

Paper III

Multisite musculoskeletal pain in adolescence and later receipt of medical and social welfare benefits from adolescence into young adulthood – The NAAHS cohort study.

Christian Eckhoff^{a,b}, MD, Bjørn Straume^c, MD, PhD, Siv Kvernmo^{a,b}, MD, PhD

^a Department of Child and Adolescent Psychiatry, Division of Child and Adolescent Health, University Hospital North Norway, N-9038 Tromsø, Norway.

^b Department of Clinical Medicine, Faculty of Health Sciences, UiT The Arctic University of Norway, N-9037 Tromsø, Norway.

^c Department of Community Medicine, Faculty of Health Sciences, UiT The Arctic University of Norway, N-9037 Tromsø, Norway.

Corresponding author

Christian Eckhoff.

Address: University Hospital North Norway HF, BUP, Postboks 43, 9038, Tromsø.

Telephone number: +47 777 55799

E-mail: Christian.Eckhoff@unn.no, eckhoff.christian@gmail.com

Abstract

Background

Pain in adolescence is associated with mental health problems, the main reason for work disability in young adults. This study explores the relationship between multisite musculoskeletal pain in adolescence and later medical (sickness and medical rehabilitation benefits) and social welfare benefits, adjusted for sociodemographic, adolescent psychosocial and mental health problems.

Methods

Data were obtained by linkage between the National Insurance Registry (2003–11) and the Norwegian Arctic Adolescent Health Study, a school-based survey in North Norway (2003–05), accepted by 3,987 15–16-year-olds (70% of the total population). Follow-up time was set to July 1st of the corresponding year the participants responded to the health study. Musculoskeletal pain was measured by the number of musculoskeletal pain sites.

Results

We found a positive linear relationship between adolescent musculoskeletal pain sites and the occurrence of medical and social welfare benefits in young adulthood ($p \leq .001$). Adolescent musculoskeletal pain was a significant predictor of sickness, in both genders, and social welfare benefits in females when adjusted for adolescent psychosocial and mental health problems. The most important adolescent psychosocial predictors were externalizing problems, less parental involvement and negative life events.

Conclusion

Adolescent musculoskeletal pain alongside externalizing problems and negative life events in were found to be important predictors of later health and social difficulties. Adolescent problems influence the working ability from adolescence into young adulthood, and addressing adolescents' problems is crucial to help them reach their potential and contribute to society.

Introduction

Musculoskeletal pain is a common complaint in adolescents [1–3], and adolescent multisite pain more associated with mental health problems than single-site pain is [2, 4–6]. Adolescent musculoskeletal pain is associated with mood and anxiety disorders [3, 7], the most prevalent mental health disorders resulting in long-term medical benefits in Norway [8]. Studies in adults have shown that multisite pain predicts long-term medical benefits, overall [9] and due to mental health disorders specifically [10]. A potential relationship between adolescent pain and later receipt of medical and non-medical benefits has only been sparsely examined.

Adolescent somatic symptoms, single-site pains and other health complaints have been shown to be associated with long-term medical benefits in young adulthood [11, 12], lacking focus on multisite pain. Mental health problems in adolescence and young adulthood have been found to be associated with reduced workforce participation, and increased medical welfare benefits in young adulthood [12–16].

Young adulthood is an important period in which major life struggles can lead to long-term benefit dependency [17, 18]. In Norway, receiving medical and social welfare benefits is more common than unemployment spells for struggling youth [17]. Continuous sickness benefits of more than eight weeks have been found to be predictive of disability pension, especially due to mental health and musculoskeletal disorders in Norwegians under 40 years of age [19]. Mental health disorders, primarily mood and anxiety disorders, are the reason for medical rehabilitation benefits in two out of three cases in 18–29-year-olds, with a 30% increase from 1996 to 2008 [8]. Mental health disorders are the primary reason for the 3.5 times increase in disability pension in 25–29-year-olds in the last three decades [20].

Frequent and recurrent pain can be an early marker of mental health problems [7]. Therefore, we wanted to explore the association between adolescent multisite musculoskeletal pain and later medical and social welfare benefits. To achieve this we linked the Norwegian Arctic Adolescent Health Study [21], a population-based study, with the Norwegian Social Insurance Registry. The two main outcomes examined were sickness and social welfare benefits from adolescence into young adulthood, received after the Norwegian Arctic Adolescent Health Study. In order to explore if adolescent musculoskeletal pain uniquely contributed to the prediction of later sickness and social welfare benefits we adjusted for sociodemographic, adolescent psychosocial and mental health problems. Secondly, we explored gender differences by stratifying these analyses.

Methods

Study design

The Norwegian Arctic Adolescent Health Study (NAAHS) [21] was conducted among 10th graders (15–16-year-olds) in nearly all junior high schools (292 out of 293) in the three northernmost counties in Norway, in spring 2003–05. The questionnaires were administered in classroom settings, monitored by project staff, and completed during two school hours. Students who were absent completed the questionnaire at a later date. The students and their parents were given written information about the study, and the students provided written consent.

