INTRODUCTION

Spinal pain is one of the most costly and disabling problems affecting adults in industrialized countries.\(^3\) Population-based surveys of adult spinal pain variously report a point prevalence of 15% to 30%, a 1-year prevalence of 50%, and a lifetime prevalence of 60% to 80%,\(^4,5\) which is concerning in terms of loss of productivity, health care costs, and personal pain and suffering. There is some evidence to suggest that spinal pain experienced in adolescence is a risk factor for spinal pain in later life,\(^6,7\) although there are scarce longitudinal studies to support this. However it is plausible that protecting the spinal health of adolescents could reduce future societal burden of adult spinal pain. In order to do this successfully, it is first necessary to understand the contributing factors to spinal pain in adolescents, and second, to introduce successful preventative strategies that reduce the presence, or impact, of these contributing factors. This paper briefly reports on our findings to date regarding spinal health risk factors, and outlines our work in developing prevention strategies (health policy and health promotion program), to address these factors within the school environment.

Our work could not have proceeded without the unique partnership that we (health researchers) have developed with the education sector (The Department of Education and Children’s Services in South Australia). This partnership has allowed us to take a long-term collaborative approach to the development of background knowledge and implementation strategies, and in our actual interventions into the school environment. To our knowledge, these are the first spinal care interventions for school students that are based on sound research and a commitment from both the health and education sectors.

OUR RESEARCH

Adolescents have been repeatedly identified around the world as suffering from spinal pain.\(^8,9\) The repetitive carriage of heavy loads, the poor ergonomic fit of school furniture, and the repetitive poor study postures adopted have been hypothesized as potential causes of adolescent spinal pain.\(^10,11\) Our research has consisted of a number of approaches: pilot work, population-based research (cross-sectional and longitudinal studies), and experimental and laboratory studies. This work aimed to identify correlates of spinal pain in adolescents.

Pilot Studies

The valid, reliable measurement of posture was our key concern to ensure the success of our research into the stresses of load carriage on adolescent spinal posture. We validated the use of two-dimensional photography of adolescents in standing (using digitization of anatomical points on head, neck, shoulder, hip, thigh, knee, and ankle) as a way of reliably describing changes to posture when carrying posterior loads.\(^12\)

Population-based Studies

In 1998 we completed a cross-sectional study on approximately 1300 adolescents (aged 12-18 years) from 12 metropolitan South Australian high schools (reflecting 5 high school year levels).\(^13,14\) We found that approximately 50% of adolescents repeatedly reported a recent event of spinal pain (neck or low back). Our research identified strong associates of adolescent low back pain, particularly for young people in the rapid spinal growth years (12-14 years for girls and 13-16 years for boys), as repeatedly carrying school backpacks weighing over 3 kg, more than 5 hours of sitting (outside school hours), having very tall children or short children sitting for any length of time in ‘usual’ school furniture, having an abnormal trunk height to leg length ratio (during growth spurts for boys), and playing high level sports for more than 8 hours per week (for 12-14 year old boys and girls).\(^15,16\) While some of these contributing factors are not amenable to change (trunk height to leg length ratio), the effect of others may be reduced through changes in the students’ behavior (eg, hours spent sitting outside of school day), or to the school environment (eg, availability of different sized school furniture in the classroom).

Keen to validate the cross-sectional study findings, we embarked on a longitudinal study in 1999, repeatedly testing a cohort of adolescents entering their first year of high school in 1999 up until they completed high school in 2003. Preliminary analysis of the data suggests that our cross-sectional study findings were an accurate reflection of risk factors for low back and neck pain in adolescents. We are particularly concerned with evidence of an increase in incidence of spinal pain with age, and with increases in poor posture as students’ age. We are currently testing the longitudinal data for hypotheses regarding posture, pain, poor muscle endurance and strength, poor motor control, changes in anthropometry, and times spent sitting per day.

Experimental and Laboratory Studies

We conducted a series of experimental and laboratory studies designed to explore the effect on adolescent spinal posture of carrying posterior (backpack) loads.\(^17\) We found the most useful way of interpreting the effect of posterior load was to report it as a percentage of body weight. The underlying aim of these investigations was to identify critical ‘safe’ loads that could be carried in school backpacks, and to describe the effect on posture of the position of the load on the spine. Our findings suggest that carrying a school backpack centered around the waist level incurs least postural adjustment; however, we are yet to recommend a critical load carrying limit.\(^18\)

Backpack Development

The results of our research have lead to the development of an ergonomic backpack (PhysioPak) manufactured by Spartan School Supplies (www.physiospak.com).

INTERVENTIONS FOR ADOLESCENT SPINAL PAIN

As a result of our extensive involvement in school communities in conducting our research to date, we have constructed a view that adolescent spinal pain and its’ contributing factors are multifactorial in nature, with both student behaviors and the school environment contributing (as mentioned previously), along with input from other stakeholders who need to be considered when attempting to intervene to improve the
We believe that a key reason for ongoing concerns world-wide regarding adolescent spinal health is the lack of recognition and ownership of the problem, reflecting the variable involvement of different government sectors (health, education, workplace injury management), leaders of school communities, the student peer group, and families of students. Adolescents seem relatively powerless to make sustainable decisions regarding their spinal health, as they have limited input on the purchase and design of school or home furniture, the design and performance of recommended school backpacks, the choice of school textbooks, school timetables and homework requirements, and the use of computers at school and home. Therefore undertaking interventions that target adolescents alone would appear to be unlikely to succeed. Thus, any school-based intervention aiming to decrease the prevalence of spinal pain in school students should:

- address multifactorial risk factors (student behavior, school environment, influence of stakeholders),
- be ‘owned’ and promoted by key adults within that environment, and
- encourage the school community as a whole to adopt a culture of adolescent spinal health promotion.

