University of South Australia

Child and Adolescent Spinal Health

Professor Karen Grimmer

Representing
International Centre for Allied Health Evidence Spinal Health Team
University of South Australia

Acknowledging the financial support of the Financial Markets Foundation for children

iCAHE
International Centre for Allied Health Evidence

University of South Australia

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**

University of South Australia

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

University of South Australia

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?

University of South Australia

International debate

- 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

University of South Australia

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

University of South Australia

Our research path

1997

Setting the scene

focus groups, surveys, lab-based pilot studies

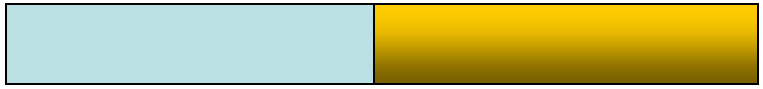
International Centre for Allied Health Evidence

University of South Australia

Our research path

1997

1998



Setting the scene

Quantifying the problem:

Population-based research

N=1269 students in 12 Adelaide high schools

International Centre for Allied Health Evidence

University of South Australia

Our research path

1997 1998 1999

Setting the scene

Quantifying the problem

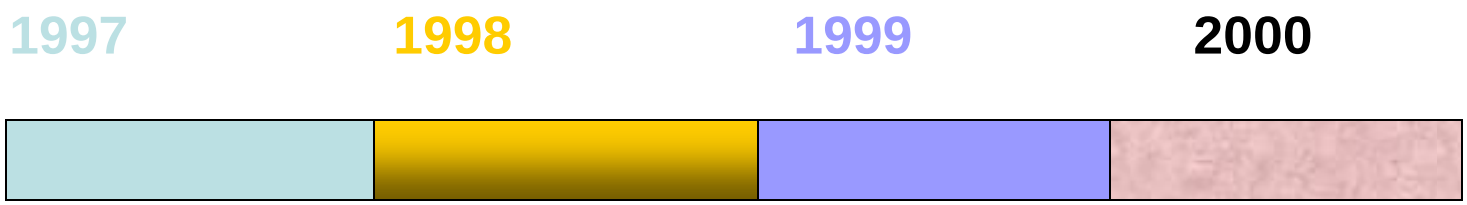
Understanding the problem

1. Laboratory study of critical loads & carrying positions

2. Longitudinal adolescent study Yr1

University of South Australia

Our research path



Setting the scene

Quantifying the problem

Understanding the problem

Commercialisation

Policy / curriculum development

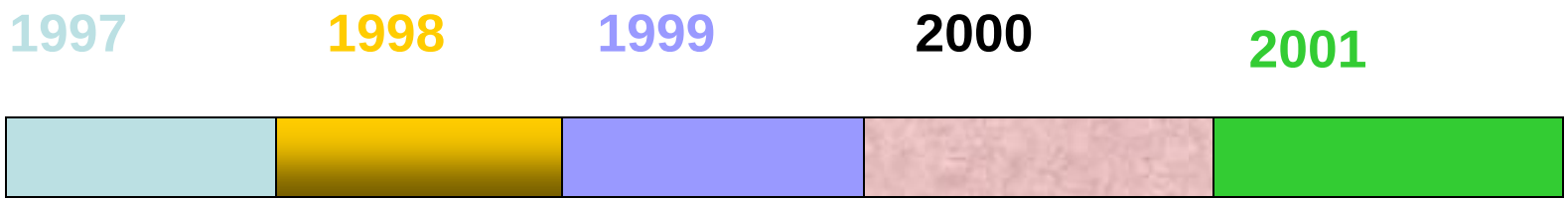
Longitudinal adolescent study →

Yr1 Yr2

International Centre for
Allied Health Evidence

University of South Australia

Our research path



Setting the scene

Quantifying the problem

Understanding the problem

Primary school study Yr 1

Commercialisation

Policy / curriculum refinement →

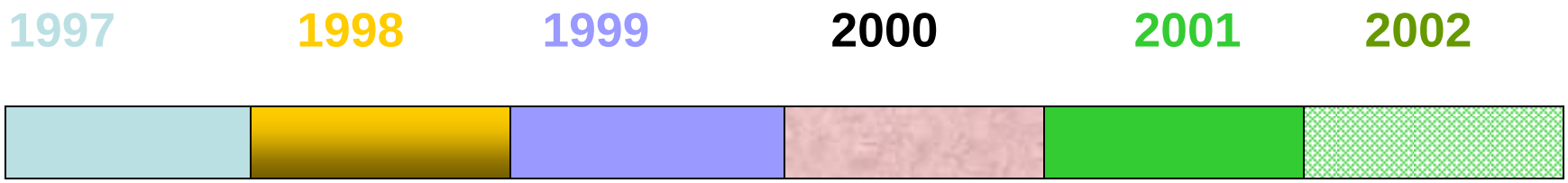
Longitudinal adolescent study →

Yr1 Yr2 Yr3

International Centre for Allied Health Evidence

University of South Australia

Our research path



Setting the scene

Quantifying the problem

Understanding the problem

Primary school study

Yr 1

Yr 2

Commercialisation

Policy / curriculum testing

Longitudinal adolescent study

Yr1

Yr2