Adolescent musculoskeletal pain and later welfare benefits

The participants from the NAAHS were linked to the National Insurance Administration Registry (FD-trygd) that keeps records of national medical and non-medical welfare benefits. We used available data from 2003 through 2011. Follow-up time started at July 1st of the corresponding year the participants responded to the NAAHS, and had finished Norwegian junior high school. Resulting in a total follow-up time of 6.5–8.5 years.

In Norway, citizens can receive medical benefits for work impairing illness. Medical benefits included sickness benefits (up to 52 weeks for employed citizens), medical and vocational rehabilitation, and temporary and permanent disability pension. Medical and vocational rehabilitation and temporary disability pension were organized into one single benefit in 2010, called AAP (work assessment allowance). Citizens have to be at least 18 years old to be eligible for AAP and disability pension, which requires 50% reduced work ability due to disease, injury or impairment. Social welfare benefits can be received by people who do not qualify for any other benefits and who are unable to financially support themselves.

Sample

In total, 4,881 of 5,877 (83% of the total population) invited students responded to the NAAHS, and 3,987 (70% of the total population) consented to a future registry linkage. The sample consisted of 49.9% females and 9.2% indigenous Sami.

Ethics

The Norwegian Data Inspectorate and the school authorities approved the NAAHS. The Regional Medical Ethical Committee approved the NAAHS and the registry linkage. The Norwegian Institute of Public Health and Statistics Norway carried out the linkage.

Outcome measures: Medical and non-medical insurance benefits

Medical insurance benefits

Sickness benefits were measured as a continuous variable on the total number of 100% sickness days during the registry period, and was used as a main outcome in the multivariable analysis. Graded sick leave days were recalculated into 100% sickness days. Sickness benefits were also organized into the proportion of participants with <1, 1–3, 3–6 and 6–12 months of benefits in a 12-month period, not within a calendar year. This was done in order to examine for a relationship between adolescent musculoskeletal pain and different degrees of the main outcome.

Sickness benefits due to mental health included disorders primarily from the ICPC-2 [22]. Primarily three diagnostic codes were used: P76 (Depressive disorder, 42.1%), P02 (Acute stress reaction, 26.2%), and P29 (Psychological symptom/complaint, 12.0%).

Sickness benefits due to musculoskeletal problems from the ICPC-2 were measured. Musculoskeletal problems due to injuries (L72-81) were excluded.

Medical rehabilitation benefits, overall and due to mental health problems, and disability pension were recorded. Participants with these benefits and no previous sickness benefits (n=83) were not included as outcomes in the multivariable analyses.

Non-medical welfare benefits

Adolescent musculoskeletal pain and later welfare benefits

Social welfare benefits were measured as a continuous variable by the total number of months with social welfare benefits during the registry period, and was used as a main outcome in the multivariable analysis. The mean of total social welfare months was converted from months into days in Figure 1 and Table 1 and 2 for comparison purposes with sickness days. Due to being recorded on a monthly basis social welfare benefits were organized into 1–3, 3–6 and 6–12 months of benefits in a 12-month period.

Adolescent health: Exposure and adjusting factors from the NAAHS.

Musculoskeletal pain and physical activity

Musculoskeletal pain was measured by “yes/no” answers to the question: “*During the last 12 months have you often been troubled by pain in the head, neck/shoulder, arms/legs/knees, abdomen or back?*” Abdominal pain was excluded due to the potential confusion with menstrual pain [2], resulting in 0–4 musculoskeletal pain sites.

Pain-related functional impairment was present if the participants reported reduced activity during leisure time due to pain (yes/no).

Physical activity was measured by: “*How many hours per week do you spend on physical activity, to an extent that make you sweat and/or out of breath?*” Possible answers: 0, 1–4, 5–7 and ≥ 8 hours per week [23].

Psychosocial factors

Resilience was measured by a five-item version ($\alpha=0.77$) of the *General perceived self-efficacy scale* [24] with higher scores indicating higher resilience. Responses were scored on a four-point Likert scale from “completely wrong” to “completely right.”

Parental involvement was measured by a four-item version of the *Parental Involvement Scale* ($\alpha=0.78$) [2, 25].

Parental support ($\alpha=0.88$) was measured by five statements on family attachment, being valued and taken seriously, and receiving help when needed [2].

Peer support ($\alpha=0.84$) was measured by four statements on peer attachment and support, being valued, and receiving help when needed [2].

Parental involvement, parental and peer support were scored on a four-point Likert scale from “completely agree” to “completely disagree.” Higher scores indicating more problems.

School-related stress ($\alpha=0.66$) was measured by the following four experiences: work pressure, pressure to succeed, concentration difficulties and understanding the teacher [2]. Responses were scored on a three-point Likert scale from “no” to “yes, often.”

Negative life events ($\alpha=0.55$) such as parental drug problems, bullying and assault were measured by 12 dichotomized questions previously described by Eckhoff and Kvernmo [2].