Based on these factors, and our findings of spinal pain prevalence and its potential risk factors, in 2000 we designed two school-based, public health interventions. Both interventions aim to address spinal health risk factors that are potentially amenable to change. Underpinning this work is the NH&MRC ‘Effective school health promotion: towards health promoting schools’ document (1996), which aims to:

- provide advice to Australian State and Commonwealth Health Ministers and their departments on the best approaches to health promotion in schools and
- make clear recommendations concerning the types of investments likely to lead to measurable health outcomes.

The remainder of this paper describes our 2 intervention strategies: the spinal health for school students' policy and the spinal health promotion program.

1. Spinal Health for Students’ Policy

It is important that adolescents are protected from situations that may produce injury, in the same way as adults are protected from workplace injury by legislation. While adolescents spend the majority of their ‘work’ time at school, there are few legislative or workplace standards specifically in place in schools to protect adolescents from ‘work-related’ injury, and in particular, no formal approaches to decrease the risk of injury to students’ spines. Ironically, teachers (adults) are protected from injuries in the same workplace (the school) by legislation. Therefore, in conjunction with the South Australian Department of Education and Children’s Services (DECS) (formerly the Department of Education, Training, and Employment), we constructed a spinal health policy based on findings of our research. The policy was formally launched in Adelaide, South Australia in October 2002 by the Minister for Education and Children’s Services, and represents the position of the South Australian State Government with respect to promoting good spinal health of adolescent school students (http://www.decs.sa.gov.au/deptinit). The policy advocates awareness of good spinal health within the school community, and promotes it as an issue that needs to be owned by all (teachers, parents, students). It makes practical suggestions to improve individual student knowledge, attitudes, and behaviors, as well as improvements to the school environment (such as the location of lockers with respect to classrooms). Schools across South Australia have been encouraged to use the document to underpin their school occupational health and safety activities, to recognize risks to students’ spinal health within their environment, and to take practical steps to address these risks. The uptake of this policy will be tested by questionnaire of a sample of South Australian schools at the first anniversary of its launch (end 2003). The first 2 pages of the policy document are reproduced in Figure 1. The remainder of the policy can be found on the website listed above.

2. Spinal Health Promotion Program

Our second approach to the prevention of spinal pain in adolescents has been to develop, in conjunction with DECS, a unique health promotion program that uses the Health Promoting Schools model. The underlying philosophy behind health promotion in schools is that a comprehensive program, rather than curriculum alone, is required to encourage children to adopt health-enhancing behaviors. Therefore our program also targets parents and the school community as secondary target groups, through literature and involvement in education sessions, and encourages school-wide adoption of our spinal health for students policy (discussed above).

The health promotion program aims to increase awareness of adolescent spinal health, and good spinal health behaviors in all target groups. The backbone of the program is a formal curriculum, written by a recognized curriculum design expert in conjunction with our research team, using the guidelines provided by DECS and the South Australian Curriculum, Standards and Accountability (SACSA) Framework. The curriculum was written for students entering the first year of high school (aged 12-13 years), since this is the age of the largest adolescent growth spurt when the spine is at its’ most vulnerable to injury. The curriculum sets out a framework of teaching/learning modules that incorporate the findings of our research in the context of 5 core learning areas (English, Mathematics, Health and Physical Education, Society and the Environment, and Science). Teaching and learning activities in the curriculum include:

- **English**—students develop a survey instrument and apply it to teachers and peers to determine others’ attitudes to load carrying, understanding of spinal health issues, and perceptions of good and poor postures;
- **Mathematics and Science**—school bags are weighed daily for a week, and basic mathematical calculations are undertaken of load and percentage of body weight. The forces and postures produced by different load carrying postures are assessed, and differences in spinal performance between young people of different sizes and shapes identified;
- **Society and Environment**—societal issues of good spinal health, pain, posture, work environments and workplace injury are investigated, allowing young people to reflect on their own spinal health choices, those of their peers, and the adults with whom they interact;
- **Physical Education**—students and teacher develop good spinal health strategies for everyday activities (such as exercise behaviors, posture, furniture choices, and use).

Preliminary content validation of the curriculum and wider health promotion program has already been undertaken by curriculum experts within DECS, school health promotion experts, and teachers and parents at metropolitan high schools in South Australia. In May 2003, a pilot study of the curriculum in the context of the wider school health promotion began and will be evaluated at one South
**CONCLUSION**

Spinal pain in adolescence should be a concern to health practitioners and educators due to high prevalence rates, and the potential for it to be associated with adult back pain, with all its consequences. While there is worldwide recognition of the problem of adolescent spinal pain, few groups worldwide seem to have progressed beyond the stage of ‘describing the problem.’ The multifactorial nature of spinal pain, and the multiple stakeholders in the issue of adolescent spinal pain, mean that to make a sustainable difference requires strong intersectoral partnerships that support multiple intervention strategies that are based on sound research, and target different aspects of the problem.

**REFERENCES**


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