1_2013guidelines.pdf, (accessed 21 Feb 2013).
- 19 Fendrich M, Weissman MM, Warner V. Screening for depressive disorder in children and adolescents: validating the Center for Epidemiologic Studies Depression Scale for Children. *Am J Epidemiol* 1990;131:538–51.
- 20 Idler EL, Benyamini Y. Self-rated health and mortality: a review of twenty-seven community studies. *J Health Soc Behav* 1997;38:21–37.
- 21 Cole TJ, Bellizzi MC, Flegal KM, et al. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ* 2000;320:1240–3.
- 22 Eriksson M, Lindstrom B. Validity of Antonovsky's sense of coherence scale: a systematic review. *J Epidemiol Community Health* 2005;59:460–6.
- 23 Turner RJ, Lloyd DA, Roszell P. Personal resources and the social distribution of depression. *Am J Community Psychol* 1999;27:643–72.
- 24 Lundberg I, Damstrom Thakker K, Hallstrom T, et al. Determinants of non-participation, and the effects of non-participation on potential cause-effect relationships, in the PART study on mental disorders. *Soc Psychiatry Psychiatr Epidemiol* 2005;40:475–83.
- 25 Korkeila K, Suominen S, Ahvenainen J, et al. Non-response and related factors in a nation-wide health survey. *Eur J Epidemiol* 2001;17:991–9.
- 26 Littman AJ, Boyko EJ, Jacobson IG, et al. Assessing nonresponse bias at follow-up in a large prospective cohort of relatively young and mobile military service members. *BMC Med Res Methodol* 2010;10:99.
- 27 Van Loon AJ, Tjihuis M, Picavet HS, et al. Survey non-response in the Netherlands: effects on prevalence estimates and associations. *Ann Epidemiol* 2003;13:105–10.
- 28 Goldberg M, Chastang JF, Zins M, et al. Health problems were the strongest predictors of attrition during follow-up of the GAZEL cohort. *J Clin Epidemiol* 2006;59:1213–21.
- 29 Gustavson K, von Soest T, Karevold E, et al. Attrition and generalizability in longitudinal studies: findings from a 15-year population-based study and a Monte Carlo simulation study. *BMC Public Health* 2012;12:918.
- 30 Ekholm O, Gundgaard J, Rasmussen NK, et al. The effect of health, socio-economic position, and mode of data collection on non-response in health interview surveys. *Scand J Public Health* 2010;38:699–706.
- 31 Weuve J, Tchetgen Tchetgen EJ, Glymour MM, et al. Accounting for bias due to selective attrition: the example of smoking and cognitive decline. *Epidemiology* 2012;23:119–28.
- 32 Donders AR, van der Heijden GJ, Stijnen T, et al. Review: a gentle introduction to imputation of missing values. *J Clin Epidemiol* 2006;59:1087–91.
- 33 van der Heijden GJ, Donders AR, Stijnen T, et al. Imputation of missing values is superior to complete case analysis and the missing-indicator method in multivariable diagnostic research: a clinical example. *J Clin Epidemiol* 2006;59:1102–9.

Supplementary table 1: Relative Odds Ratios (ROR) comparing odds ratios in the source population and the follow-up populations in 2007 or 2010.

		Odds ratios for educational attainment															
Source population (n=3539) ^a		Participants at follow-up in 2007 (n=2348) [†]				Participants at follow-up in 2010 (n=2098) [‡]				Relative Odds Ratios (ROR) ^{**}							
		Still studying (n=286)		Dropping out (n=111)		Still studying (n=198)		Dropping out (n=108)		Follow-up in 2007		Follow-up in 2010					
OR ^{††}		OR ^{††}		OR ^{††}		OR ^{††}		OR ^{††}		ROR ^{†††} 95% CI		ROR ^{†††} 95% CI					
Still studying		Dropping out		Still studying		Dropping out		Still studying		Dropping out		Still studying		Dropping out			
Register-based risk factors																	
Grades - oral Danish																	
8 or above	ref	ref	ref	ref	ref	ref	ref	ref	ref	1,24	0,62 ; 2,48	1,31	0,22 ; 7,90	1,23	0,57 ; 2,64	0,96	0,32 ; 2,93
7 or below	2,33	3,56	2,89	4,68	2,87	3,43	3,43	3,43	3,43								
Grades - written math																	
8 or above	ref	ref	ref	ref	ref	ref	ref	ref	ref	1,02	0,53 ; 1,99	1,27	0,15 ; 10,5	1,12	0,45 ; 2,78	1,11	0,20 ; 6,12
7 or below	3,23	4,19	3,30	5,33	3,61	4,64	4,64	4,64	4,64								
Drug use																	
no	ref	ref	ref	ref	ref	ref	ref	ref	ref	1,23	0,52 ; 2,94	0,90	0,41 ; 2,00	1,29	0,47 ; 3,54	1,33	0,39 ; 4,50
yes	1,67	1,43	2,07	1,30	2,15	1,90	1,90	1,90	1,90								
Household income																	
highest	ref	ref	ref	ref	ref	ref	ref	ref	ref	0,91	0,72 ; 1,16	0,98	0,56 ; 1,73	0,86	0,65 ; 1,12	0,93	0,51 ; 1,72
middle	1,52	1,46	1,38	1,44	1,30	1,37	1,37	1,37	1,37								
lowest	2,27	3,45	2,01	3,04	2,15	4,08	4,08	4,08	4,08								
Highest household education																	
>12 years	ref	ref	ref	ref	ref	ref	ref	ref	ref	1,02	0,77 ; 1,34	1,04	0,57 ; 1,91	1,04	0,73 ; 1,48	1,15	0,55 ; 2,41
10-12 years	1,39	1,53	1,41	1,59	1,45	1,75	1,75	1,75	1,75								
<10 years	2,22	3,56	1,58	4,85	1,78	4,56	4,56	4,56	4,56								
Family type																	
two adults	ref	ref	ref	ref	ref	ref	ref	ref	ref	0,71	0,56 ; 0,91	1,36	0,13 ; 14,6	0,80	0,49 ; 1,33	1,28	0,13 ; 12,8
one adult	1,63	2,13	1,51	1,75	1,91	2,16	2,16	2,16	2,16								

^aIncludes 2835 participants who had completed a secondary education (reference group). Information about age when completing 9th grade was missing for six persons.

[†]Includes 2006 participants who had completed a secondary education (reference group). Information about age when completing 9th grade was missing for one person.

[‡]Includes 1792 participants who had completed a secondary education (reference group). Information about age when completing 9th grade was missing for one person.

^{**}Relative Odds Ratios, comparing OR's for the source population with OR's of participants at follow-up in 2007 or 2010, respectively.

^{††}Adjusted for gender and age when completing 9th grade



Paper III

Risk factors for poor work environment among young workers

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Abstract

Background

In order to reduce future inequality in health and prevent unstable labour market participation, it is essential to investigate if certain individual or background characteristics are associated with increased risk of experiencing poor work environment among young workers.

Aims

To describe the work environment of Danish 20/21 year olds and to investigate the influence of family socioeconomic background and individual characteristics at age 14/15 on later experience of physical and psychosocial work environment.