Mental health

Adolescent mental health was examined by *anxiety/depression* symptoms measured by the Hopkins Symptom Checklist 10-item version (HSCL-10) [26]. The HSCL-10 ($\alpha=0.87$) measures symptoms in the previous week. Psychometrics has been validated among subjects

aged 16–24 years [27], with a cutoff of 1.85 indicating a presence of emotional distress. The factor was handled continuously in all multivariable analyses.

For *externalizing problems* ($\alpha=0.69$) the SDQ conduct and hyperactivity subscales [28] were summed into one scale as proposed by Goodman et al. [29].

Sociodemographic factors

Parental education: Parents' highest education was obtained from Statistics Norway's education registry, registered when the participants were 15–16 years old. Parental education was categorized from "lower secondary" (≤ 10 th grade), "upper secondary" (≤ 13 th grade), "lower university degree" (up to 5 years) to "higher university degree" (more than 4 years) [30].

Sami ethnicity was measured by participants reporting one or more of the following factors: Sami parentage and Sami language competence in parents, grandparents and the participants, and Sami ethnic self-labeling.

Data analysis

We examined the adolescent factors to see whether the participants refusing the registry linkage differed from those who accepted and we only found a slightly lower mean of negative life events in the missing sample (Supplement Table S3). In the univariate analyses, Chi-square tests and One-way ANOVA were used.

Linear regression was used in the multivariable analyses on the total length of sickness and social welfare benefits (Tables 3 and 4). First, multivariable linear regression analyses with the sociodemographic, physical, psychosocial and mental health factors were analyzed in their characterized groups (Supplement Tables S1 and S2). The insignificant factors were excluded and the significant factors were used to adjust for adolescent musculoskeletal pain (Tables 3 and 4). Gender and parental education level were included in the models regardless due to adjustment reasons. In Tables 3 and 4 "Model 1" presents the adjustment for sociodemographic factors, "Model 2" with the addition of adolescent psychosocial factors, "Model 3" for adolescent mental health problems. To explore gender differences "Model 3" was stratified by gender. Adjustments for follow-up time and counties did not alter the multivariable findings and are not presented in this paper.

All analyses were conducted using SPSS version 23 (IBM software). The statistical significance level was set to .05. Bonferroni-adjusted significance levels for multiple comparisons ($.05/n_{\text{factors}}$) are presented for "Model 3" in the multivariable analysis tables as a conservative comparison of significance.

Results

The proportion of sickness benefit recipients, amount of sickness days and sickness benefits due to mental health problems were higher in females (Table 1). There was no significant gender difference for social welfare benefits. Of the sickness benefit recipients, 24.8% had received social welfare benefits, and 39.8% of social welfare benefit recipients had received sickness benefits. Mental health disorders were the primary reason for medical rehabilitation benefits (56.7%) and none were due to intellectual disabilities. Of the medical rehabilitation

recipients 41.1% had received sickness benefits, and 86.5% of these for more than three months in a 12-month period.

In total, 22.2% of the participants reported 3–4 musculoskeletal pain sites (Table 2). We found a significant increase in sickness, social welfare and medical benefits due to mental health and musculoskeletal problems in relation to the increasing number of adolescent musculoskeletal pain sites (Figure 1 and Table 2). This relationship was not significant in the participants receiving less than one month of sickness benefits and in those with less than three months of social welfare benefits in a 12-month period. The total amount of sickness and social welfare benefits were significantly higher ($\chi^2_{\text{sickness}}(1, n=2900)=28.46, p<.001$ and $\chi^2_{\text{social welfare}}(1, n=2900)=10.85, p=.001$) in those reporting pain-related functional impairment (mean_{sickness}=46.83 days, mean_{social welfare}=2.14 months) compared to the non-impaired (mean_{sickness}=28.75 days, mean_{social welfare}=1.43 months).

Supplement Table S1 and S2 presents the multivariable analyses of the adolescent predictors of later sickness and social welfare benefits, analyzed within their respective characterized groups. Insignificant factors were excluded, and the significant factors are presented as adjusting factors for the relationship between adolescent musculoskeletal pain and later welfare benefits (Table 3 and 4).

Table 3 shows that adolescent musculoskeletal pain was a significant predictor of sickness benefits in young adulthood when adjusted for adolescent psychosocial and mental health factors. Adolescent musculoskeletal pain was the strongest predictor followed by externalizing problems, a significant predictor in males. Model 3 had an explained variance of 3.2%.

Adolescent musculoskeletal pain was a significant predictor of later social welfare benefits when adjusted for adolescent psychosocial and mental health factors (Table 4). However, the stratified analysis found adolescent musculoskeletal pain to be a predictor of social welfare benefits in females only. Model 3 had an explained variance of 7.3%. The strongest predictors were externalizing problems, low physical activity, negative life events and less parental involvement.