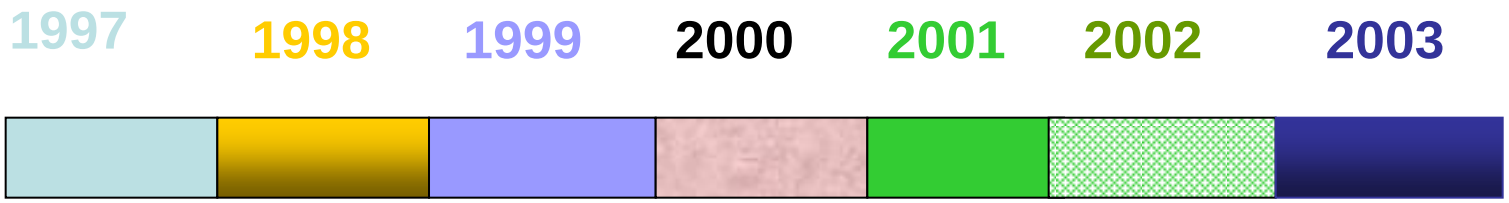
Yr3

Yr4

International Centre for Allied Health Evidence

University of South Australia

Our research path



Setting the scene

Understanding the problem

Primary school study →

Yr 1 Yr 2 Yr 3

Quantifying the problem

Commercialisation

Policy / curriculum implementation →

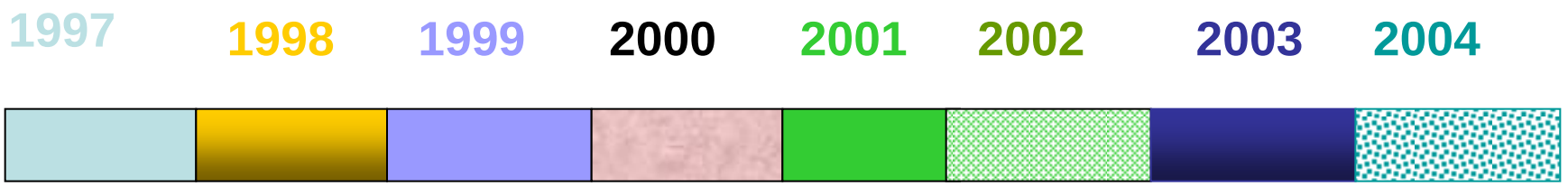
Longitudinal adolescent study

Yr1 Yr2 Yr3 Yr4 Yr5 →

International Centre for Allied Health Evidence

University of South Australia

Our research path



Setting the scene

Understanding the problem

Primary school study

Yr 1 Yr 2 Yr 3 Yr 4

Quantifying the problem

Commercialisation

Policy / curriculum implementation

Curriculum uptake

Longitudinal adolescent study

Yr1 Yr2 Yr3 Yr4 Yr5

Analysis

International Centre for Allied Health Evidence

University of South Australia

Our research path

Setting the scene

Quantifying the problem

Understanding the problem

Primary school study

Yr 1 Yr 2 Yr 3 Yr 4 Yr5

Commercialisation

Policy / curriculum implementation

Curriculum uptake

Longitudinal adolescent study

Yr1 Yr2 Yr3 Yr4 Yr5 Analysis

International Centre for Allied Health Evidence

University of South Australia

Our research path

1997 1998 1999 2000 2001 2002 2003 2004 2005 2006

Setting the scene

Quantifying the problem

Understanding the problem

Primary school study →

Yr 1 Yr 2 Yr 3 Yr 4 Yr5 Y6

Commercialisation

Policy / curriculum implementation

→ Curriculum uptake

Longitudinal adolescent study

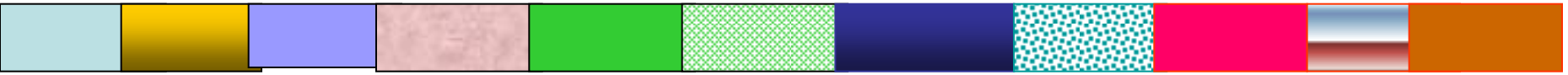
Yr1 Yr2 Yr3 Yr4 Yr5 Analysis →

International Centre for Allied Health Evidence

University of South Australia

Our research path

1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007



Setting the scene

Understanding the problem

Primary school study →

Yr 1 Yr 2 Yr 3 Yr 4 Yr5 Y6 Y7

Quantifying the problem

Commercialisation

Policy / curriculum implementation

→ Curriculum uptake

Longitudinal adolescent study

Yr1 Yr2 Yr3 Yr4 Yr5

Analysis →

International Centre for Allied Health Evidence

University of South Australia

Qualitative study 1997

- 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

University of South Australia

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

University of South Australia

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

University of South Australia

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)

