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In a prospective population-based cohort, we found a more than three-fold higher risk of work absenteeism in early adulthood among those with adolescent spinal pain-related absenteeism (148.7 (SD 243.4) hours/year), compared to those without (43.7 (SD 95.2) hours/year). Our findings suggest that - as early as during adolescence - to keep a sustainable workforce, pain-related behavior should be an important focus of pain prevention and management.

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Key terms: absenteeism; adolescence; adolescent; adolescent spinal-pain-related absenteeism; back pain; early adulthood; neck pain; pain; population-based cohort; Raine Study; spinal pain

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The association of adolescent spinal-pain-related absenteeism with early adulthood work absenteeism: A six-year follow-up data from a population-based cohort

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Objectives Spinal (ie, back and neck) pain often develops as early as during adolescence and can set a trajectory for later life. However, whether early-life spinal-pain-related behavioral responses of missing school/work are predictive of future work absenteeism is yet unknown. We assessed the association of adolescent spinal-pain-related work or school absenteeism with early adulthood work absenteeism in a prospective population-based cohort.

Methods Six year follow-up data from the Western Australian Pregnancy Cohort (Raine) study were used (N=476; with a 54% response rate). At age 17, participants reported spinal pain (using the Nordic questionnaire) and adolescent spinal-pain-related work/school absenteeism (with a single item question). Annual total and health-related work absenteeism was assessed with the Health and Work Performance questionnaire distributed in four quarterly text messages during the 23rd year of age. We modelled the association of adolescent spinal-pain-related absenteeism with work absenteeism during early adulthood, using negative binomial regression adjusting for sex, occupation and comorbidities.

Results Participants with adolescent low-back or neck pain with work/school absenteeism reported higher total work absenteeism in early adulthood [148.7, standard deviation (SD) 243.4 hours/year], than those without pain [43.7 (SD 95.2) hours/year); incidence rate ratio 3.4 (95% CI 1.2–9.2)]. Comparable findings were found when considering low-back and neck separately, and when considering health-related absenteeism.

Conclusions We found a more than three-fold higher risk of work absenteeism in early adulthood among those with adolescent spinal-pain-related absenteeism, compared to those without. These findings suggest that, to keep a sustainable workforce, pain prevention and management should focus on pain-related behaviors as early as in adolescence.

Key terms adolescence; back pain; neck pain; Raine Study.

Spinal pain, such as low-back and neck pain, has a high prevalence (1). However, while for some people spinal pain is benign, for others it becomes chronic (2) and disabling (3), thereby having an important impact on their lives and creating a substantial problem in our society. The impact of spinal pain can be reflected in seeking health professional advice and treatment (4, 5) and the use of medication (6). Moreover, spinal pain can result in avoiding normal and physical activities (7), restricted education attendance (8) and limited work productivity (9), such as work absenteeism (10, 11).

In turn, work absenteeism related to spinal pain can have important consequences, as participation in work activities is known to be essential for obtaining economic resources, well-being, developing identity, social roles and status (12). Moreover, evidence has shown that being employed is generally good for physical (13) and mental health and well-being (14, 15), while return to

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work often leads to improvements in general health (16).

To ensure that people are able to continue participating in work and other activities, it is important to target negative behavioral responses to spinal pain which are known to affect work participation. This approach aligns with contemporary models of care for the management of musculoskeletal pain disorders among workers (17). To facilitate positive behaviors, more knowledge on the etiology and development of these behaviors is needed, in particular early in their development (18). The prevalence of spinal pain commonly increases across adolescence (19) and reaches adulthood levels around the age of 18 years (20). We have also found evidence that already at 17 years of age, spinal pain can be a substantial burden with low-back pain having a negative impact on the lives of 20–30% of people in this age group (6). We have also found that there was a substantial group (30%) among young people 17–22 years old for which the burden of disabling spinal pain was substantial and/or growing (21). On the other hand, it has been shown that physical work demands at a young age can have a long lasting effect on low-back pain later in life (22). It can thus be concluded that the period from adolescence to early adulthood is key as this is the age in which pain, and related behavior, develops and sets a trajectory for people's lives. Focusing on this age group is particularly important as this is the time when people are first entering the workforce.