Methods

The study population consisted of 679 young workers who had primary work affiliation at age 20/21. From registers and a questionnaire filled out in 2004, information on school performance, vulnerability, health and parental socioeconomic status was obtained. Outcome information from a questionnaire in 2010 included eight measures for psychosocial or physical work environment.

Results

The psychosocial work environment of the young workers was in general good but they experienced more demanding physical work than adults. Overall, individual as well as family factors had limited impact on their assessment of the work environment. Low self-esteem at age 14/15 was associated with experiencing high demands, low trust and low fairness at work whereas low parental socioeconomic status was associated with poor physical work environment.

Conclusions

This study showed a social gradient in experiencing poor physical work environment at age 20/21. The psychosocial work environment in young workers was on average good, but vulnerable young people may need special attention to prevent them from being selected into psychosocially demanding job functions later in life.

Background

A successful integration on the labour market is essential if we want to reduce future inequality in health and social status [1,2]. Psychosocial work environment in young adulthood is an important determinant of health inequality in a lifetime perspective [3,4]. The objective of this study is not to address social inequalities of health per se but to explore some of the individual and family background factors affecting the experienced work environment among young workers, which eventually can lead to poor health outcomes.

Low socioeconomic status has been associated with poor work environment in adult populations [5,6] but little is known about how work environment among young workers is influenced by family socioeconomic status [7] or individual factors like school performance [8] or mental health [9]. Female gender, low family socioeconomic status, and poor academic achievement at age 16 has been associated with low job control and high job strain at age 31 [7] and social/emotional competence in high school seems to be related to reporting of poor work environment five years later [8]. Self-esteem was found positively related to job satisfaction [10] whereas the association between sense of coherence and psychosocial work environment is less convincing [11]. These results are based on adult populations and further information about childhood vulnerability and later experienced work environment is needed.

In order to reduce future inequality in health and prevent unstable labour market participation, it is essential to investigate if certain individual or background characteristics are associated with increased risk of experiencing poor work environment among young workers when the effect of the other family and individual risk factors are taken into account.

Therefore the aims of the present study were to 1) describe the work environment of working Danish 20/21 year olds and compare them to the Danish general working population and 2) to investigate if family socioeconomic background and individual characteristics at age 14/15 were associated with the assessment of physical and psychosocial work environment at age 20/21. Additionally, gender differences were examined.

Methods

The study population was derived from the prospective cohort Vestliv, which is a youth cohort based upon all individuals born in 1989 and living in the county of Ringkjoebing, Denmark in early April 2004 [12,13]. All together, 3,681 adolescents were identified using information from The Central Office of Civil Registration [14] and from public schools. Of these, 3,054 (83%) chose to participate

at baseline in 2004, when the participants were 14/15 years old. The questionnaire collection took place during school hours at the respondents' schools and those not at school at the day of collection received the questionnaire by mail. A follow-up was conducted in 2007 when the participants were 17/18 years old, using both e-mailed and postal questionnaires. A second follow-up was carried out in 2010 when the participants were 20/21 years old, using only e-mailed questionnaires. Of the 3,054 baseline responders, 2,181 (71%) chose to participate in 2007 and 1,945 (64%) in 2010. Information for the present study was derived from all three questionnaires but the main analyses were based on questionnaire information from 2004 and 2010 as well as register information. The population was defined as those who answered a questionnaire at baseline and at follow-up in 2010, including information on at least one of the outcomes and who were working or attending a vocational education with an apprenticeship at age 20/21. Those attending other educations were excluded leaving 679 young workers in the final study population (Figure 1).

To retrieve register information on background risk factors, respondents were linked to their parents or guardians by using their personal identification number from the Central Person Register (CPR number), which is given to every inhabitant in Denmark at birth or at immigration [14]. The study and the data linkage procedures were approved by the Danish Data Protection Agency. According to Danish law, questionnaire and register-based studies do not need approval by ethical and scientific committees, nor informed consent.

Information on psychosocial work environment came from the 2010 follow-up questionnaire and was based on selected items from the short edition of the 'Copenhagen Psychosocial Questionnaire' (COPSOQ II) [15,16]. Mean scores on six aspects of psychosocial work environment were calculated and compared with the mean scores of a representative sample of Danish wage earners [17]. Each aspect was generated from two items, and transformed to scales measuring: quantitative demands, work pace, emotional demands, influence, trust and fairness at the work place, with scores in the range from 0 to 8. Low scores on the three scales measuring quantitative demands, work pace and emotional demands and high scores on the three scales measuring influence, trust and fairness indicated good work environment.

Information about the physical work environment was originally derived from the Dutch Musculoskeletal Questionnaire (DMQ) [18]. The four items were transformed to scales measuring monotonous repetitive work and physical hard work, with scores in the range from 2 to 8 and with low scores indicating good work environment. The mean values of the two scales were compared to the mean values of a large Danish sample of working adults [19].

Risk factors were divided into four domains; vulnerability, health, school performance and family socioeconomic status, which are all described in details below. Information on vulnerability and health came from the baseline questionnaire while information about school performance and family

socioeconomic status was based on registers available in Statistics Denmark [20,21].

Vulnerability. Self-esteem was measured by using six items from Rosenberg's 10 items self-esteem scale [22]. Data was dichotomised into low self-esteem and normal/high self-esteem by applying a cut-off point at the 25% percentile corresponding to a self-esteem score >17. From the 'Sense of coherence- revised short version for children', four items about sense of meaningfulness were used [23]. The answers were categorised with cut-off point at the 25% percentile corresponding to a sense of meaningfulness score >12.

Health. Self-rated health was used as a general indicator of health, using a single item from SF-36 with five response alternatives [24]. The variable was dichotomised into 'high' (excellent, very good) and 'low' (good, not so good, bad) general health status. Depressive symptoms were measured using the four-item validated version of 'The Center for Epidemiologic Studies Depression Scale for Children'. The responses were dichotomised into 'depressive symptoms' and 'no depressive symptoms' with the recommended cut-off at 3 and above indicating increasing levels of depressive symptoms [25].

School performance. The exam grades for oral Danish and written math after compulsory school (9th grade) were used. Before September 2007, grades were given according to the so-called 13-point scale (00,03,5,6,7,8,9,10,11,13). A dichotomous variable indicating high grades (8-13 equivalent to B+ and above) and low grades (00-7) was generated.

Family socioeconomic status. Information about highest attained education in the household and household income was obtained in year 2003. Highest attained education in the household was divided into three categories: < 10 years, 10-12 years, >12 years [20]. Yearly household income was divided into tertiles corresponding to lowest (<64,540 EUR), middle (64,540 – 82,402 EUR) and highest tertile (>82,402 EUR) [21].

Across all risk factors, the mean values of the work environment outcomes were calculated. Q-Q plots were used to check for normal distribution, which was confirmed for all the included outcomes. A test of collinearity was performed revealing only minor correlation between risk factors with a maximum correlation of 0.3.

The mean differences of the work environment outcomes were calculated according to each risk factor using linear regression models and presented with 95% confidence limits. Adjustments were performed in two steps. At first, the individual risk factors were adjusted for family risk factors and vice versa. Secondly, every single risk factor was adjusted for all other risk factors. In addition, the statistical models were adjusted for whether the young workers were in an apprenticeship or employees.