University of South Australia

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

University of South Australia

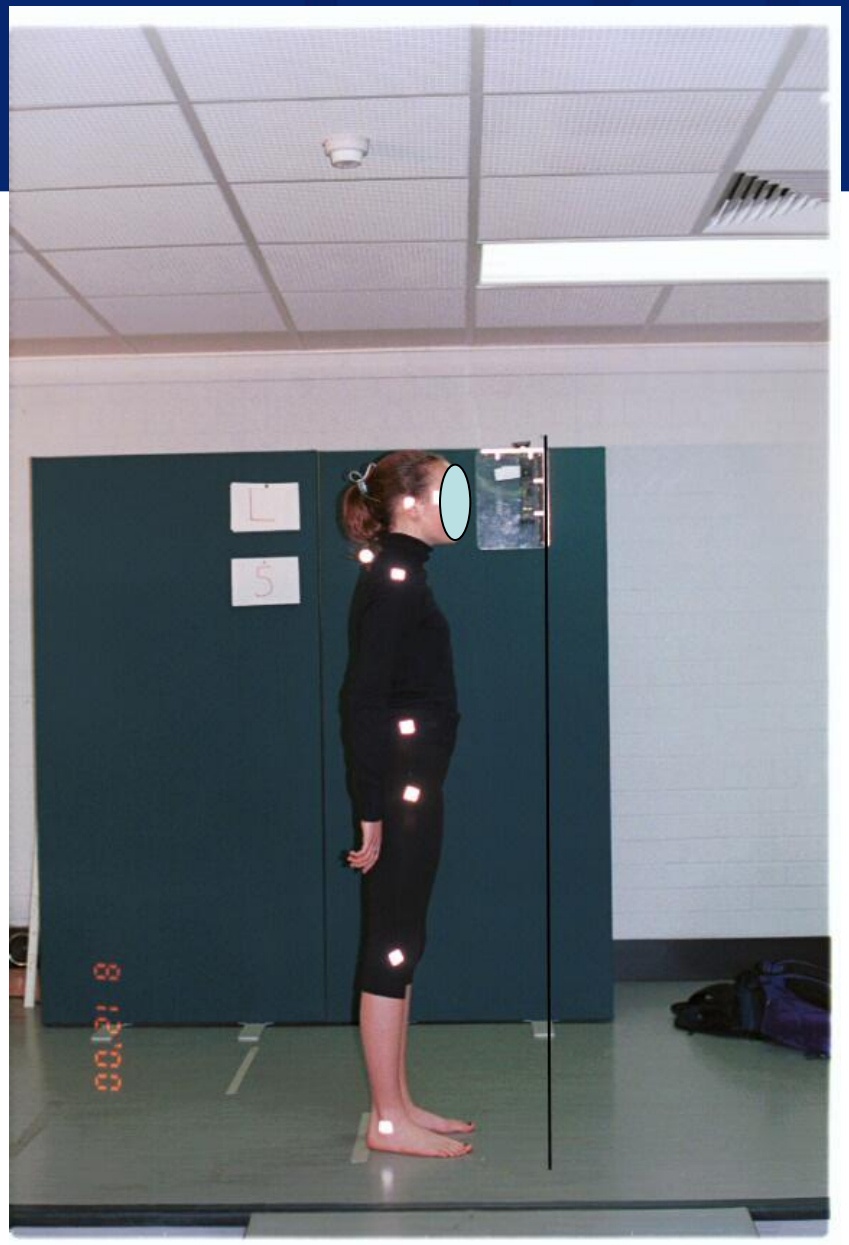
Posture change from wearing backpacks: Laboratory study 1999 & Physiopak development