Spinal pain has been shown to have a cross-sectional association with school absenteeism in adolescents (6, 23) and with work absenteeism in young adults (24). Spinal pain is furthermore known to negatively impact on work absenteeism in cohorts of adult workers (25, 26), although other studies did not find such associations (27, 28). However, whether adolescent spinal-pain-related absenteeism is predictive of work absenteeism in early adulthood is as yet unknown.

We aimed to assess the association of adolescent spinal-pain-related work or school absenteeism with work absenteeism in early adulthood in a prospective population-based cohort study.

Methods

Participants

We utilized data from the Western Australian Pregnancy Cohort (Raine) Study (www.rainestudy.org.au), a long-term study that began as a pregnancy cohort in which a total of 2900 women attending antenatal clinics in Perth, Australia were enrolled (29). Families of the 2868 children born to 2826 mothers were invited to participate in regular follow-up assessments. Ethics approval was obtained from the University of Western Australia, Princess Margaret Hospital and Curtin University human research ethics committees (HR84/2005, HR67/2013; RA/4/1/5202; RA/4/1/2646). The study was conducted in accordance with the Declaration of Helsinki and informed consent was obtained from the primary caregivers (with assent from participants) at year 17, and at year 22 from the participants themselves.

At age 17, participants completed a questionnaire assessing spinal pain and spinal-pain-related absenteeism, in particular whether they took time off school or work due to their spinal pain. At year 22, participants completed questionnaires about work status. These questionnaires were followed by a one-year assessment protocol with four quarterly questionnaires about work absenteeism. In the current study, data from those 1146 participants who were still in the cohort during the 22-year follow-up were included. A comparison of the representativeness of the study sample at year 22 (compared to contemporaneous Western Australian Census data) has been provided earlier (29), showing that sociodemographic factors such as family structure, income level and work status were fairly comparable, Raine Study participants were more often working in clerical jobs with longer working hours while having a lower education level than the average Western Australian population.

Data collection

Spinal pain and school/work absenteeism at year 17. At year 17, spinal pain in the low-back and neck was assessed using the Nordic Musculoskeletal Pain Questionnaire (30), modified to ask about pain in the last month (yes/no) as previously used in adolescents (6). Spinal-pain-related absenteeism of work or school (yes/no) in the last month was also assessed, by asking participants *"Have you missed work or study due to the low-back pain?"and "Have you missed work or study due to the neck pain?".* This item is known to be associated with spinal pain disability (24), is of importance in adolescence (6), and construct validity has been demonstrated (31). For each of the spinal pain areas (low-back, neck, and low-back and neck combined) responses to these two questions were combined to construct a nominal variable with three categories: No pain, pain without pain-related work/school absenteeism and pain with pain-related work/school absenteeism.

Work absenteeism at year 22. In the year following the 22-year follow-up measurement, work absenteeism was measured using the Health and Work Performance Questionnaire (HPQ) (32) every three months (quarterly) using text messaging and electronically distributed questionnaires. The HPQ provides estimates of work absenteeism over the previous four weeks, by reports of whole and partial days absent from work for "problems with your physical or mental health" or for "any other reason". A strong association between HPQ absenteeism and payroll records has been reported (33). The HPQ enables consistent estimates across multiple organizations where there may be different standards and measures of work absenteeism and is thus useful for community samples.

Other variables

Participant's sex was self-reported by the participant's parent/caregiver at the time of birth. During the 22-year follow-up, measurement demographic variables, including work status (ie, being employed; yes/no), occupation, working hours per week and after-tax weekly income were assessed via questionnaire. Also, participants were asked whether they have now or in the past ever had any of the following 16 health professionally diagnosed medical conditions or health problems: anxiety problems, arthritis or joint problems, asthma, bladder control problems, chronic respiratory or breathing problems (other than asthma), coeliac disease, depression, diabetes, eating disorder/weight problems, hay fever or some other allergy, hearing impairment or deafness, heart condition, hemochromatosis (iron overload disease), migraine or severe headache, sleep disturbance or thyroid gland problems. A count of these conditions was derived for each participant, which was collapsed to 0, 1, 2, 3 or ≥4 for use as a covariate in further analyses (34).