First, risk factors were included in the models as continuous or categorical variables but since changes in scales or cut-off points did not affect the main results, six of the eight risk factors were dichotomised to gain comprehensibility of the results.

Results from a crude analysis including only the 578 participants with complete information on all exposures and outcomes were only slightly different from the partly adjusted and fully adjusted estimates and did not change the overall conclusions. To gain as large power as possible, the analyses were therefore carried out on the originally defined study population (n=679). When gender was included in the analyses, some indication of effect modification was seen, why gender was not adjusted for. Instead a crude, stratified analysis was carried out. A sub-analysis of the associations between the four vulnerability and health measures and work environment was performed, using data collected both at baseline in 2004 and at follow-up in 2007. The responses were categorised into those who: 1) scored positive at both time points, 2) scored negative in 2004 and positive in 2007, 3) scored positive in 2004 and negative in 2007, 4) scored negative at both time points.

Results

In their psychosocial work environment the young workers in our study experienced less quantitative demands, less emotional demands, and higher trust and fairness at the workplace compared to a population of working adults in Denmark (Table 1). Quantitative demands showed the most positive results with a mean score of 2.22 compared to an overall mean of 3.3 among working adults. Physical work environment measures showed increased physical demands with more repetitive movements and especially more hard physical work among young workers with a mean score of 4.25 compared to an overall mean of 3.4 in the adult population.

Table 2 shows mean differences across the eight exposures according to the six psychosocial work environment outcomes. Young workers with low self-esteem reported higher mean values of quantitative demands and work pace compared to those with normal/high self-esteem. Also, low general health status was associated with high quantitative demands.

Low self-esteem and depressive symptoms were associated with experiencing higher emotional demands at work. In contrast young workers from low/middle socioeconomic status families experienced less emotional demands at work than those from high socioeconomic status families. Especially low/middle parental education was associated with low emotional demands compared to high parental education. Low sense of meaningfulness was associated with experiencing low influence at work compared to those with normal/high sense of meaningfulness. The largest differences in experienced trust and fairness were found between those with low self-esteem compared to those with normal/high self-esteem. Figure 2 illustrates the mean differences of psychosocial work environment

between those with low self-esteem and normal/high self-esteem.

Table 3 shows the results for the physical work environment measures. Low/middle parental income or education were associated with reporting of repetitive movements compared to high parental income or education. Low/middle family income was associated with reporting of hard physical work compared to high family income.

Among those with low general health status, higher mean values of repetitive movements were seen compared to those with normal/high general health status. On the contrary, those with low general health status reported less amount of hard physical work compared to those with high general health status.

Stratification on gender showed some differences in experienced work environment [See supplementary table 1]. Among females, low self-esteem was stronger associated with high quantitative demands, low influence and repetitive movements at work than among males. Also, the association between low sense of meaningfulness and low influence at work and the association between low parental education and repetitive movements were stronger among females than among males.

The sub analysis using information about vulnerability and health from 2004 and 2007 showed that reporting of low self-esteem at both time-points increased the risk of experiencing high quantitative demands and low influence, trust and fairness compared to those who scored normal/high self-esteem at both time-points (results not shown).

Discussion

Overall, the psychosocial work environment of these young workers was good compared to the Danish general working population, but they experienced more demanding physical work than adults. None of the risk factors showed any strong association with experienced work environment and all the mean differences were below the recommended minimal important difference of 0.5 SD [15]. Low self-esteem at age 14/15 was associated with high demands, low trust and fairness at work and among females or those reporting low self-esteem both at age 14/15 and age 17/18 low self-esteem was associated with the experience of low influence at work at age 20/21. Low parental socioeconomic status showed the strongest associations with poor physical work environment.

This study benefits from the prospective design with follow-up after three and six years and a high response rate at baseline (83%). Additionally strengths of the study are the use of both register- and questionnaire based data, which minimises the risk of common method variance [26] as well as almost complete information from the registers.

A limitation of the study is the use of abbreviated scales when measuring self-esteem and sense of meaningfulness, which reduces the ability to compare our results with others. Despite the relatively high response rates, especially at baseline, people with poor work environment may be under-represented in our study. One explanation could be that the young workers with the poorest work environment have already lost connection to the labour market, which could possibly underestimate the associations under study [27]. Another explanation could be that for some reason those with the poorest work environment did not want to participate, and therefore are not represented in the study population. In order to assess any potential selection problems, the distribution of four register variables (grades in math and Danish, household income and highest parental education) were compared between the participants (n= 679) and the potential participants, meaning those with information on work environment but no questionnaire information from baseline in 2004 (n=746). The results only showed minor variations and did not change the overall findings.

Caution prevails in generalising the results of this study to all Danish young people. The cohort is based on young people having primary affiliation to the labour market or attending a vocational education with an apprenticeship at age 20/21. This means that the young people attending a tertiary education in the university or other institution were not represented. Thus, this cohort likely consists of fewer persons who will end up completing a tertiary education compared to adult cohorts. Another consideration is that due to the occupational structure in the region from where the cohort was sampled, with a lot of textile industry and agriculture, relatively many young people could be performing unskilled and physical demanding jobs compared to other parts of the country. It is therefore possible that the amount of young workers who perform physical demanding jobs is over-estimated. However, there is no reason to believe that it will affect the validity of the associations found in the study.

The reason why young workers perform more physical demanding work than their older colleagues could be that young workers do not yet have the same degree of experience and social position as their older colleagues and in that way they are selected to perform the hardest job functions.

Although the results of this study are in favour of the work environment among young workers, the importance of vulnerability, especially low self-esteem in late childhood, is relevant to discuss. Previous studies on adults have shown an association between self-esteem and job satisfaction [10] but we were not able to identify studies that investigated the association between childhood self-esteem and psychosocial work environment later in life. Two previous studies have investigated the association between sense of coherence and psychosocial work environment but the results were not conclusive [11,28]. Although Modin et al. found that school level high sense of coherence may modify the association between adverse psychosocial work environment and health, this was done in a cross sectional design which impairs any causal interpretation [28]. Togari et al. did not find an association between sense of coherence and experienced psychosocial work environment one year later in a population of 20 to 40 year old workers [11].

The finding of low self-esteem as an important risk factor for poor psychosocial work environment could be explained in several ways. Firstly, those with low self-esteem could be selected into jobs with poor work environment due to their low self-esteem. Secondly, another explanation could be negative affectivity [29] where low self-esteem could influence the way the individual perceives the work environment, meaning those who report low self-esteem automatically will report negatively on all aspects of work environment. Since low self-esteem was not found to be associated equally negatively with all aspects of work environment, the first possibility seems to be more likely.

Previous studies on adult populations have shown low socioeconomic status to be strongly related to poor physical [6] and psychosocial work environment [5,6]. In the present study, the strongest associations were seen between low socioeconomic status and poor physical work environment. In contrast, a reverse tendency was seen with low socioeconomic status being associated with experiencing low emotional demands at work. That high emotional work demands are frequent in high social positions has been confirmed previously [5,6] and does in itself not necessarily have negative health implications unless combined with low job control [30].