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

iCAHE

International Centre for Allied Health Evidence

University of
South Australia

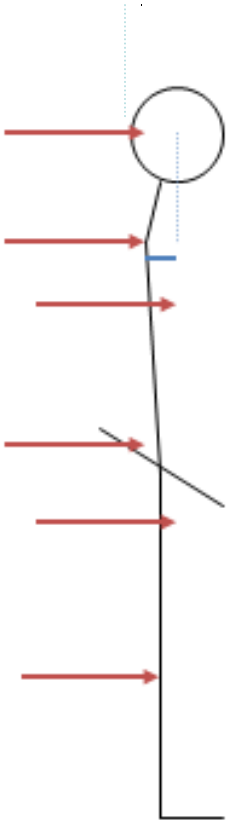


International Centre for
Allied Health Evidence

University of
South Australia

International Centre for
Allied Health Evidence

unloaded



Loaded with a pack

Difference in segmental response

Similarly for each segment

Summed segmental response

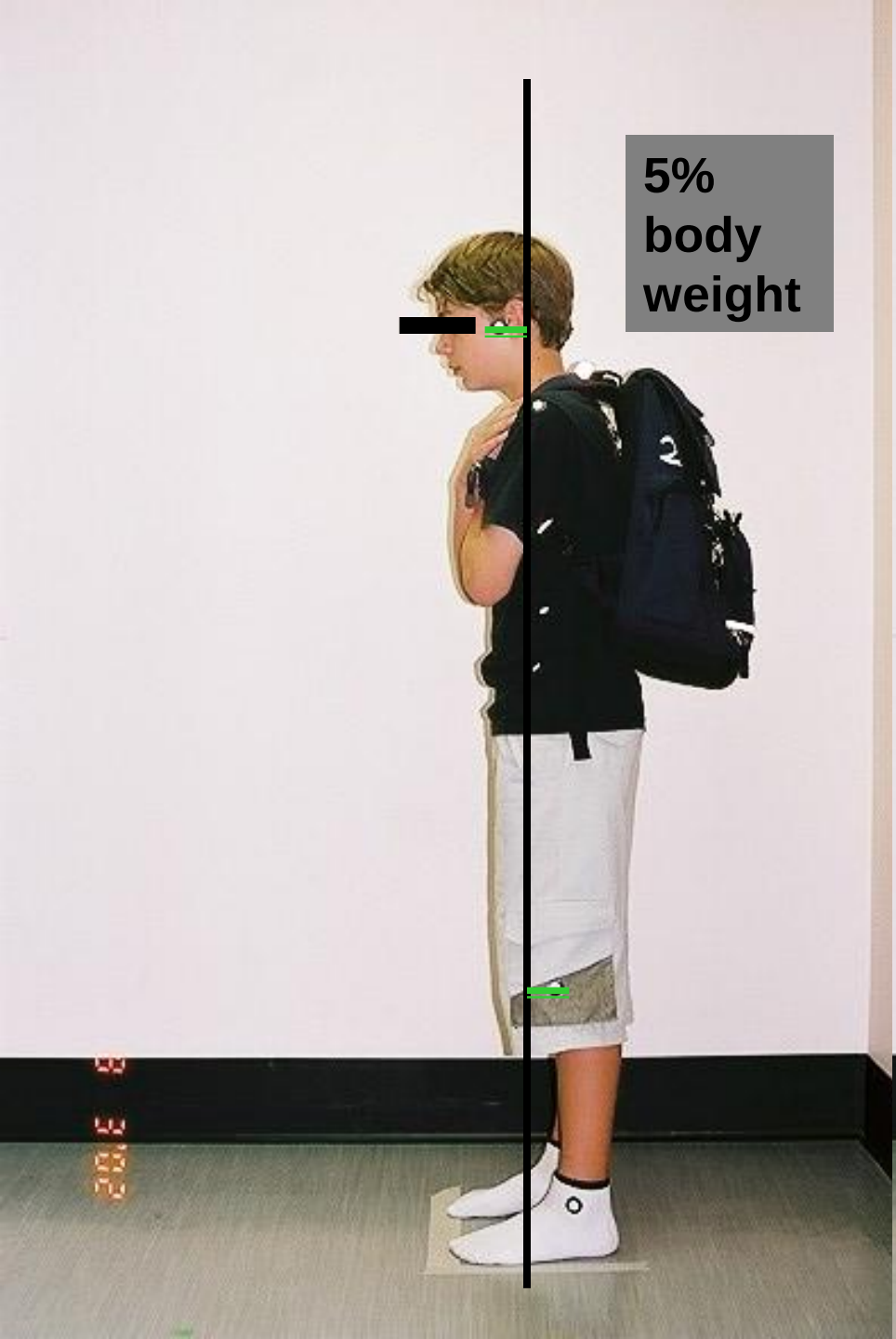
University of South Australia

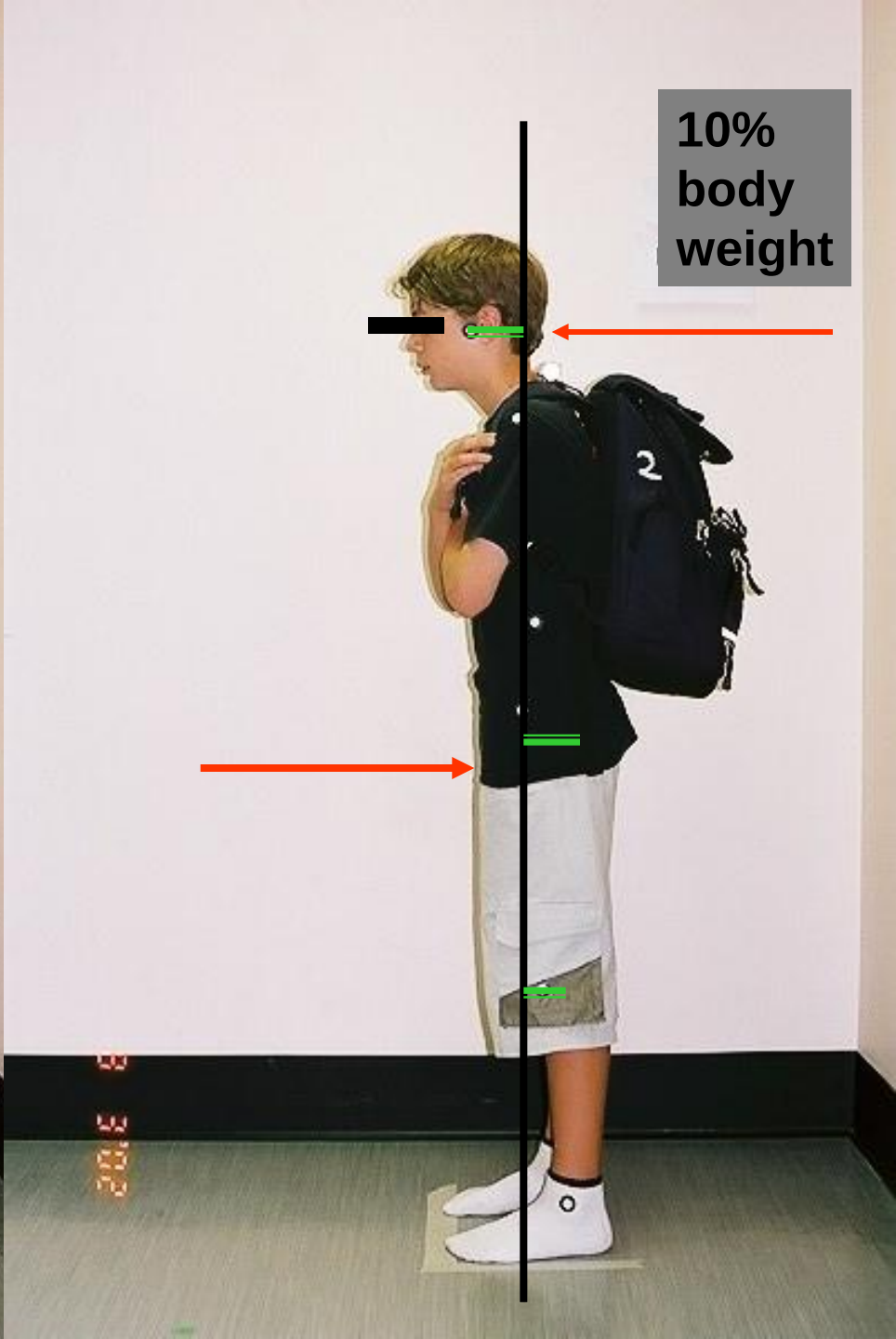
Findings

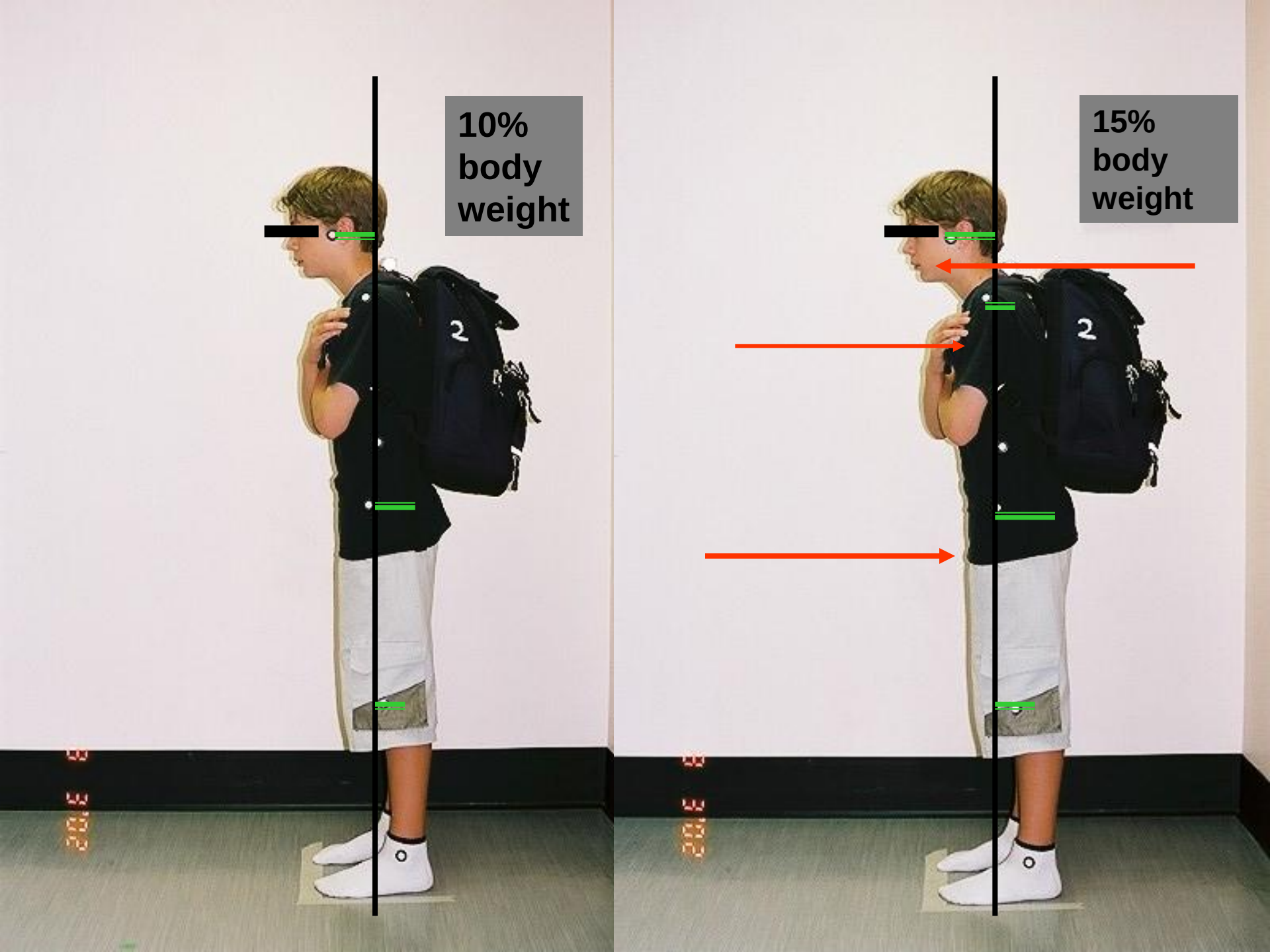
- Low weights consume least postural energy to maintain erect posture
- Least trunk muscle activity occurs when