Discussion

Main findings

We found multisite musculoskeletal pain in adolescence to be associated with medical and social welfare benefits from adolescence into young adulthood. Adolescent musculoskeletal pain was significantly associated with sickness benefits when adjusted for adolescent sociodemographic, psychosocial and mental health problems in both genders. The relationship between adolescent musculoskeletal pain and later social welfare benefits was significant in females, when adjusted for the adolescent factors. Adolescent externalizing problems was an important predictor of later sickness and social welfare benefits.

Comparison to previous studies

The positive association between the number of adolescent musculoskeletal pain sites and later receipt of medical and social welfare benefits was supportive of an earlier study in which

single-site pains and somatic health complaints were found to be predictive of welfare benefits [11]. The relationship between adolescent musculoskeletal pain and medical benefits due to mental health problems supports the relationship between physical pain and mental health problems [2–5]. Previous studies have found adolescent mental health problems to be predictive of later medical and non-medical benefits [12–16].

The relationship between adolescent musculoskeletal pain and later medical welfare benefits was comparable to findings in adults [9, 10, 31], though musculoskeletal disorders are more common in adults over 30 years of age. The nature of the association might therefore be somewhat different. Øverland et al. found that in persons over 40 years of age multisite musculoskeletal pain was a stronger predictor of disability pension due to musculoskeletal than mental health disorders [10]. In our sample of young adults, the univariate associations were somewhat stronger between adolescent musculoskeletal pain and medical benefits due to mental health problems than due to musculoskeletal problems. The significant prediction of sickness benefits is most likely due to a relationship between adolescent pain and physical illness or other mediating factors not included in the regression models.

Even though we found significant associations between adolescent factors and later welfare benefits, the explained variance for the models was low. However, it is a relative measure dependent on the nature of the associations examined [32]. The low explained variance is probably due to the fact that there are more present events resulting in welfare benefits than the participants' adolescent health.

The participants reporting pain-related functional impairment in adolescence received significantly more sickness and social welfare benefits from adolescence into young adulthood. This shows that not only symptom load as multisite pain, but also symptom-related function is important in the long run.

Several adolescent psychosocial and mental health factors were associated with sickness and social welfare benefits, supporting previous studies [13, 14, 33]. Adolescent mental health problems are predictive of later mental health problems [34], with subsequent risk of social, academic and work related difficulties [33, 35]. Most mental health disorders debut during the 12–24 year age range [35] and having the resources and the will to aid youth with their problems is most important to improve their outcomes. The most important predictors in our sample were externalizing problems, less parental involvement and negative life events. Externalizing problems was a strong predictor of sickness benefits in males only, while a predictor of social welfare benefits in both genders. Externalizing problems can be an indication of attention deficit hyperactivity disorder which is associated with poor school performance and comorbid disorders. Externalizing behavior in adolescence has been found to be associated with several adult social and health impairments [33].

The considerable proportion of participants that had received long-term sickness and social welfare benefits is a concern since long-term sickness benefits have been found to be predictive of disability pensions in young adulthood [19]. Comparable to national findings [36], females received more sickness benefits, which could be related to the higher rates of mental health problems in females. Adjusted for psychosocial factors, we found evidence a social gradient for social welfare benefit recipients as lower parental education, primarily the lower secondary education group, was associated with increased social welfare benefits.

If the Bonferroni correction is used for the multivariable analyses then adolescent musculoskeletal pain, male gender and lower parental education would not be significant predictors of later social welfare benefits.

Study strengths and limitations

The main strength of this study is the linkage of an unselected population-based study the national insurance registries. The study had equal gender distribution and a high participation rate, thereby strengthening its generalizability. It is known that nonresponders might be more troubled than responders and we examined the predictors in the NAAHS participants refusing registry linkage and found no increase in problems in these adolescents. Sickness benefit data from the three northernmost counties in the first quarter of 2011 from Statistics Norway [36], showed a 5.2% sickness absence compared to our 4.0% in our sample, in the same period, indicating increased sickness benefits in the nonresponders.

In contrast to earlier studies, where six months of sickness benefits has been used as a cutoff and merged with medical rehabilitation benefits [12, 13, 11], we explored the outcomes on multiple levels. We found it more reasonable to use the total amount of benefits received over the entire study period because this would be a better measure of health and work related difficulties over time, differentiating between short and long-term recipients and provide more exact knowledge. We also recalculated graded sickness days into 100% sickness days, rather than just counting 100% sickness days [11], thereby increasing the validity of the measure.

Only 83 participants received medical rehabilitation benefits or disability pension, but no sickness benefits, and should therefore not have influenced our findings. Almost half of the medical rehabilitation recipients had received sickness benefits. Disability pensions were excluded in this study due to the low number of recipients and the young age of our sample, and because the affected individuals seemingly had other difficulties such as intellectual disability. We therefore found it more reasonable to explore sickness benefits as an outcome. In Norway, 34% of 19–24-year-olds are students [37] and 60% of them are working part-time [38]. Bachelor students works 11 hours a week on average [39]. Of the total population we only have 14% fulltime students not working, and therefore are potentially 86% (66% + 20%) of the 19–24-year-old population entitled to sickness benefits if they work and get ill.