Data processing and analysis

From the four quarterly work absenteeism questionnaires, annual absenteeism (expressed in hours/year) was estimated. For the data from each of the four measurement time points, we calculated average hours per day that participants were at work by dividing the self-reported estimated hours worked over the past seven days by the number of days at work during that time. For each of the four measurement time points, we multiplied the days lost over the last four weeks by the average hours per day that participants were at work to get hours lost over four weeks (using mean hours per day estimated for that quarter). In these calculations, partial days were treated as half days. An estimate of absenteeism per year was calculated by multiplying hours lost over the last four weeks by 12. As such, absenteeism annual estimates were based on 48 working weeks/year to account for the Australian standard of four weeks/year of annual leave. Annual estimates of absenteeism were calculated for each worker by averaging quarterly measured values of work absenteeism, for participants with at least three of the four quarterly work absenteeism assessments. Here, both health-related work absenteeism and total work absenteeism (i.e., health-related absenteeism and absenteeism for any other reason combined) were assessed and used for statistical analyses.

Due to the count nature of our response variable, negative binomial regression was used (35) to assess the association of adolescent spinal-pain-related absenteeism and work absenteeism during early adulthood. Separate models were created for the three spinal pain areas (ie, low-back, neck and low-back/neck) and for health-related and total work absenteeism. Incidence rate ratios (IRR) with 95% confidence interval (95% CI) were estimated from simple bivariate models, as well as from models in which we also adjusted for sex, occupation and comorbidities. P-values of <0.05 were considered statistically significant and all statistical procedures were performed using Stata version 13 (StataCorp LP, College Station, TX, USA).

Due to the potential for excess of zero absenteeism, which is not accounted for in the usual negative binominal model, the robustness of our effect sizes was estimated using a zero-inflated negative binominal (ZINB) model (36, 37), which has been used before on work absenteeism data (38). This ZINB regression allows for modelling of participants with a very high propensity to have zero days of absenteeism (ie, the zero-inflated part of the model) and subjects with substantial probability of at least one day of absenteeism (the count part of the model). In the zero-inflated part, only variables that contribute to the model in a statistically significant way (with P<0.05) as well as the constant term were maintained. Effect sizes were reported in IRR (with 95% CI).

Results

Of the 1146 participants from the Raine Study 22-year follow-up, a total of 867 were working and provided sufficient information on their work status (figure 1). Of those participants, 655 completed questions related to spinal pain at year 17, while 604 provided data on at least three of the four quarterly assessments of work absenteeism. A group of 476 participants had sufficient data on adolescent spinal-pain-related absenteeism and work absenteeism in early adulthood for analysis in this study, with a response rate of 54% among those who were employed at year 22. Characteristics of this group are provided in table 1. A comparison of the characteristics of the group of participants eligible for the current study with those who were part of the 22 year follow-up of the Raine Study are shown in Appendix 1 (www.sjweh.fi/show_abstract.php?abstract_id=3744).

At follow-up, 252 (53%) participants reported no total absenteeism, while 224 (47%) reported some level