It is reassuring that young Danish workers in general experience a good psychosocial work environment at the beginning of their carrier and that individual as well as family factors in late childhood only have limited impact on how they report their work environment at age 20/21. Nevertheless, the results call for attention to vulnerable young people in the transition from the educational system to work life and efforts should be made to prevent young people with low self-esteem from being selected into psychosocially demanding job functions later in life.

Key points

- The psychosocial work environment in young workers was on average good but they experienced more demanding physical work tasks than adults.
- It seems that young people with low self-esteem need special attention in order to prevent them from being selected into psychosocially demanding job functions later in life.
- This study showed a social gradient in experiencing poor physical work environment at age 20/21.

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References

1. Rahkonen O, Laaksonen M, Martikainen P, Roos E, Lahelma E. Job control, job demands, or social class? The impact of working conditions on the relation between social class and health. *J Epidemiol Community Health* 2006;60:50-54.
2. Marmot M, Siegrist J, Theorell T. Health and psychosocial environment at work. In: Marmot M, Wilkinson RG, editors. *Social determinants of health*. Oxford: Oxford university press; 2011. p. 97-130.
3. Diderichsen F, Andersen I, Manuel C, Working Group of Danish Review on Social Determinants of Health, Andersen AM, Bach E, et al. Health inequality--determinants and policies. *Scand J Public Health* 2012;40:12-105.
4. Marmot M. Social determinants of health inequalities. *Lancet* 2005;365:1099-1104.
5. Kristensen TS, Borg V, Hannerz H. Socioeconomic status and psychosocial work environment: results from a Danish national study. *Scand J Public Health Suppl* 2002;59:41-48.
6. Borg V, Kristensen TS. Social class and self-rated health: can the gradient be explained by differences in life style or work environment? *Soc Sci Med* 2000;51:1019-1030.
7. Elovainio M, Kivimaki M, Ek E, Vahtera J, Honkonen T, Taanila A, et al. The effect of pre-employment factors on job control, job strain and psychological distress: a 31-year longitudinal study. *Soc Sci Med* 2007;65:187-199.
8. Fitzgerald ST, Brown KM, Sonnega JR, Ewart CK. Early antecedents of adult work stress: social-emotional competence and anger in adolescence. *J Behav Med* 2005;28:223-230.
9. Melchior M, Caspi A, Milne BJ, Danese A, Poulton R, Moffitt TE. Work stress precipitates depression and anxiety in young, working women and men. *Psychol Med* 2007;37:1119-1129.
10. Judge TA, Bono JE. Relationship of core self-evaluations traits--self-esteem, generalized self-efficacy, locus of control, and emotional stability--with job satisfaction and job performance: a meta-analysis. *J Appl Psychol* 2001;86:80-92.
11. Togari T, Yamazaki Y. A causal relationship between sense of coherence and psycho-social work environment: from one-year follow-up data among Japanese young adult workers. *Global Health Promotion* 2012;19:32-42.
12. Glasscock DJ, Andersen JH, Labriola M, Rasmussen K, Hansen CD. Can negative life events and coping style help explain socioeconomic differences in perceived stress among adolescents? A cross-sectional study based on the West Jutland cohort study. *BMC Public Health* 2013;13:532.
13. Winding TN, Nohr EA, Labriola M, Biering K, Andersen JH. Personal predictors of educational attainment after compulsory school: Influence of measures of vulnerability, health, and school performance. *Scand J Public Health* 2013;41:92-101.

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14. Pedersen CB. The Danish Civil Registration System. *Scand J Public Health* 2011;39:22-25.
 15. Pejtersen JH, Kristensen TS, Borg V, Bjorner JB. The second version of the Copenhagen Psychosocial Questionnaire. *Scand J Public Health* 2010;38:8-24.
 16. Kristensen TS, Hannerz H, Høgh A, Borg V. The Copenhagen Psychosocial Questionnaire--a tool for the assessment and improvement of the psychosocial work environment. *Scand J Work Environ Health* 2005;31:438-449.
 17. National Research Centre for the Working Environment. Instruction of the short questionnaire on psychosocial work environment. Available at: <http://www.arbejdsmiljoforskning.dk/da/publikationer/spoergeskemaer/psykisk-arbejdsmiljoe>. Accessed August/20, 2013.
 18. Hildebrandt VH, Bongers PM, van Dijk FJ, Kemper HC, Dul J. Dutch Musculoskeletal Questionnaire: description and basic qualities. *Ergonomics* 2001;44:1038-1055.
 19. Hansen CD, Andersen JH. Sick at work--a risk factor for long-term sickness absence at a later date? *J Epidemiol Community Health* 2009;63:397-402.
 20. Jensen VM, Rasmussen AW. Danish Education Registers. *Scand J Public Health* 2011;39:91-94.
 21. Baadsgaard M, Quitzau J. Danish registers on personal income and transfer payments. *Scand J Public Health* 2011;39:103-105.
 22. Turner RJ, Lloyd DA, Roszell P. Personal resources and the social distribution of depression. *Am J Community Psychol* 1999;27:643-672.
 23. Torsheim T, Aaroe LE, Wold B. Sense of coherence and school-related stress as predictors of subjective health complaints in early adolescence: interactive, indirect or direct relationships? *Soc Sci Med* 2001;53:603-614.
 24. Idler EL, Benyamini Y. Self-rated health and mortality: a review of twenty-seven community studies. *J Health Soc Behav* 1997;38:21-37.
 25. Fendrich M, Weissman MM, Warner V. Screening for depressive disorder in children and adolescents: validating the Center for Epidemiologic Studies Depression Scale for Children. *Am J Epidemiol* 1990;131:538-551.
 26. Spector PE. Method variance as an artifact in self-reported affect and perceptions of work: myth or significant problem? *J Appl Psychol* 1987;72:438-443.
 27. Rothman K, Greenland S, Lash T. Validity in Epidemiologic Studies. In: Rothman K, Greenland S, Lash T, editors. *Modern Epidemiology*. 3rd ed. Philadelphia (PA): Lippincott Williams & Wilkins; 2008. p. 128-150.

28. Modin B, Ostberg V, Toivanen S, Sundell K. Psychosocial working conditions, school sense of coherence and subjective health complaints. A multilevel analysis of ninth grade pupils in the Stockholm area. *J Adolesc* 2011;34:129-139.
29. Watson D, Clark LA. Negative affectivity: the disposition to experience aversive emotional states. *Psychol Bull* 1984;96:465-490.
30. Karasek R. Job demands, job decision latitude, and mental strain: implications for job redesign. *Administrative Science Quarterly* 1979;24:285-310.

Figure 1
Flow chart of participants eligible for this study.