The National Insurance Registry had some errors, primarily evident in the diagnostic coding where 20 out of 33 disability pension, 12% of medical rehabilitation and 21% of the sickness benefits recipients had no registered diagnosis. We discovered some issues where the date for the completion of a benefit period was missing. Here we used the last registered date for the benefit, leading to an underestimation of the outcomes.

The specification of a 12-month period for the pain questions may have increased the risk of recall bias compared to shorter time periods. The expression “several times” is objectively vague and is open to interpretation, but it indicates some regularity and seriousness of pain. A more stringent measure of pain, as in the Young HUNT studies [4], might have resulted in stronger associations with the outcomes. However, the importance of multisite pain is still emphasized. The population study relied on self-reports with the risk of information bias. The psychosocial predictors from the population study are not frequently used by other studies making it hard to replicate the findings, though their internal consistency was high. The HSCL-10 and SDQ subscales used for indication of adolescent

mental health problems are more commonly used and validated [26, 28]. Mental health problems are complex and including several factors that potentially moderate/mediate or confound each other in a model can lead to underestimation of some relationships. The adolescent psychosocial and mental health factors are primarily included for adjustment reasons and should be evaluated in light of other studies.

The low explained variance in the models could lead us to question the true impact of the significant factors. More prospective studies, including studies with a different design, are needed. Repeated measures in adolescence could potentially single out more troubled individuals than our single population study is able to do. The Bonferroni adjustment for multiple comparisons is a conservative correction, with increased risk of false negatives, but was included to distinguish the more reliable associations from the more questionable.

Conclusions

We found multisite musculoskeletal pain in adolescence to be associated with sickness, in both genders, and social welfare benefits in females from adolescence into young adulthood, when adjusted for adolescent psychosocial and mental health problems. Musculoskeletal pain alongside externalizing problems and negative life events in adolescence were found to be important predictors of later health problems and social difficulties. More research, with improved epidemiological measures for pain reports and from other countries, is needed to validate these findings. Adolescent problems influence the working ability from adolescence into young adulthood, and addressing adolescents physical, mental and social problems is crucial to help them reach their personal potential and contribute to society.

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Competing interests

All authors declare no conflicts of interest.

Figure legends

Fig 1 Chi-squared test for trend. The relationship between the number of adolescent musculoskeletal pain sites and later sickness and social welfare benefits (total benefit days) from adolescence into young adulthood, in females and males.

Table legends

Table 1 Medical and social welfare benefits from adolescence into young adulthood in an adolescent population cohort, stratified by gender

Table 2 The relationship between adolescent musculoskeletal pain sites and later medical and social welfare benefits from adolescence into young adulthood

Table 3 The relationship between adolescent musculoskeletal pain and later sickness benefits adjusted for gender, parental education and potential psychosocial confounders/mediators (n=3107 in Model 3)

Table 4 The relationship between adolescent musculoskeletal pain and later social welfare benefits adjusted for gender, parental education and potential psychosocial confounders/mediators (n=3316 in Model 3)

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Fig 1 Chi-squared test for trend. The relationship between the number of adolescent musculoskeletal pain sites and later sickness and social welfare benefits (total benefit days) from adolescence into young adulthood, in females and males.