  - loads are held close to the trunk
  - backpacks are positioned with the centre about waist level
- Greatest trunk muscle activity occurs when load is carried furtherest from the spine


No load


5% body weight

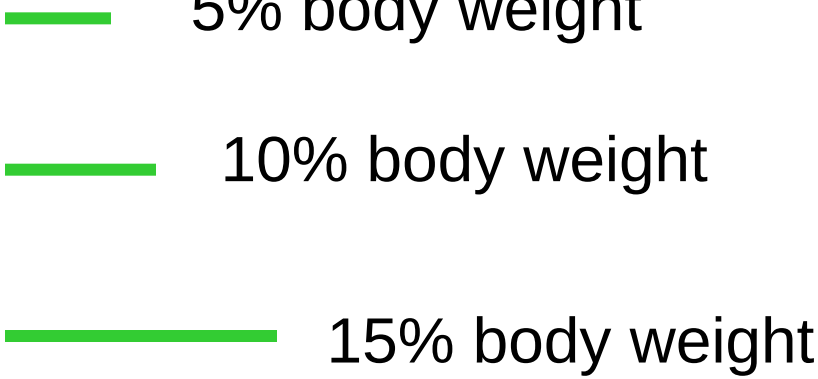

5%
body
weight


10%
body
weight


10%
body
weight
15%
body
weight

University of South Australia

Progressive & linear deviation from postural 'norm'



University of South Australia

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)

University of South Australia

Measures

- Anthropometry
- Muscle performance
- Motor control / planning
- Standing posture
- School bag weight & dimensions
- Questionnaire about the student