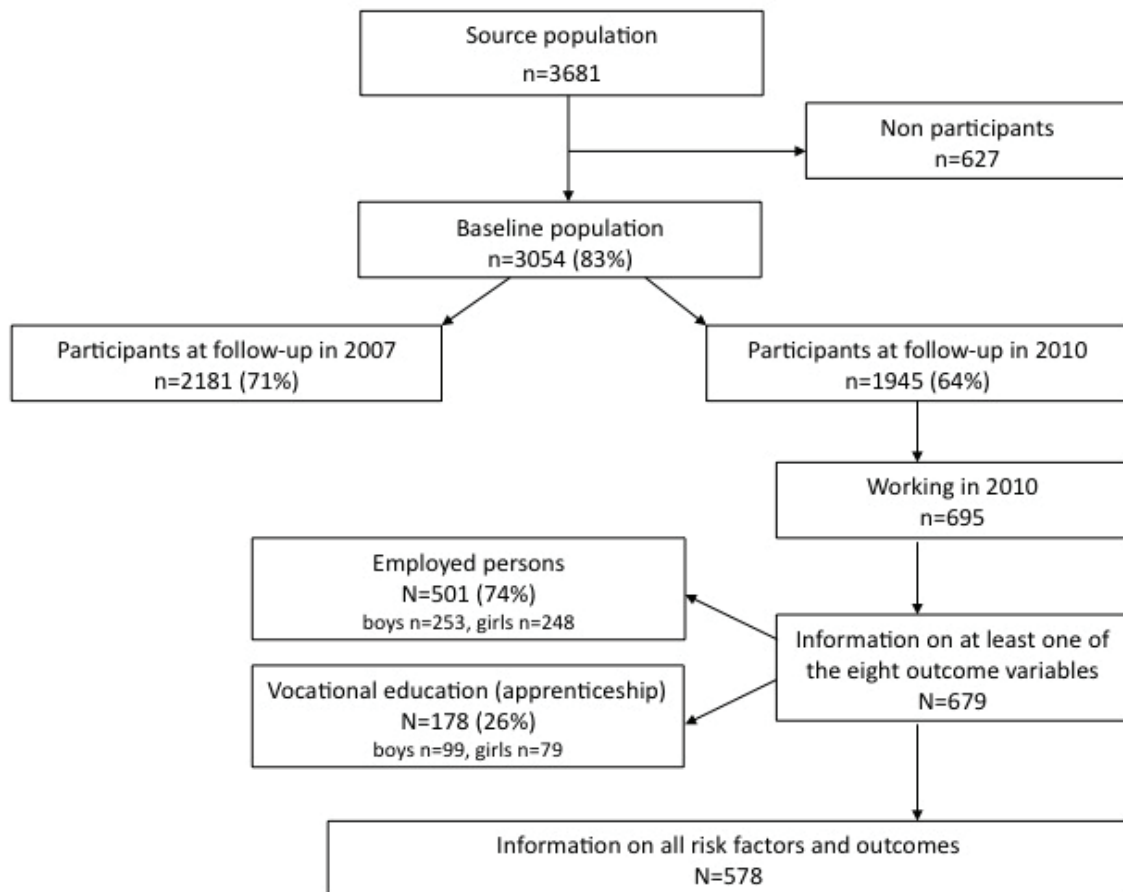


Figure 2
Mean differences of psychosocial work environment among those with low self-esteem and normal/high self-esteem (fully adjusted).