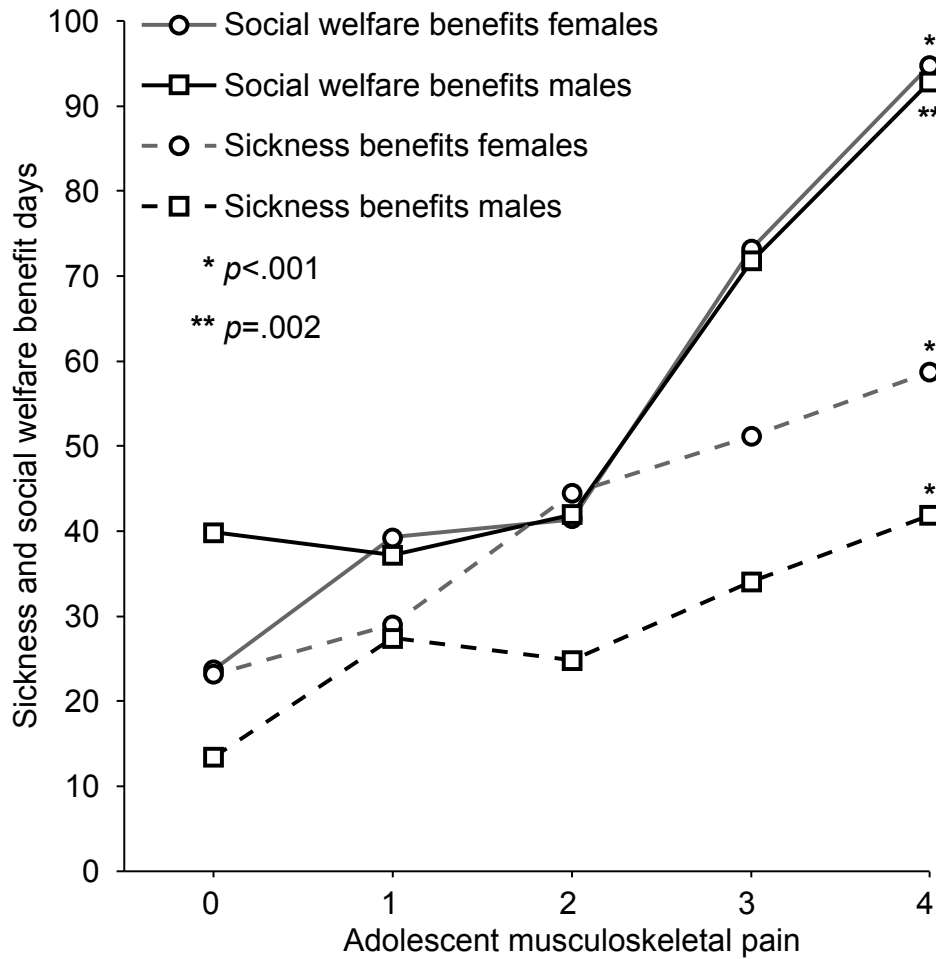


Table 1 Medical and social welfare benefits from adolescence into young adulthood in an adolescent population cohort, stratified by gender

Benefits (%/mean)	Females n=1991	Males n=1996	Total n=3987	χ^2 / F-ratio
Medical insurance benefits (%/M):	34.8	25.1	29.9	44.30 ^{p<.001}
Sickness benefits (%):	32.8	23.2	28.0	44.61 ^{p<.001}
Sickness <1 months (%)*	5.9	6.0	6.0	0.01 ^{p=.963}
Sickness 1–3 months (%)*	10.3	7.6	9.0	9.12 ^{p=.003}
Sickness 3–6 months (%)*	7.0	3.5	5.2	24.33 ^{p<.001}
Sickness 6–12 months (%)*	6.3	3.7	5.0	13.96 ^{p<.001}
Total sickness benefit days (M)	39.85 (93.42)	23.34 (72.87)	31.58 (84.16)	38.70 ^{p<.001}
Medical rehabilitation benefit (%)	2.6	2.0	2.3	1.40 ^{p=.236}
Non-medical benefits (%/M):				
Social welfare benefits (%):	16.9	17.9	17.4	0.64 ^{p=.425}
Social welfare 1–3 months (%)*	5.3	6.3	5.8	1.44 ^{p=.230}
Social welfare 3–6 months (%)*	4.1	5.2	4.6	2.43 ^{p=.101}
Social welfare 6–12 months (%)*	7.4	6.2	6.8	1.97 ^{p=.160}
Total social welfare days (M)	49.2 (169.08)	47.7 (169.32)	48.3 (169.17)	0.08 ^{p=.781}
Medical benefits diagnoses (%):				
Sickness benefits mental health	6.4	2.9	4.6	26.39 ^{p<.001}
Sickness benefits musculoskeletal	9.3	6.8	8.0	8.29 ^{p=.004}
Medical rehabilitation mental health	1.5	1.1	1.3	1.29 ^{p=.256}

Note: Statistical analyses: Chi-square analysis and One-way ANOVA.

*The number of months of benefits in a 12-month period.

Table 2 The relationship between adolescent musculoskeletal pain sites and later medical and social welfare benefits from adolescence into young adulthood

Benefits (%/mean)	Adolescent musculoskeletal pain sites						χ^2 / F-ratio
	n=3720	0 n=1033	1 n=1070	2 n=792	3 n=495	4 n=330	
Medical insurance benefits (%/M):							
Sickness benefits (%)	3720	19.4	26.0	32.7	34.3	39.4	77.19 ^{p<.001}
Males (%)	1877	16.8	24.3	28.1	28.7	31.7	24.50 ^{p<.001}
Females (%)	1843	23.5	27.9	36.5	37.6	44.0	36.59 ^{p<.001}
Sickness <1 months (%)*	3720	4.9	5.6	7.1	6.1	7.3	3.41 ^{p=.065}
Sickness 1–3 months (%)*	3720	6.6	7.9	10.9	12.3	9.7	13.47 ^{p<.001}
Sickness 3–6 months (%)*	3720	2.9	4.8	6.2	5.9	9.1	21.51 ^{p<.001}
Sickness 6–12 months (%)*	3720	2.4	4.4	5.4	7.5	9.7	37.10 ^{p<.001}
Total sickness benefit days (M)	3720	17.1	28.2	35.5	45.0	52.4	17.40 ^{p<.001}
Medical rehabilitation (%)	3720	1.9	1.3	2.0	3.0	5.2	11.63 ^{p=.001}
Non-medical benefit (%/M):							
Social welfare benefits (%)	3720	13.7	14.9	16.9	22.4	27.3	41.23 ^{p<.001}
Males (%)	1877	15.4	15.3	15.6	26.5	31.7	21.42 ^{p<.001}
Females (%)	1843	11.1	14.4	17.8	20.1	24.6	22.89 ^{p<.001}
Social welfare 1–3 months (%)*	3720	5.3	4.8	6.3	7.3	5.5	1.64 ^{p=.200}
Social welfare 3–6 months (%)*	3720	3.6	4.2	4.5	5.1	8.2	9.82 ^{p=.002}
Social welfare 6–12 months (%)*	3720	4.5	5.7	5.9	9.9	13.3	35.06 ^{p<.001}
Total social welfare days (M)	3720	33.6	38.1	41.7	72.6	93.9	12.17 ^{p<.001}
Medical benefit diagnoses (%):							
Sickness benefits mental health	3720	2.6	3.4	4.8	6.9	8.5	30.16 ^{p<.001}
Sickness benefits musculoskeletal	3720	4.1	8.6	10.1	10.5	8.8	19.06 ^{p<.001}
Medical rehabilitation mental health	3720	0.9	0.9	1.3	1.8	2.7	7.76 ^{p=.005}