University of South Australia

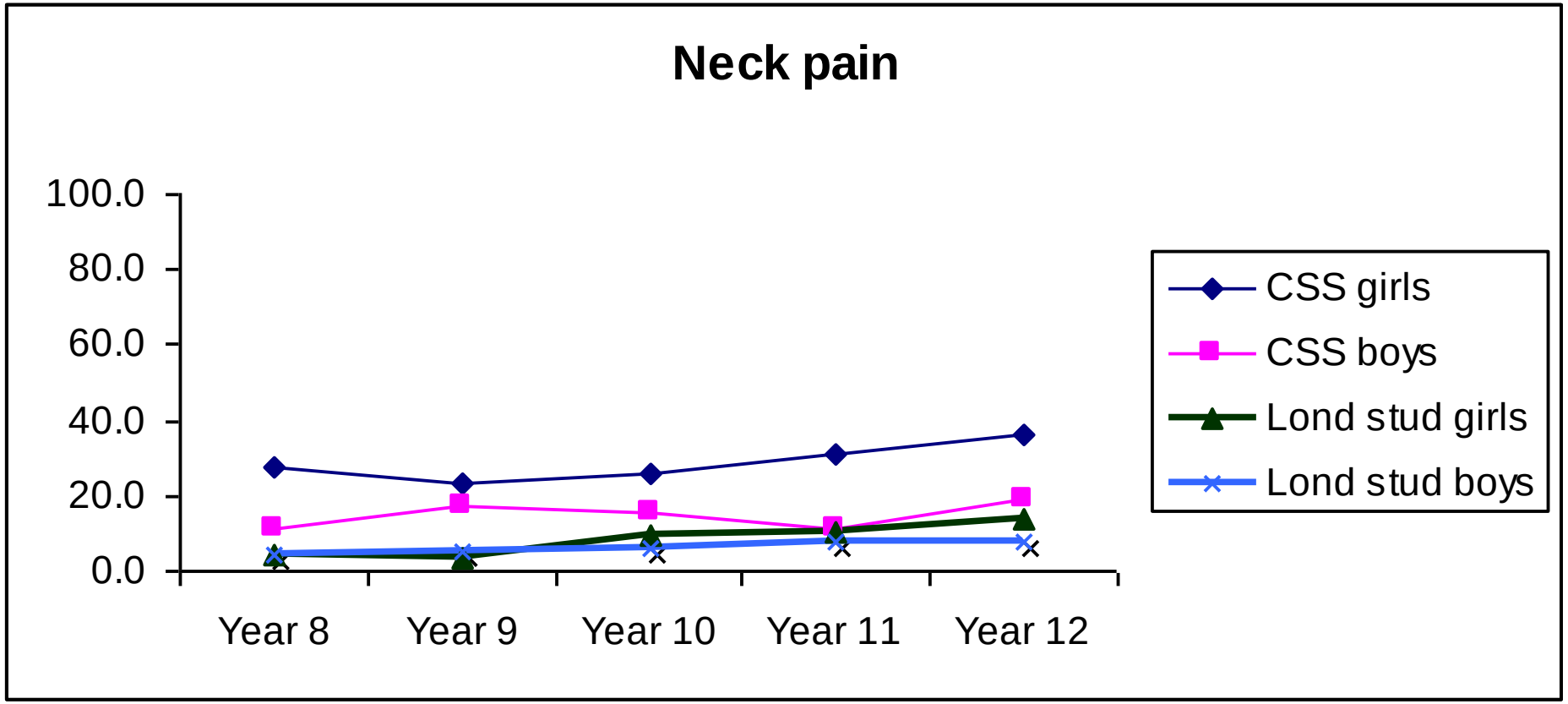
Comparing cross-sectional and longitudinal data sets

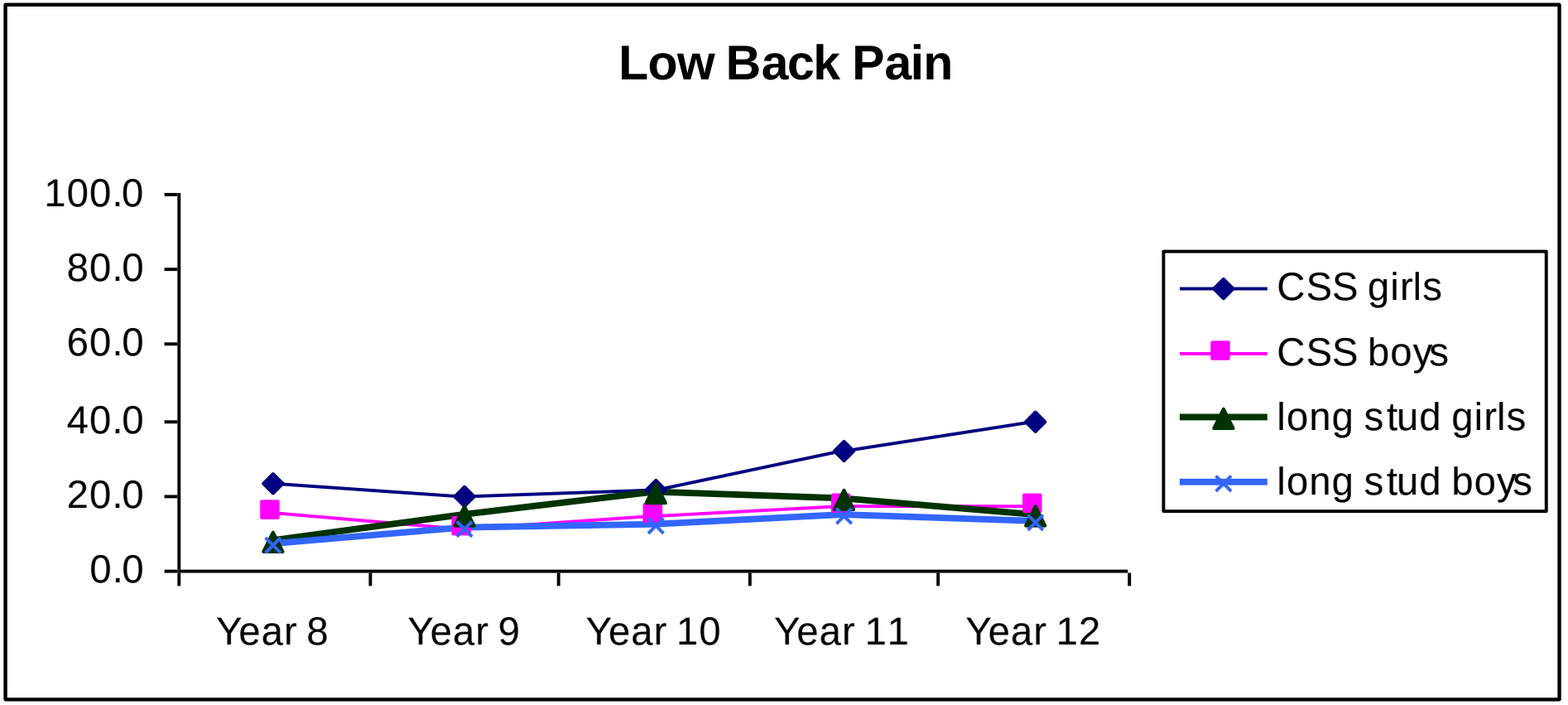
iCAHE
International Centre for Allied Health Evidence