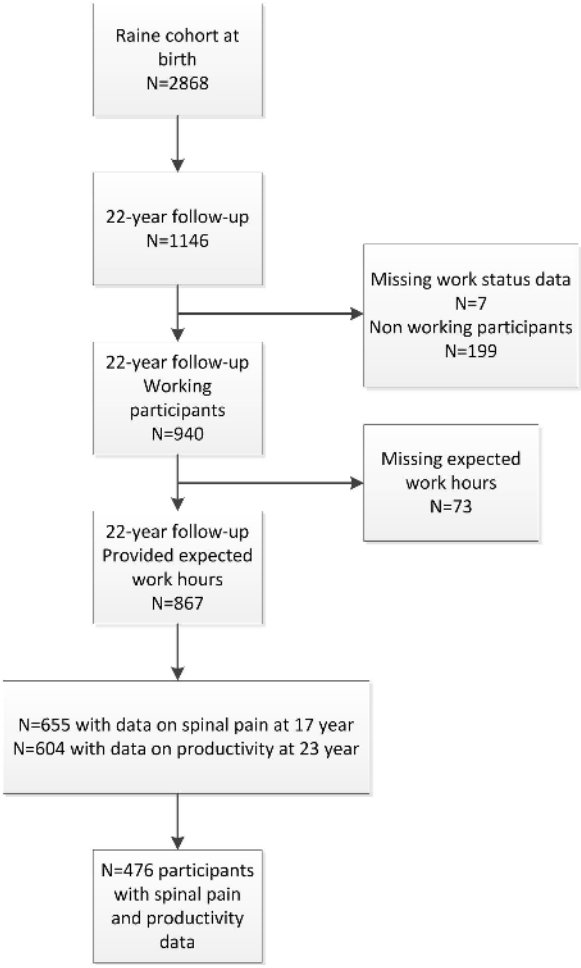

Figure 1. Flow chart of the study sample selection procedure.

of absenteeism (due to health or other reasons). The mean absenteeism (SD) in this latter group was 130.6 [standard deviation (SD) 153.5] hours/year with a median of 75.0 with interquartile range (IQR) 36.0– 169.7. Participants with adolescent low-back/neck pain with work/school absenteeism reported significantly higher mean total work absenteeism in early adulthood [148.7 (SD 243.4) hours/year], compared to those without pain [43.7 (SD 95.2) hours/year]; with an incidence rate ratio (IRR) 3.4 [95% confidence interval (CI) 1.3–8.9] (table 2). Somewhat lower (and non-significant), but still substantial, effect sizes were found when considering pain in the low-back and neck separately (table 2). Findings were relatively unaffected by adjustment for sex, occupation and comorbidities, for example, with an IRR 3.4 (95% CI 1.2–9.2) for low-back/neck pain. Although the effect sizes suggested adolescents with low-back/neck pain and no school/work absenteeism were at increased risk of work absenteeism as young adults [IRR 1.5 (95% CI 0.9–2.6)], this was not statistically significant. In a

Table 1. Characteristics of the study sample (N=476).

	N (%)
Sex	
Females	255 (54)
Males	221 (46)
Occupation	
Managers	16 (3)
Professionals	77 (16)
Technicians and trades workers	63 (13)
Community and personal service workers	90 (19)
Clerical and administrative workers	86 (18)
Sales workers	80 (17)
Machinery operators and drivers	16 (3)
Laborers	46 (10)
Comorbidity (count)	
0	175 (37)
1	147 (31)
2	73 (15)
3	41 (9)
4	37 (8)
Work hours (per week)	
≤19	138 (29)
>19–38	175 (37)
>38–45	92 (19)
>45	71 (15)
Years in the current job	
<1	70 (15)
1–3	148 (31)
>3	258 (54)

sensitivity analysis, testing for the robustness of our effect sizes using a ZINB model (Appendix 2, www.sjweh.fi/show_abstract.php?abstract_id=3744), we showed fairly comparable effect sizes to those obtained from the negative binominal model.

Of the included participants, 270 reported having no health-related absenteeism and 206 (43%) did report some level of absenteeism. The mean health-related absenteeism in this latter group was 92.1 (SD 129.2) hours/year with a median of 49.4 (IQR 28.5–97.1). Participants with adolescent low-back/neck pain with work/school absenteeism reported significantly higher mean health-related work absenteeism in early adulthood [94.1 (SD 201.5) hours/year], compared to those without pain [29.3 (SD 75.0) hours/year]; with an IRR 3.2 (95% CI 1.2–8.8) (table 3). Somewhat lower (and non-significant), but still substantial, effect sizes were found when considering pain in the low-back and neck separately (table 3). Findings were relatively unaffected by adjustment for sex, occupation and comorbidities, for example, with an IRR 3.1(95% CI 1.1–8.9) for spinal low-back/neck pain. As for total absenteeism, although the effect sizes suggested adolescents with spinal pain and no school/work absenteeism were at increased risk of work absenteeism as young adults [IRR 1.4 (95% CI 0.8–2.5)], this was also not statistically significant. In a sensitivity analysis, testing for the robustness of our effect sizes using a ZINB model (Appendix 3, www.sjweh.fi/show_abstract.php?abstract_id=3744), we showed fairly comparable effect sizes to those obtained from the negative binominal model.