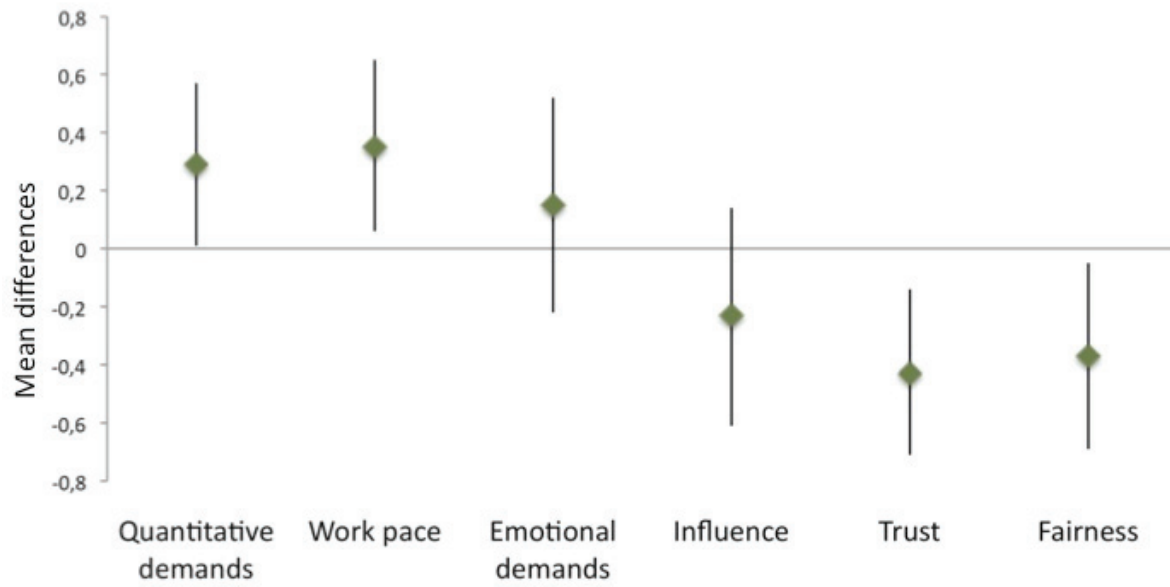


Table 1: Work environment according to individual and family risk factors

	Psychosocial work environment						Physical work environment																		
	Demands at work ^a			Job control ^b			Values at the workplace ^a			Repetitive movement ^b			Hard physical work ^b												
	Quantitative mean (adults) = 3,3 ^c n	Work pace mean (adults) = 4,7 ^c n	Emotional mean (adults) = 3,3 ^c n	Influence mean (adults) = 4,1 ^c n	Trust mean (adults) = 5,4 ^c n	Fairness mean (adults) = 4,8 ^c n	mean (adults) = 4,2 ^d n	mean (adults) = 4,2 ^d n	mean (adults) = 4,2 ^d n	mean (adults) = 4,2 ^d n	mean (adults) = 3,4 ^d n	SD	SD	SD	SD	SD									
Individual risk factors																									
All	678	2,22	1,42	676	4,80	1,50	677	2,61	1,84	674	4,21	1,86	668	6,24	1,40	668	5,55	1,62	664	4,66	1,94	665	4,25	1,75	
Grades - oral Danish	654			652			653			650			644			644			641			641			
8 or above	449	2,17	1,39	449	4,76	1,53	448	2,70	1,86	448	4,23	1,86	443	6,23	1,44	444	5,55	1,58	441	4,58	1,99	442	4,14	1,77	
7 or below	205	2,32	1,43	203	4,88	1,40	205	2,46	1,83	202	4,20	1,87	201	6,25	1,35	200	5,56	1,71	200	4,82	1,83	199	4,45	1,67	
Grades - written math	647			645			646			643			637			637			634			634			
8 or above	464	2,20	1,37	461	4,72	1,49	463	2,60	1,87	462	4,18	1,85	456	6,23	1,43	455	5,57	1,57	454	4,61	1,99	453	4,17	1,73	
7 or below	183	2,26	1,50	184	4,99	1,50	183	2,67	1,84	181	4,32	1,89	181	6,27	1,34	182	5,51	1,69	180	4,76	1,81	181	4,34	1,74	
Self-esteem	664			662			663			660			655			655			651			652			
normal/high	510	2,16	1,36	508	4,71	1,49	509	2,54	1,84	508	4,24	1,86	504	6,33	1,37	503	5,63	1,56	499	4,55	1,92	499	4,20	1,70	
low	154	2,43	1,55	154	5,06	1,45	154	2,73	1,76	152	4,08	1,83	151	5,90	1,47	152	5,24	1,75	152	4,93	1,90	153	4,35	1,83	
Sense of meaningfulness	673			671			672			669			663			663			659			660			
normal/high	561	2,21	1,41	559	4,79	1,52	560	2,63	1,87	558	4,26	1,82	552	6,30	1,37	552	5,59	1,59	550	4,60	1,93	551	4,21	1,71	
low	112	2,30	1,44	112	4,87	1,47	112	2,54	1,72	111	3,88	2,01	111	5,94	1,52	111	5,32	1,73	109	4,99	1,99	109	4,49	1,90	
General health status	674			672			673			670			665			665			661			662			
high	651	2,20	1,41	649	4,80	1,50	650	2,61	1,85	648	4,21	1,86	642	6,25	1,39	642	5,55	1,62	638	4,63	1,93	639	4,27	1,73	
low	23	2,83	1,53	23	4,78	1,65	23	2,48	1,50	22	3,95	1,84	23	6,09	1,73	23	5,52	1,44	23	5,26	2,12	23	3,52	1,88	
Depressive symptoms	668			666			667			664			659			659			655			656			
no	466	2,24	1,43	465	4,79	1,48	467	2,56	1,88	465	4,22	1,90	461	6,30	1,35	459	5,66	1,57	456	4,56	1,93	459	4,24	1,74	
yes	202	2,19	1,41	201	4,80	1,57	200	2,74	1,80	199	4,17	1,77	198	6,15	1,48	200	5,35	1,69	199	4,88	1,94	197	4,25	1,76	
Family risk factors																									
Household income	678			676			677			674			668			668			664			665			
highest	225	2,22	1,35	226	4,75	1,50	226	2,78	1,84	225	4,24	1,77	219	6,10	1,46	220	5,44	1,75	223	4,39	1,93	223	4,04	1,60	
middle	256	2,08	1,37	256	4,82	1,51	255	2,48	1,87	254	4,17	1,89	255	6,29	1,39	254	5,59	1,56	251	4,74	1,96	251	4,27	1,83	
lowest	197	2,41	1,53	194	4,84	1,50	196	2,57	1,81	195	4,23	1,92	194	6,34	1,35	194	5,64	1,52	190	4,88	1,90	191	4,47	1,77	
Highest household education	673			671			672			669			663			663			660			660			
>12 years	227	2,18	1,33	225	4,66	1,53	227	2,83	1,98	227	4,19	1,81	219	6,29	1,38	222	5,59	1,57	221	4,29	1,86	221	4,10	1,66	
10-12 years	365	2,24	1,46	366	4,91	1,48	365	2,54	1,77	363	4,21	1,90	363	6,21	1,45	361	5,49	1,67	359	4,87	1,98	359	4,36	1,78	
<10 years	81	2,26	1,46	80	4,65	1,50	80	2,28	1,76	79	4,24	1,78	81	6,22	1,26	80	5,70	1,47	80	4,75	1,79	80	4,16	1,80	

n = number of young workers; SD = standard deviation.

^a The psychosocial work environment variables were generated from the COPSOQ II (short version) questionnaire.

^b The physical work environment variables were generated from the DMQ questionnaire.

^c Mean values of psychosocial work environment in a population of 3517 adult Danish employees (17). For demands at work low values are considered positive. For job control and values at the work place high values are considered positive.

^d Mean values of physical work environment in a population of 20 464 Danish employees (19). For repetitive movements and hard physical work low values are considered positive.

Table 2. Mean differences in psychosocial work environment according to individual and family risk factors

	Psychosocial work environment																					
	Demands at work				Job control				Values at the workplace													
	Quantitative		Work pace		Emotional		Influence		Trust		Fairness											
crude	adj1 ^a	adj2 ^b	crude	adj1 ^a	adj2 ^b	crude	adj1 ^a	adj2 ^b	crude	adj1 ^a	adj2 ^b	crude	adj1 ^a	adj2 ^b								
Beta	Beta	95%-CI	Beta	Beta	95%-CI	Beta	Beta	95%-CI	Beta	Beta	95%-CI	Beta	Beta	95%-CI								
Individual risk factors																						
Grades - oral Danish																						
8 or above	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref							
7 or below	0,15	0,10	-0,11 ; -0,15 ; 0,36	0,13	0,09	-0,02 ; -0,29 ; 0,25	-0,24	-0,19	-0,23	-0,57 ; 0,11	-0,03	-0,06	-0,08	-0,43 ; 0,26	0,01	0,00	0,08	-0,21 ; 0,38				
Grades - written math																						
8 or above	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref				
7 or below	0,06	0,03	-0,04 ; -0,31 ; 0,22	0,27	0,24	0,15 ; -0,13 ; 0,43	0,07	0,13	0,07	-0,28 ; 0,42	0,15	0,15	0,19	-0,17 ; 0,54	0,04	0,04	0,01	-0,26 ; 0,27				
Self-esteem																						
normal/high	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref				
low	0,27	0,29	0,01 ; 0,57	0,34	0,33	0,06 ; 0,65	0,19	0,21	0,15	-0,22 ; 0,52	-0,16	-0,19	-0,23	-0,61 ; 0,14	-0,43	-0,43	-0,71 ; -0,14	-0,39	-0,41	-0,37	-0,69 ; -0,05	
Sense of meaningfulness																						
normal/high	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref				
low	0,10	0,10	0,05 ; -0,26 ; 0,37	0,08	0,08	0,07 ; -0,27 ; 0,40	-0,08	-0,06	-0,17	-0,59 ; 0,24	-0,38	-0,38	-0,40	-0,83 ; 0,02	-0,36	-0,41	-0,31	-0,63 ; 0,01	-0,27	-0,28	-0,13	-0,49 ; 0,23
General health status																						
high	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref				
low	0,63	0,66	0,46 ; -0,17 ; 1,10	-0,01	0,03	-0,21 ; -0,88 ; 0,46	-0,13	-0,12	-0,12	-0,96 ; 0,72	-0,26	-0,28	-0,12	-0,99 ; 0,75	-0,16	-0,12	0,11	-0,53 ; 0,75	-0,03	-0,05	0,30	-0,43 ; 1,03
Depressive symptoms																						
no	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref				
yes	-0,05	-0,03	-0,15 ; -0,41 ; 0,11	0,01	-0,01	-0,14 ; -0,42 ; 0,13	0,18	0,21	0,19	-0,15 ; 0,54	-0,06	-0,08	0,04	-0,31 ; 0,38	-0,15	-0,17	-0,03	-0,29 ; 0,23	-0,31	-0,34	-0,24	-0,54 ; 0,05
Family risk factors																						
Household income																						
highest	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref				
middle	-0,14	-0,12	-0,13 ; -0,39 ; 0,14	0,07	0,07	0,03 ; -0,25 ; 0,32	-0,30	-0,41	-0,34	-0,70 ; 0,01	-0,07	-0,05	-0,08	-0,44 ; 0,28	0,19	0,22	0,24	-0,03 ; 0,51	0,15	0,19	0,19	-0,12 ; 0,50
lowest	0,19	0,23	0,24 ; -0,06 ; 0,55	0,09	0,16	0,11 ; -0,21 ; 0,44	-0,22	-0,19	-0,04	0,36	-0,01	0,06	-0,02	-0,43 ; 0,38	0,23	0,23	0,26	-0,05 ; 0,56	0,20	0,21	0,15	-0,20 ; 0,50
Highest household education																						
>12 years	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref				
10-12 years	0,06	0,06	0,04 ; -0,21 ; 0,29	0,25	0,21	0,20 ; -0,07 ; 0,46	-0,29	-0,37	-0,33	-0,67 ; 0,00	0,03	0,03	0,04	-0,30 ; 0,38	-0,09	-0,08	-0,13	-0,39 ; 0,12	-0,10	-0,03	-0,32	-0,36 ; 0,23
<10 years	0,08	0,10	-0,03 ; -0,43 ; 0,38	-0,01	0,14	0,09 ; -0,34 ; 0,52	-0,56	-0,59	-1,12 ; -0,05	0,06	0,22	0,22	-0,33 ; 0,77	-0,07	-0,08	-0,17	-0,58 ; 0,24	0,11	0,18	0,14	-0,33 ; 0,61	