University of South Australia

Validation of other work

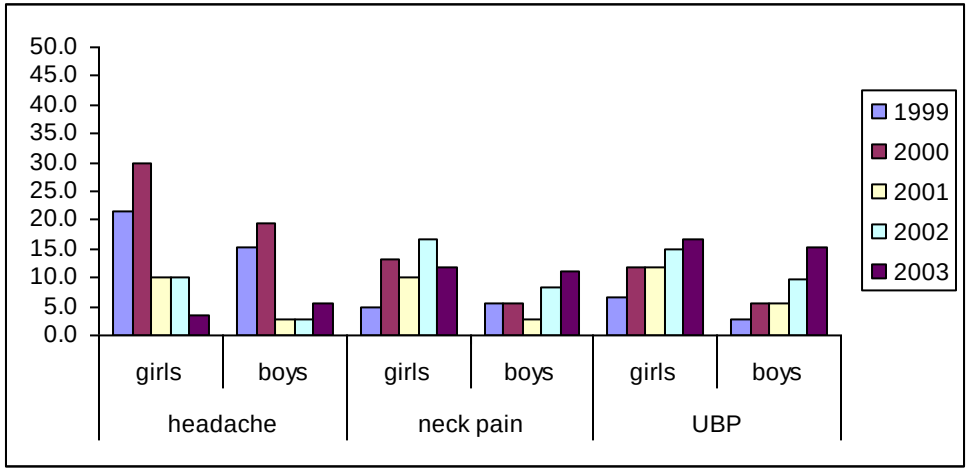
- Our longitudinal data validates our 1998 cross-sectional data
- Girls' growth spurt is well underway by entry into high school (12-13 years) and slows significantly by age 14-15 years
- Boys' growth spurt commences at 13-14 years and continues linearly …….

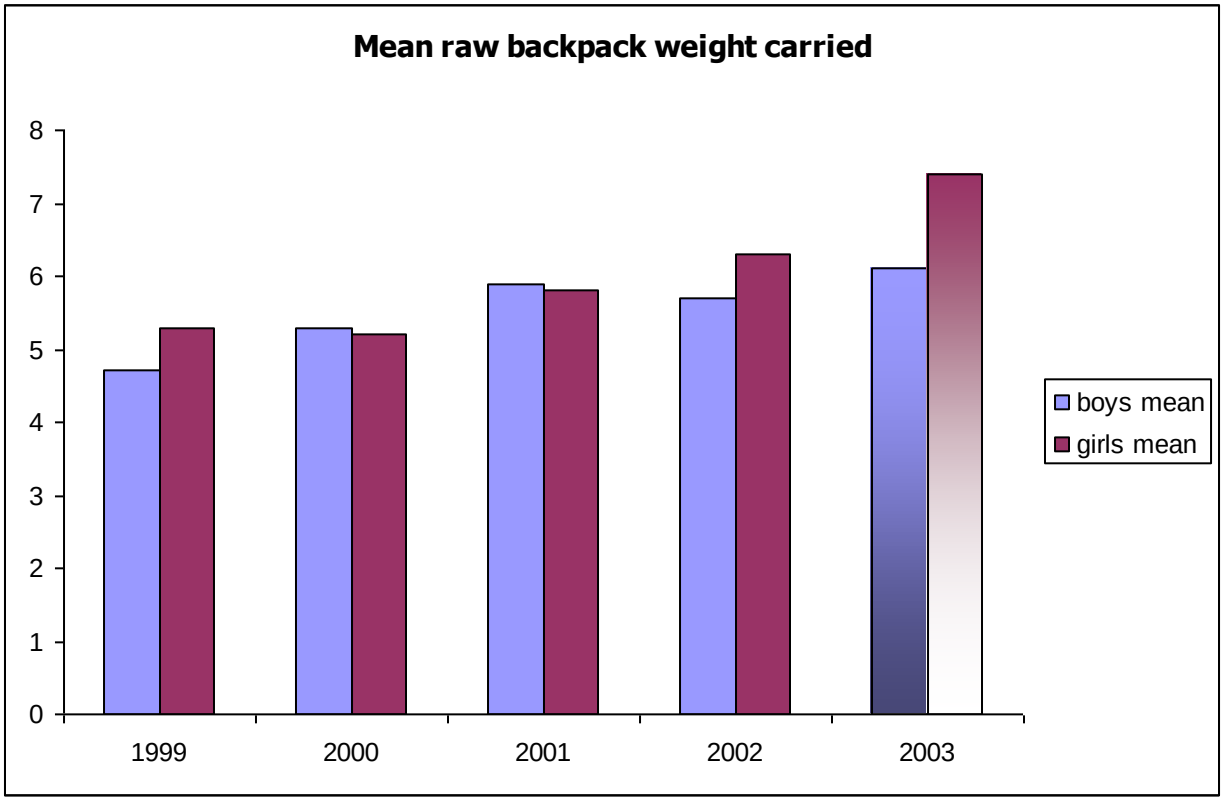

Neck pain
100.0
80.0
60.0
40.0
20.0
0.0
Year 8
Year 9
Year 10
Year 11
Year 12
CSS girls
CSS boys
Lond stud girls
Lond stud boys