Table 2. The association of adolescent spinal-pain-related absenteeism and early adulthood total work absenteeism (hours per year). Statistically significant findings (P<0.05) are printed in **bold**. [SD=standard deviation; IRR=incidence rate ratio; CI=confidence interval]

	N	Total work absenteeism	Unadjusted		Adjusted [a]	
		Mean (SD)	IRR (95% CI)	P-value	IRR (95% CI)	P-value
Back pain						
No pain	314	52.6 (104.0)	Reference		Reference	
Pain without pain-related absenteeism	135	72.3 (146.2)	1.4 (0.8–2.5)	0.287	1.3 (0.7–2.5)	0.394
Pain with pain-related absenteeism	22	130.1 (203.5)	2.5 (0.7–8.6)	0.157	2.4 (0.7–8.9)	0.173
Neck pain						
No pain	319	50.2 (109.7)	Reference		Reference	
Pain without pain-related absenteeism	130	73.2 (112.2)	1.5 (0.8–2.6)	0.212	1.5 (0.8–2.8)	0.195
Pain with pain-related absenteeism	24	150.7 (261.6)	3.0 (0.9–10.0)	0.074	2.8 (0.8–9.6)	0.110
Low-back/neck pain						
No pain	243	43.7 (95.2)	Reference		Reference	
Pain without pain-related absenteeism	192	66.2 (111.8)	1.5 (0.9–2.6)	0.136	1.5 (0.8–2.6)	0.190
Pain with pain-related absenteeism	**40**	**148.7 (243.4)**	**3.4 (1.3–8.9)**	**0.013**	**3.4 (1.2–9.2)**	**0.017**

[a] Adjusted for sex, occupation and comorbidities.

Table 3. The association of adolescent spinal-pain-related absenteeism and early adulthood health-related work absenteeism (hours per year). Statistically significant findings (P<0.05) are printed in **bold**. [SD=standard deviation; IRR=incidence rate ratio; CI=confidence interval]

	N	Health-related work absenteeism	Unadjusted		Adjusted [a]	
		Mean (SD)	IRR (95% CI) [a]	P-value	IRR (95% CI)	P-value
Back pain						
No pain	314	31.9 (72.5)	Reference		Reference	
Pain without pain-related absenteeism	135	50.5 (123.9)	1.6 (0.9–2.9)	0.138	1.4 (0.7–2.6)	0.342
Pain with pain-related absenteeism	22	91.7 (168.1)	2.9 (0.8–10.6)	0.112	2.9 (0.8–11.3)	0.118
Neck pain						
No pain	319	34.2 (88.8)	Reference		Reference	
Pain without pain-related absenteeism	130	45.9 (79.7)	1.3 (0.7–2.5)	0.353	1.2 (0.6–2.4)	0.501
Pain with pain-related absenteeism	24	81.7 (210.8)	2.4 (0.7–8.4)	0.175	2.0 (0.5–7.6)	0.317
Low-back/neck pain						
No pain	243	29.3 (75.0)	Reference		Reference	
Pain without pain-related absenteeism	192	41.8 (83.1)	1.4 (0.8–2.5)	0.222	1.3 (0.7–2.3)	0.450
Pain with pain-related absenteeism	**40**	**94.1 (201.5)**	**3.2 (1.2–8.8)**	**0.023**	**3.1 (1.1–8.9)**	**0.038**

[a] Adjusted for sex, occupation and comorbidities.

Discussion

In this prospective population-based cohort study we aimed to assess the association of adolescence spinal-pain related school or work absenteeism with early adulthood work absenteeism. Results of our study show a more than three-fold higher risk of work absenteeism in early adulthood among those with adolescents with spinal pain who reported missing work/school compared to those without spinal pain. These findings extend earlier research showing a cross-sectional association of spinal pain and work absenteeism in adults (25, 26) as well as our previous work with this cohort showing that spinal pain early in life can become disabling and have a negative impact on people's lives (6, 21). Our findings of comparable effect sizes in total and health-related absenteeism, as well as for low-back, neck and low-back/neck pain combined suggest absenteeism is mainly driven by health-related issues and that similar mechanisms are existent for various spinal areas. Alternatively, it may suggest that participants prefer to attribute absenteeism to a health problem.