Note: Statistical analyses: Chi-square analysis (Linear-by-linear association) and One-way ANOVA.

*The number of months of benefits in a 12-month period.

Table 3 The relationship between adolescent musculoskeletal pain and later sickness benefits adjusted for gender, parental education and potential confounders/mediators (n=3107 in Model 3)

Factors	Sickness benefits				
	Model 1	Model 2	Model 3 [§]	Model 3	Model 3
	Total sample			Females	Males
	β				
Model R ²	<i>R</i> ² = .025	<i>R</i> ² = .027	<i>R</i> ² = .032	<i>R</i> ² = .024	<i>R</i> ² = .029
Musculoskeletal pain	.12 ^{p<.001}	.11 ^{p<.001}	.10 ^{p<.001}	.12 ^{p<.001}	.08 ^{p=.005}
Physical activity	-.03 ^{p=.128}	-.02 ^{p=.186}	-.02 ^{p=.226}	-.02 ^{p=.512}	-.03 ^{p=.235}
Gender (ref: females)	-.06 ^{p<.001}	-.05 ^{p=.003}	-.07 ^{p=.001}	—	—
Higher parental education	.01 ^{p=.511}	.01 ^{p=.739}	.01 ^{p=.749}	-.003 ^{p=.907}	.02 ^{p=.459}
Sami	.04 ^{p=.026}	.03 ^{p=.083}	.03 ^{p=.104}	.02 ^{p=.508}	.04 ^{p=.084}
School-related stress		.05 ^{p=.021}	.02 ^{p=.322}	.04 ^{p=.185}	.002 ^{p=.939}
Negative life events		.01 ^{p=.462}	.004 ^{p=.859}	.01 ^{p=.838}	.004 ^{p=.898}
Anxiety/depression			-.02 ^{p=.478}	-.01 ^{p=.721}	-.03 ^{p=.259}
Externalizing problems			.08 ^{p<.001}	.04 ^{p=.226}	.13 ^{p<.001}

Note: Statistical analyses: Linear regression, presenting standardized coefficients (β). Model 1: Adolescent physical factors adjusted for sociodemographic factors Model 2: As Model 1 with additional adjustment for adolescent psychosocial factors. Model 3: As Model 2 with additional adjustments for adolescent mental health problems. Model 3 was stratified by gender: females n=1549, and males n=1558.

[§]Bonferroni-adjusted significance level .0056 for Model 3 (total sample).

Table 4 The relationship between adolescent musculoskeletal pain and later social welfare benefits adjusted for gender, parental education and potential confounders/mediators (n=3316 in Model 3)

Factors	Social welfare benefits				
	Model 1	Model 2	Model 3 [§]	Model 3	Model 3
	Total sample			Females	Males
	β				
Model R ²	<i>R</i> ² = .025	<i>R</i> ² = .060	<i>R</i> ² = .073	<i>R</i> ² = .086	<i>R</i> ² = .064
Musculoskeletal pain	.11 ^{p<.001}	.05 ^{p=.008}	.04 ^{p=.038}	.06 ^{p=.036}	.02 ^{p=.505}
Physical activity	-.11 ^{p<.001}	-.09 ^{p<.001}	-.09 ^{p<.001}	-.09 ^{p=.001}	-.09 ^{p=.010}
Gender (ref: female)	.03 ^{p=.054}	.05 ^{p=.004}	.04 ^{p=.041}	—	—
Higher parental education	-.04 ^{p=.031}	-.04 ^{p=.013}	-.04 ^{p=.010}	-.07 ^{p=.004}	-.02 ^{p=.450}
Resilience		-.04 ^{p=.032}	-.03 ^{p=.166}	-.04 ^{p=.131}	-.01 ^{p=.694}
Parental involvement		.09 ^{p<.001}	.07 ^{p=.001}	.05 ^{p=.113}	.09 ^{p=.001}
Parental support		.05 ^{p=.020}	.04 ^{p=.081}	.04 ^{p=.216}	.03 ^{p=.288}
School-related stress		.03 ^{p=.172}	-.02 ^{p=.290}	-.03 ^{p=.263}	-.01 ^{p=.611}
Negative life events		.10 ^{p<.001}	.08 ^{p<.001}	.07 ^{p=.017}	.08 ^{p=.002}
Externalizing problems			.14 ^{p<.001}	.17 ^{p<.001}	.12 ^{p<.001}