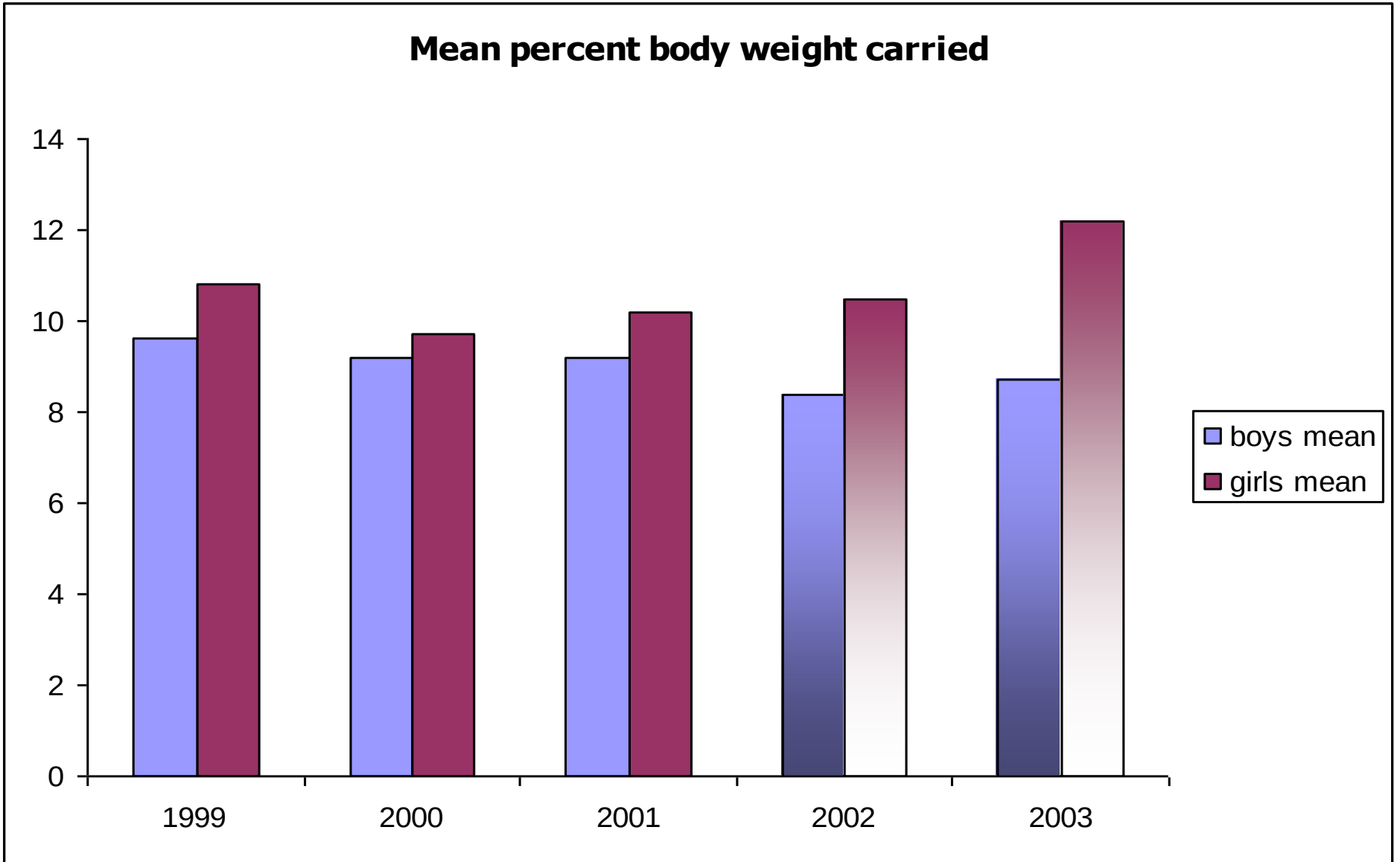

Low Back Pain
100.0
80.0
60.0
40.0
20.0
0.0
Year 8
Year 9
Year 10
Year 11
Year 12
CSS girls
CSS boys
long stud girls
long stud boys

University of South Australia

Longitudinal study findings




Mean raw backpack weight carried
8
7
6
5
4
3
2
1
0
1999
2000
2001
2002
2003
boys mean
girls mean


Mean percent body weight carried
14
12
10
8
6
4
2
0
1999
2000
2001
2002
2003
boys mean
girls mean

University of South Australia

Bag weight and spinal pain

- 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???

University of South Australia

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?

University of South Australia

Collecting longitudinal data from primary schools

iCAHE
International Centre for Allied Health Evidence

University of South Australia

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

University of South Australia

School bag weight (kgs)

Grade	Mean	SD	Min	Max
R	2.6	0.8	1.3	5.5
1	2.3	0.7	0.6	4.4
2	2.4	1.1	0.7	6.5
3	2.6	0.9	0.9	6.2
4	2.3	1.4	1.3	5.6
5	2.6	1.7	1.3	12.3
6	2.6	0.9	0.9	6.4
7	2.4	1.2	0.7	7.1
8	5.7	2.8	1.2	10.5
9	5.5	1.7	0.6	12.5
10	5.4	2.2	0.7	15.6

University of South Australia

Percent body weight carried

Grade	Mean	SD	Min	Max
R	8.7	2.7	3.5	14.2
1	7.5	2.7	2.7	14.3
2	7.9	2.9	3.2	16.6
3	8.3	3.5	3.1	22.7
4	7.3	4.2	3.7	16.2
5	8.4	6.9	3.8	52.2
6	7.5	2.9	2.6	15.2
7	7.1	3.7	2.3	17.3
8	10.7	3.7	3.5	18.2
9	9.5	2.7	2.2	16.3
10	9.9	2.2	3.2	16.9

University of South Australia

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)

University of South Australia

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

University of South Australia

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

University of South Australia

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*

University of South Australia

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