Child and Adolescent Spinal Health

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Acknowledging the financial support of the Financial Markets Foundation for children
Involving to date......

- Over 3400 young South Australians aged 5-18 years
- Over 800 final year physiotherapy students as project officers
- 6 Masters of Physiotherapy students
- 3 PhD students
Occupational health and safety

- Occupational spinal health for school teachers and students over 18 years, in schools, is protected by legislation
  - Loads
  - Furniture
  - Lifting
  - Hazard identification and reduction
- No legislation protecting occupational spinal health issues in schools for students < 18 years
  - ‘Work experience’ provides limited exposure and legislation protection
Our underlying questions

• Is there really an issue with child and adolescent spinal pain?
• Is any pain acceptable?
  – Is pain part of growing?
• Does exposure to adolescent spinal pain increase likelihood of adult spinal pain?
• Is heavy load carriage good for growing spines?
  – If so, how much load is sufficient?
• International arguments around bony growth, prevention of osteoporosis, development of muscle strength/endurance vs repetitive loading causing cumulative micro-damage
Our research aims

• To describe the frequency of child & adolescent spinal pain
  – To understand its causes

• To identify whether adolescent pain becomes adult spinal pain

• To understand and influence the ‘systems’ influencing good child – adolescent spinal health
1997

Setting the scene

focus groups, surveys, lab-based pilot studies

International Centre for Allied Health Evidence
Our research path

1997

Setting the scene

1998

Quantifying the problem:

Population-based research

N=1269 students in 12 Adelaide high schools
Our research path

1997
Setting the scene

1998
Quantifying the problem
1. Laboratory study of critical loads & carrying positions
2. Longitudinal adolescent study Yr1

1999
Understanding the problem
Our research path

1997
Setting the scene

1998
Quantifying the problem

1999
Understanding the problem

2000
Commercialisation
Policy / curriculum development

Longitudinal adolescent study
Yr1 Yr2

International Centre for Allied Health Evidence
Our research path

1997

Setting the scene

1998

Quantifying the problem

1999

Understanding the problem

2000

Commercialisation

Policy / curriculum refinement

2001

Primary school study Yr 1

Longitudinal adolescent study

Yr1

Yr2

Yr3
Our research path

1997 Setting the scene
1998 Quantifying the problem
1999 Understanding the problem
2000 Commercialisation
2001 Primary school study Yr 1
2002 Primary school study Yr 2

Longitudinal adolescent study
- Yr 1
- Yr 2
- Yr 3
- Yr 4
Our research path

1997

Setting the scene

1998

Understanding the problem

1999

Quantifying the problem

2000

Commercialisation

2001

Policy / curriculum implementation

2002

Primary school study

2003

Yr 1

Yr 2

Yr 3

Yr 4

2004

Curriculum uptake

Longitudinal adolescent study

Yr 1

Yr 2

Yr 3

Yr 4

Yr 5

Analysis

International Centre for Allied Health Evidence
Our research path

1997
Setting the scene

1998
Quantifying the problem

1999
Understanding the problem

2000
Primary school study

2001
Commercialisation

2002
Policy / curriculum implementation

2003

2004

2005
Curriculum uptake

Longitudinal adolescent study

Yr 1      Yr 2        Yr 3      Yr 4      Yr 5

Analysis

International Centre for
Allied Health Evidence
Our research path


Setting the scene

Understanding the problem

Primary school study

Commercialisation

Policy / curriculum implementation

Curriculum uptake

Longitudinal adolescent study

Yr1 Yr2 Yr3 Yr4 Yr5 Analysis

International Centre for Allied Health Evidence
Our research path

1997 Setting the scene
1998 Understanding the problem
1999 Quantifying the problem
2000 Commercialisation
2001 Policy / curriculum implementation
2002 Primary school study
2003 Yr 1
2004 Yr 2
2005 Yr 3
2006 Yr 4
2007 Yr 5

Longitudinal adolescent study
Yr1 Yr2 Yr3 Yr4 Yr5

Analysis

Curriculum uptake

International Centre for Allied Health Evidence
Established a range of potential pain causes in secondary school
  - heavy school bags, poor furniture choices, multi-lesson timetabling

Identified lack of high school student ‘power’ in decision-making

Identified lack of ‘evidence’ on which decisions were based regarding adolescent spinal health
Cross-sectional study 1998

- We measured 1239 students aged 12-18 years in 12 high schools
  - Posture (with & without school bag)
  - Questionnaire
    - Spinal pain
    - Recreational activities
    - Use of school and home furniture
  - School bag weight & dimensions
  - Anthropometry
Cross-sectional findings

- 15% Year 8 students report spinal pain
  - Why?
- Girls’ spinal pain increases by approx 20% each year (from Year 8)
- Boys spinal pain increases by approx 10% each year (from Year 8)
  - Approx. twice as many girls as boys report regular spinal pain
- Anthropometric & environmental predictors of boys’ pain are more readily identifiable than for girls
Spinal pain is associated with