95%-CI = 95% confidence interval. Bold denotes significance. Jobtype is included in all adjusted models.

^a Adj1: individual risk factors are adjusted for all family risk factors and family risk factors are adjusted for all individual risk factors.

^b Adj2: All risk factors are mutually adjusted.

Table 3. Mean differences in physical work environment according to individual and family risk factors

	Physical work environment											
	Repetitive movement					Hard physical work						
	crude	adj1 ^a		adj2 ^b		crude	adj1 ^a		adj2 ^b			
Beta	95%-CI	Beta	95%-CI	Beta	95%-CI	Beta	95%-CI	Beta	95%-CI	Beta	95%-CI	
Individual risk factors												
Grades - oral Danish												
8 or above	ref		ref		ref		ref		ref		ref	
7 or below	0,24	-0,09 ; 0,56	0,16	-0,17 ; 0,48	-0,01	-0,37 ; 0,34	0,31	0,02 ; 0,60	0,33	0,03 ; 0,62	0,18	-0,14 ; 0,50
Grades - written math												
8 or above	ref		ref		ref		ref		ref		ref	
7 or below	0,15	-0,18 ; 0,49	0,06	-0,28 ; 0,39	0,01	-0,35 ; 0,37	0,17	-0,13 ; 0,47	0,15	-0,15 ; 0,45	0,03	-0,30 ; 0,36
Self-esteem												
normal/ high	ref		ref		ref		ref		ref		ref	
low	0,38	0,03 ; 0,73	0,36	0,01 ; 0,70	0,37	-0,01 ; 0,75	0,15	-0,16 ; 0,47	0,13	-0,19 ; 0,44	0,23	-0,12 ; 0,57
Sense of meaningfulness												
normal/high	ref		ref		ref		ref		ref		ref	
low	0,39	-0,01 ; 0,79	0,35	-0,05 ; 0,75	0,19	-0,24 ; 0,62	0,28	-0,08 ; 0,64	0,23	-0,13 ; 0,60	0,11	-0,28 ; 0,50
General health status												
high	ref		ref		ref		ref		ref		ref	
low	0,63	-0,18 ; 1,44	0,69	-0,11 ; 1,50	0,46	-0,40 ; 1,32	-0,75	-1,48 ; -0,03	-0,74	-1,47 ; -0,02	-0,72	-1,50 ; 0,06
Depressive symptoms												
no	ref		ref		ref		ref		ref		ref	
yes	0,33	0,00 ; 0,65	0,29	-0,03 ; 0,61	0,05	-0,30 ; 0,40	0,01	-0,28 ; 0,31	-0,03	-0,32 ; 0,26	-0,04	-0,36 ; 0,28
Family risk factors												
Household income												
highest	ref		ref		ref		ref		ref		ref	
middle	0,34	-0,01 ; 0,69	0,41	0,05 ; 0,78	0,34	-0,02 ; 0,71	0,24	-0,08 ; 0,55	0,30	-0,03 ; 0,62	0,27	-0,06 ; 0,60
lowest	0,48	0,11 ; 0,86	0,48	0,08 ; 0,87	0,40	-0,01 ; 0,82	0,43	0,09 ; 0,77	0,37	0,02 ; 0,73	0,43	0,05 ; 0,80
Highest household education												
>12 years	ref		ref		ref		ref		ref		ref	
10-12 years	0,58	0,26 ; 0,91	0,59	0,26 ; 0,93	0,51	0,17 ; 0,86	0,26	-0,03 ; 0,55	0,25	-0,05 ; 0,56	0,18	-0,14 ; 0,49
<10 years	0,46	-0,03 ; 0,96	0,42	-0,11 ; 0,94	0,27	-0,28 ; 0,83	0,06	-0,39 ; 0,51	-0,10	-0,58 ; 0,37	-0,27	-0,77 ; 0,23

95%-CI = 95% confidence interval; Bold denotes significance. Jobtype is included in all adjusted models.

^a Adj1: individual risk factors are adjusted for all family risk factors and family risk factors are adjusted for all individual risk factors.

^b Adj2: All risk factors are mutually adjusted.

Supplementary table 1: Mean differences in physical and psychosocial work environment according to individual and family risk factors, stratified on gender