The findings suggest that adolescent spinal pain related school or work absenteeism might be an important factor that sets a trajectory for work absenteeism later in life. It may therefore be beneficial to target behavioral responses to pain early in life to keep people participating in activities, particularly in work activities. This would align with a well-established model of chronic low-back pain behavior: the fear avoidance model. This model suggests that pain-related beliefs are an important driver of low-back pain-related avoidance behavior (39), with mechanisms of avoidance and catastrophic worry suppression underlying this behavior (40). Negative pain beliefs have been shown to be associated with spinal pain disability behavior in adults (41, 42) as well as adolescents (43). Whilst the current study suggests pain-related behaviors are evident in late adolescence, it remains unclear how early these behaviors, and the beliefs which may underpin these behaviors (43), emerge.

Early targeting of spinal pain beliefs and behavioral responses to pain may be effective as these beliefs and behaviors have previously been shown to be modifiable. For example, providing positive messages about back pain has been shown to improve back pain beliefs, which even reduced disability and workers' compensation costs (44). Moreover, people who have positive beliefs about their spinal pain and its future consequences are reported to have a reduced risk of disabilities (45). A behavioral approach may be more fruitful than targeting individual causative factors which are known to be complex, temporally variable and show limited effect with treatment on their own (46, 47).

Key considerations for early intervention may require determination of personal characteristics of those being targeted by the intervention, including their motivation, readiness, opportunity and ability to change (48). It has to be acknowledged that only a relatively small proportion (<10%) of our sample reported adolescent spinal pain–related absenteeism. Despite this low proportion, these participants account for a large percentage of the total absenteeism (24). Potentially, targeting these individuals may be more effective and cost-efficient than targeting the entire population. A better understanding of this group is therefore needed and should be a focus of future research. Additionally, given associations between adolescent back pain and primary carer (ie, his/her parent) back pain (49), management may need to be implemented at a family level, in conjunction with a school-based approach.

Strengths and limitations

The strengths of this study included the use of data from a prospective population-based cohort study with multiple estimates for work absenteeism over a year. The population-based sample provided a better representation of the general population than clinical or occupation based samples and it had a good spread across occupations, both sexes and socio-economic status.

Our data showed an excess of zeros with 53% of the study participants reporting no absenteeism days. Despite this, our study findings were relatively robust when the effect sizes obtained from negative binominal (table 2 and 3) were compared with those from ZINB modelling (Appendix 2 and 3).

As a single recall has been shown to not be sufficiently robust to estimate work absenteeism (50), our approach of a series of four measurements spread over the course of one year may provide more accurate estimations. The HPQ questionnaire was used which has been shown to be reasonably valid (33). However, our procedure of using four measurements with a 4-week recall (16 weeks in total) to estimate absenteeism over a year may be prone to recall bias, attenuating the association of spinal pain and work absenteeism.

There was a substantial drop-out of participants in this study. This has resulted in a relatively low number of participants in our analysis, which may be an important reason as to why we failed to find statistical significance for some of the associations. Although, our statistically significant findings are in the smallest group in each of the comparisons, and therefore the most prone to sampling error (potentially type 1 errors), we found significant findings in other associations and large and clinically important effect sizes even for the non-significant associations. Another issue with the substantial drop-out is a possible impact on the generalizability of our findings. Participants in the Raine Study who were not in the workforce at year 22 were excluded, while it remains unknown for what reasons (for example, spinal pain, still doing tertiary studies or other) these people did not have a job. Moreover, it was shown that, compared to the total group of participants in the 22-year follow-up of the Raine Study, participants eligible for the current analysis showed no difference in spinal pain, had slightly less work absenteeism and comorbidities and worked fewer hours per week (Appendix 1).

Concluding remarks

In this current study, we reported a more than threefold higher risk of work absenteeism in early adulthood among those with adolescent spinal-pain-related absenteeism, compared to those without. Our findings suggest that, in order to maintain a sustainable workforce, pain prevention and management should focus on pain-related behaviors as early as in adolescence.

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