- ‘forward’ head on neck posture (boys & girls)
- long legs relative to trunk height (boys)
- backpack loads > 3.7 kgs (boys > girls)
- sport participation in early adolescence (boys & girls)
- being very tall or very short, and sitting > 4 hours/ day (boys and girls)
- carrying a backpack for more than one hour per day (cumulative) (boys & girls)
- imbalanced muscle control around the trunk (boys & girls)
Issues with inferring causality from cross-sectional studies

- Measures of exposure and disease at only one point in time
  - ‘Association’ can be determined, not ‘cause’
  - Key question: Are the year 12 students in a CSS equivalent to the Year 8 students in a CSS if they were to be measured again in 5 years’ time?
  - CSS provides a proxy longitudinal measure
    - measures different aged students at the one time point, not the same students at different time points
Posture change from wearing backpacks: Laboratory study 1999 & Physiopak development

Experiment to test the effect of bag weight and wearing position on standing posture
unloaded

Loaded with a pack

Difference in segmental response

Similarly for each segment

Summed segmental response
Findings

- Low weights consume least postural energy to maintain erect posture

- Least trunk muscle activity occurs when
  - loads are held close to the trunk
  - backpacks are positioned with the centre about waist level

- Greatest trunk muscle activity occurs when load is carried furtherest from the spine
No load

5% body weight
Progressive & linear deviation from postural ‘norm’

- 5% body weight
- 10% body weight
- 15% body weight
Longitudinal high school study

• Commenced 1999, completed 2003
  – 538 Yr 8 students invited to participate
    • 435 participated in 1999 (82.3% invited students)
      – 315 participated in 2000 (Yr 9) (72% 1999 cohort)
      – 298 participated in 2001 (Yr 10) (68% 1999 cohort)
      – 242 participating in 2002 (Yr 11) (46% 1999 cohort)
      – 174 participating in 2003 (Yr 12) (40% 1999 cohort)
• Anthropometry
• Muscle performance
• Motor control / planning
• Standing posture
• School bag weight & dimensions
• Questionnaire about the student
Comparing cross-sectional and longitudinal data sets
Validation of other work

• Our longitudinal data validates our 1998 cross-sectional data
• Girls’ growth spurt is well underway by entry into high school (12-13 years) and slows significantly by age 14-15 years
• Boys’ growth spurt commences at 13-14 years and continues linearly …….
Neck pain

- CSS girls
- CSS boys
- Lond stud girls
- Lond stud boys

Year 8 Year 9 Year 10 Year 11 Year 12

Unisa

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Longitudinal study findings
Mean raw backpack weight carried

- 1999
- 2000
- 2001
- 2002
- 2003

**Boys mean**

**Girls mean**

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International Centre for
Allied Health Evidence
Mean percent body weight carried

- **1999**
- **2000**
- **2001**
- **2002**
- **2003**

**Boys mean**

**Girls mean**
Increasing reports of low back pain are associated with heavier backpack weights.

Headache in Year 8 leads to reports of neck and upper back pain in older grades.

- Some association with heavy backpack weights in Year 8 and 9.
  - Cumulative effect???
Primary school data

- We know now that there are significant reports of spinal pain in Yr 8
  - When does spinal pain first become prevalent?
  - Are the factors associated with adolescent spinal pain consistent in pre-adolescence?
- Is there an issue with heavy load carriage in primary school?
- How early does girls’ growth spurt start?
Collecting longitudinal data from primary schools
Student numbers

- 2001 336 students  
  – R to Yr7
- 2002 266 students  
  – Yr1 to Yr7
- 2003 187 students  
  – Yr2 to Yr7
- 2004 211 students  
  – Yr3 to Yr7
- 2005 120 students  
  – Y4 to Yr 7
- 2006 81 students  
  – Y5 to Y7
- 2007 ??70 students  
  – Y6 to Yr 7

Representative sample of ‘usual’ children in terms of socioeconomic status, ethnicity
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Girls’ growth spurt

- Starts variably from age 10 years
- Well established before entry into high school for approx 65% girls in sample
  - precedes menarche
  - puts girls most at risk for extrinsic influences on spine
    - heavy load carriage
    - poor posture
    - poor environment (furniture etc)
Spinal pain

• Low prevalence
  – <1% in Grades R-3
  – 2% in Grades 4-5
  – 3% in Grades 5-6
  – 5-7% in Grade 7
  – 15%+ in Grade 8 ----

• Primary school pain
  – Not related to school bag weight
  – Not related to posture
School bags

- Most carried by parents
- Most too big for child
  - Volume
  - Length
  - Width
    - Bought to last
- Few storage problems
- Bags not carried between classes
- No instructions about packing or carrying bags
Curriculum & policy

• Systems approach to influence spinal health in secondary schools
  – Policy document endorsed by DECS, released in 2002, currently under revision
  – Curriculum material for Year 8 core subjects, currently being approved by DECS
  – Documents available free of charge on www.unisa.edu.au/cahe
Where to from here?

- How to bridge the gap between primary and secondary school environments
- How to influence high school ‘systems’ to
  - Reduce educational loads
    - Timetabling
    - Text book choice
    - Use of intra/internet
  - Provide a choice of well-designed ergonomic furniture in classrooms & labs
  - Support use of ergonomically designed backpacks for body type
  - Support student and parent voice in school ergonomics decisions
  - Consider students as ‘workers’ in the school environment and protected by appropriate legislation