	Work environment															
	Psychosocial										Physical					
	Quantitative		Demands at work		Emotional		Job control		Values at the workplace		Repetitive movement		Hard physical work			
	mean (adults) =3,3 ^a		Workpace		mean (adults) =3,3 ^a		Influence		Trust		Fairness		mean (adults) = 4,2 ^b		mean (adults) = 3,4 ^b	
Beta	95%-CI	Beta	95%-CI	Beta	95%-CI	Beta	95%-CI	Beta	95%-CI	Beta	95%-CI	Beta	95%-CI	Beta	95%-CI	
Individual risk factors																
Grades - oral Danish																
male																
high	ref		ref		ref		ref		ref		ref		ref		ref	
low	0,18	-0,12 ; 0,48	0,15	-0,18 ; 0,49	-0,49	-0,88 ; -0,09	-0,09	-0,51 ; 0,33	-0,13	-0,44 ; 0,19	0,00	-0,36 ; 0,36	0,28	-0,13 ; 0,70	0,63 0,24 ; 1,02	
female																
high	ref		ref		ref		ref		ref		ref		ref		ref	
low	0,13	-0,24 ; 0,49	0,12	-0,25 ; 0,50	0,20	-0,27 ; 0,67	0,01	-0,46 ; 0,48	0,22	-0,15 ; 0,58	-0,01	-0,43 ; 0,40	0,27	-0,24 ; 0,78	-0,16	-0,59 ; 0,28
Grades - written math																
male																
high	ref		ref		ref		ref		ref		ref		ref		ref	
low	0,02	-0,32 ; 0,35	-0,04	-0,41 ; 0,32	-0,01	-0,45 ; 0,42	-0,41	-0,87 ; 0,04	-0,18	-0,52 ; 0,16	-0,26	-0,65 ; 0,13	0,11	-0,34 ; 0,56	0,35	-0,07 ; 0,77
female																
high	ref		ref		ref		ref		ref		ref		ref		ref	
low	0,11	-0,24 ; 0,47	0,56	0,20 ; 0,92	0,09	-0,37 ; 0,54	0,71	0,26 ; 1,15	0,24	-0,11 ; 0,59	0,14	-0,26 ; 0,53	0,15	-0,35 ; 0,65	0,02	-0,40 ; 0,45
Self-esteem																
male																
high	ref		ref		ref		ref		ref		ref		ref		ref	
low	0,12	-0,30 ; 0,54	0,40	-0,06 ; 0,85	0,18	-0,36 ; 0,72	0,29	-0,30 ; 0,88	-0,51	-0,94 ; -0,08	-0,29	-0,79 ; 0,21	-0,29	-0,87 ; 0,28	0,29	-0,25 ; 0,83
female																
high	ref		ref		ref		ref		ref		ref		ref		ref	
low	0,39	0,05 ; 0,73	0,28	-0,07 ; 0,63	-0,11	-0,54 ; 0,33	-0,34	-0,77 ; 0,09	-0,46	-0,80 ; -0,13	-0,40	-0,78 ; -0,01	0,56	0,09 ; 1,03	0,24	-0,17 ; 0,65
Sense of meaningfulness																
male																
high	ref		ref		ref		ref		ref		ref		ref		ref	
low	0,18	-0,19 ; 0,56	0,15	-0,27 ; 0,57	0,17	-0,33 ; 0,67	-0,18	-0,70 ; 0,35	-0,35	-0,74 ; 0,04	-0,20	-0,65 ; 0,24	0,33	-0,19 ; 0,84	0,44	-0,06 ; 0,93
female																
high	ref		ref		ref		ref		ref		ref		ref		ref	
low	-0,01	-0,45 ; 0,43	0,00	-0,45 ; 0,45	-0,34	-0,90 ; 0,21	-0,61	-1,16 ; -0,07	-0,38	-0,80 ; 0,05	-0,34	-0,83 ; 0,15	0,47	-0,14 ; 1,07	0,11	-0,41 ; 0,63
General health status																
male																
high	ref		ref		ref		ref		ref		ref		ref		ref	
low	0,77	-0,43 ; 1,96	0,28	-1,04 ; 1,59	-0,29	-1,83 ; 1,26	1,15	-0,50 ; 2,80	0,40	-0,81 ; 1,61	-0,44	-1,83 ; 0,96	-0,04	-1,63 ; 1,55	-1,22	-2,74 ; 0,29
female																
high	ref		ref		ref		ref		ref		ref		ref		ref	
low	0,62	-0,08 ; 1,33	-0,15	-0,88 ; 0,57	-0,35	-1,25 ; 0,54	-0,64	-1,54 ; 0,27	-0,36	-1,04 ; 0,33	0,15	-0,64 ; 0,94	0,66	-0,32 ; 1,64	-0,50	-1,34 ; 0,34
Depressive symptoms																
male																
no	ref		ref		ref		ref		ref		ref		ref		ref	
yes	-0,16	-0,49 ; 0,17	-0,09	-0,45 ; 0,28	0,25	-0,18 ; 0,69	0,23	-0,24 ; 0,69	-0,19	-0,53 ; 0,15	-0,23	-0,62 ; 0,15	-0,12	-0,57 ; 0,32	-0,23	-0,66 ; 0,20
female																
no	ref		ref		ref		ref		ref		ref		ref		ref	
yes	0,06	-0,28 ; 0,40	0,06	-0,29 ; 0,41	-0,04	-0,48 ; 0,39	-0,26	-0,69 ; 0,16	-0,14	-0,46 ; 0,19	-0,33	-0,71 ; 0,04	0,60	0,13 ; 1,07	0,29	-0,11 ; 0,70
Family risk factors																
Household income																
male																
highest	ref		ref		ref		ref		ref		ref		ref		ref	
middle	-0,18	-0,52 ; 0,17	0,07	-0,31 ; 0,45	-0,24	-0,68 ; 0,21	-0,05	-0,53 ; 0,43	0,13	-0,22 ; 0,48	0,12	-0,29 ; 0,52	0,39	-0,07 ; 0,85	0,35	-0,09 ; 0,79
lowest	-0,05	-0,41 ; 0,30	0,07	-0,32 ; 0,45	-0,36	-0,84 ; 0,11	-0,10	-0,60 ; 0,39	0,26	-0,11 ; 0,62	0,12	-0,30 ; 0,54	0,51	0,03 ; 0,99	0,51	0,05 ; 0,97
female																
highest	ref		ref		ref		ref		ref		ref		ref		ref	
middle	-0,11	-0,48 ; 0,27	0,06	-0,33 ; 0,46	-0,36	-0,83 ; 0,10	-0,09	-0,57 ; 0,38	0,25	-0,11 ; 0,62	0,18	-0,25 ; 0,60	0,30	-0,22 ; 0,82	0,12	-0,32 ; 0,57
lowest	0,48	0,06 ; 0,89	0,13	-0,30 ; 0,56	0,06	-0,47 ; 0,58	0,07	-0,45 ; 0,60	0,21	-0,19 ; 0,62	0,27	-0,19 ; 0,74	0,52	-0,06 ; 1,10	0,30	-0,19 ; 0,80
Highest household education																
male																
highest	ref		ref		ref		ref		ref		ref		ref		ref	
middle	0,08	-0,23 ; 0,39	0,15	-0,19 ; 0,49	-0,18	-0,59 ; 0,22	0,05	-0,38 ; 0,47	-0,07	-0,39 ; 0,25	-0,02	-0,39 ; 0,34	0,34	-0,08 ; 0,75	0,32	-0,08 ; 0,72
lowest	0,01	-0,45 ; 0,47	-0,03	-0,55 ; 0,48	-0,54	-1,15 ; 0,06	-0,03	-0,68 ; 0,61	-0,22	-0,69 ; 0,25	0,02	-0,52 ; 0,57	0,18	-0,43 ; 0,80	0,19	-0,40 ; 0,79
female																
highest	ref		ref		ref		ref		ref		ref		ref		ref	
middle	0,07	-0,30 ; 0,44	0,34	-0,03 ; 0,71	-0,57	-1,02 ; -0,11	0,05	-0,41 ; 0,50	-0,11	-0,47 ; 0,24	-0,15	-0,55 ; 0,26	0,79	0,29 ; 1,29	0,27	-0,16 ; 0,70
lowest	0,18	-0,39 ; 0,75	0,01	-0,57 ; 0,60	-0,63	-1,35 ; 0,08	0,18	-0,53 ; 0,89	0,11	-0,44 ; 0,67	0,22	-0,41 ; 0,86	0,81	0,02 ; 1,59	-0,09	-0,77 ; 0,58

95%-CI = 95% confidence interval; All estimates are based on crude analyses; Bold denotes significance.

^a Mean values of psychosocial work environment in a population of 3517 adult Danish employees (17). For demands at work low values are considered positive. For job control and values at the work place high values are considered positive.

^b Mean values of physical work environment in a population of 20 464 Danish employees (19). For repetitive movements and hard physical work low values are considered positive.