Note: Statistical analyses: Linear regression, presenting standardized coefficients (β). Model 1: Adolescent physical factors adjusted for sociodemographic factors Model 2: As Model 1 with additional adjustment for adolescent psychosocial factors. Model 3: As Model 2 with additional adjustments for adolescent mental health problems. Model 3 was stratified by gender: females n=1654, and males n=1662.

[§]Bonferroni-adjusted significance level .005 for Model 3 (total sample).

Supplement Table S1 and S2 The association between adolescent factors, within characterized groups, and later sickness and social welfare benefits from adolescence into young adulthood.

S1		S2	
Adolescent predictors	Sickness benefits	Adolescent predictors	Social welfare benefits
	β		β
<i>Sociodemographic:</i>		<i>Sociodemographic:</i>	
Gender	$R^2=.011$ -.10 ^{p<.001}	Gender	$R^2=.001$.01 ^{p=.519}
Parental education	-.01 ^{p=.600}	Parental education	.02 ^{p=.183}
Sami	.03 ^{p=.043}	Sami	.03 ^{p=.109}
<i>Physical:</i>		<i>Physical:</i>	
Musculoskeletal pain	$R^2=.020$.13 ^{p<.001}	Musculoskeletal pain	$R^2=.023$.10 ^{p<.001}
Physical activity	-.04 ^{p=.023}	Physical activity	-.10 ^{p<.001}
<i>Psychosocial:</i>		<i>Psychosocial:</i>	
Resilience	$R^2=.014$ -.03 ^{p=.093}	Resilience	$R^2=.042$ -.05 ^{p=.006}
Parental involvement	-.02 ^{p=.281}	Parental involvement	.08 ^{p<.001}
Parental support	.02 ^{p=.441}	Parental support	.05 ^{p=.006}
Peer support	-.01 ^{p=.567}	Peer support	-.01 ^{p=.747}
School-related stress	.07 ^{p<.001}	School-related stress	.04 ^{p=.028}
Negative life events	.06 ^{p=.001}	Negative life events	.09 ^{p<.001}
<i>Mental health:</i>		<i>Mental health:</i>	
Anxiety/depression	$R^2=.016$.07 ^{p<.001}	Anxiety/depression	$R^2=.037$.03 ^{p=.102}
Externalizing problems	.08 ^{p<.001}	Externalizing problems	.18 ^{p<.001}

Note:

Statistical analyses: Linear regression. Adolescent predictors examined in their respective methodological groups.

Supplementary Table S3 Descriptive analyses of the explanatory adolescent factors in the Norwegian Arctic Adolescent Health Study (NAAHS) in the total sample, the registry sample and the non-registry sample.

Factors (Mean/SD)	Total sample n=4881	Registry sample n=3987	Non-registry sample (missing) n=894	Registry vs. missing sample (F-ratio)
Family income (1–4)	2.66 (0.67)	2.66 (0.67)	2.68 (0.69)	0.84 ^{p=.36}
Musculoskeletal pain (0–4)	1.47 (1.27)	1.47 (1.27)	1.47 (1.29)	0.01 ^{p=.92}
Sedentary activity (1–4)	2.80 (0.90)	2.78 (0.90)	2.85 (0.86)	3.32 ^{p=.07}
Physical activity (0–3)	1.46 (0.93)	1.46 (0.93)	1.41 (0.93)	1.75 ^{p=.19}
Resilience (5–20)	14.74 (2.62)	14.75 (2.61)	14.76 (2.63)	0.03 ^{p=.87}
Parental involvement (4–16)	6.45 (2.26)	6.45 (2.26)	6.41 (2.22)	0.02 ^{p=.90}
Parental support (5–20)	7.21 (2.83)	7.21 (2.84)	7.22 (2.81)	0.01 ^{p=.93}
Peer support (4–16)	5.62 (1.99)	5.62 (2.00)	5.63 (1.97)	0.21 ^{p=.64}
School-related stress (4–12)	7.22 (1.96)	7.23 (1.98)	7.18 (1.87)	0.36 ^{p=.55}
Negative life events (0–12)	2.73 (1.96)	2.76 (1.79)	2.58 (1.71)	6.08 ^{p=.014}
Anxiety/depression (1–4)	1.48 (0.52)	1.47 (0.51)	1.46 (0.51)	0.80 ^{p=.37}

Note: The analyses were carried out to explore potential differences between the total NAAHS sample and the registry sub-sample used in this current paper.