Reviewer's report

Title: Adolescent postural response to backpack carrying conditions: a randomised controlled experimental study

Authors:

Karen Grimmer (karen.grimmer@unisa.edu.au)
Brenton Dansie (brenton.dansie@unisa.edu.au)
Steve Milanese (steve.milanese@unisa.edu.au)
Ubon Pirunsan (piruy001@yahoo.com)
Patricia Trott (pat.trott@unisa.edu.au)

Version: 1 Date: 27 Nov 2001

Reviewer: Dr David Pascoe

Level of interest: A paper of considerable general medical or scientific interest

Advice on publication: Unable to decide on acceptance or rejection until the authors have responded to the compulsory revisions

JOURNAL ARTICLE REVIEW

Title: Adolescent postural response to backpack carrying conditions: a randomized controlled experimental study

Level of Interest:
The topic of this paper is important to both medical and scientific interests.

Advise on Publication:
The paper has major and minor concerns that make this paper unacceptable for publication without revisions. As a reviewer, I would request a review of these revisions prior to publication.

Major Comments/Concerns:

1. This paper is strongly based on the assumption that significant deviations in postural positioning that occur between unloaded and loaded backpack carrying conditions are related to "spinal pain" and "poor posture". This approach fails to recognize the importance of postural shifts under loading conditions to compensate for the increase in weight and shift in the centre of gravity. The supportive literature is misrepresented as it describes significant postural deviations without loading and can only cautiously be applied to load carrying research.

2. Load recommendations and the interpretation of this research data extends beyond the findings of this investigation. No research is presented that suggests a "critical body position" for loaded conditions that may be physiologically or medically disadvantageous. The unloaded posture may be inappropriate, dangerous, and injurious to maintain when the subject is carrying a backpack load. Without these
deviations in posture, the students would lose their body alignment in relationship to the centre of gravity and may be placing greater stress/strain on the anterior-posterior portions of the musculoskeletal system. Further concern arises when the authors make comparisons from unloaded to loaded conditions, despite significant differences in their unloaded baseline posture measurements.

3. The researcher's focus of this paper attempts to describe backpack load carrying conditions, yet the experimental design only investigated subjects who were standing still, no movement. Load carrying implies a dynamic response, the "carrying" response as influence by movement. Dynamic postural changes will be different than the posture maintained while standing still (static). The authors do not make this distinction. In the background portion of the paper (Page 4) they discuss their previous investigation of 1269 subjects by reporting that students carried their backpacks over both shoulders, if carrying over any distance. This paper should be amended from "backpack carrying" to "backpack loading" conditions and clarify to the readers that this data represents static standing conditions.

Minor Comments/Concerns

1. Amend title from "carrying" to "loading conditions". You may need to incorporate some wording to describe "standing". You may want to delete " a randomized controlled experimental study". If it is published in a scientific journal, these are expectations of a well-designed study. Change the running title to be consistent with the intent of the project.

Abstract:

1. The connection between posture and pain are made during non-loaded conditions. The reader needs to understand the postural alignment as it relates to backpack loading.

2. The use of the word "spinal pain" suggests only bone related problems and does not account for musculoskeletal and soft tissue related problems.

3. Authors state "minimize postural response from unloaded". There is considerable backpack research and literature to support that these changes are appropriate under load bearing conditions.

4. The term "typical" when applied to the various backpack options available to school aged students is confusing. Define what is considered typical.

5. The experimental design is stated as double blind. Is it truly blinded to either the subjects or investigator? The subject knows the positioning and can feel variances in load, while the investigator observes both positioning and sag of backpack (reflective of load). Later (page 9) this paper suggests that this study is a triple blind. Again, the photographer and digitizer have some observational clues that do not keep them blinded to the experimental treatments.

6. The reader should be instructed that the postures represent those indicative of standing body alignments.

7. Analysis of variance should be stated as repeated measures. If the baseline values were significantly different, shouldn't a MANOVA be used for analysis?

8. "Subjects of all ages and genders responded similarly." This broad statement "responded similarly" suggests that there were no significant differences between subjects for all experimental study variables. More specifically, the authors should state that neither age nor gender was a significant factor when comparing backpack loads or positions.
9. "Backpack position and weight both significantly influenced posture." How? (all positions, all weights, weight by position interaction, greater or lesser forward/backward lean, etc.). Keep results specific to the findings that accurately describe your results (e.g....T7 results as presented).

10. Concluding remarks are not supported by this research data. Authors never demonstrate the importance of minimizing forward lean under loaded conditions. Lesser loads may be less of a stressor on the human posture, but this research provides no evidence to suggest an appropriate backpack load. Suggesting a "minimized" load does not provide any guidance to students as to the backpack load carriage.

11. The authors suggest that the backpack should be positioned with "its centre at waist level". Is this the centre of the backpack or centre of mass of the pack? How does one position the pack in regards to the curvature of the small of the back?

Background

Page 4, Lines 4-5 Does spinal response refer to the individual variations of vertebrae alignment (curvature, scoliosis, lordosis, kyphosis, etc.)? Does "carrying times" refer to the duration that the pack is carried? Does a distinction need to be made between carried and standing load carriage as the influence of the backpack may be dramatically different?

Page 4, Lines 14-15 Do these references specifically associate postural deviations related to spinal pain under load bearing conditions?

Page 4, lines 14-18 The authors discuss load, centre of gravity, and proximity to spine as important factors for efficient load carriage. These are important factors for all load carrying individuals. No evidence is provided to suggest that these factors should be different when applying loads to adolescent and mature individuals. However, factors related to musculoskeletal development, muscular strength, relative weight bearing loads, or differences in gender have not been investigated in the adolescent population pertaining to load carriage and may be different in these two populations.

Page 4, line 23 How should the reader interpret "if carrying over any distance"? In common speech, one might say that if I have to travel any distance, I will drive rather than walk. This wording suggests an extended locomotive effort. In contrast, this statement can also suggest that any movement (any distance).

Page 4, line 24 Typical pack needs to be defined better in light of the variations that are available in a standard or typical pack. What does box mean? Padded straps? Waist belt? Internal or external frame? Capacity of pack? Compressions traps?

Page 5, Line 5 Did the analysis for this study investigate "repeated measures" or a within/between subject design? If a subject had poor posture to begin with, were they excluded or how was this handled in the analysis and interpretation of the data?

Page 5, Line 5, 8 Can one describe "poor" posture as body alignment that is a "significant change from
unloaded"? This is a normal compensation for the load and is reported often in backpack literature. Why would you want to minimize postural changes from unloaded? Is there a critical postural lean beyond which it is detrimental to the subject?

Page 6, Line 14 Student exclusion criteria (as defined) would not eliminate subjects with scoliosis?

Page 6, Line 20 "our paper is the only report in adolescents" Head angles have been reported in the literature (See Pascoe et al; Ergonomics 40 (6):631-641, June 1997) for both static and dynamic using standard video digitizing methodology.

Page 7, Line 2 Parentheses are not correct. Remove parentheses before 25 a colon, and move to end of sentence, place a colon prior to 25. The current format could suggest only 50 students from all five schools.

Page 7, Paragraph 2 A picture of the pack positions may be helpful.

Page 7, Line 15 Describe the typical pack used in this investigation.

Page 9, Line 7 Triple blind? Is it really a blinded study? Abstract suggests a double blind study.

Page 9, Line 15 A mention is made of testing subject's fatigue. There were no procedures or measures of fatigue.

Results

Page 10, Paragraph 1 98 out of 250 refused to participate. This represents 39% of your recruitment population. Most of the individuals that refused to participate came from the 9 and 10 year. How does this affect your randomized sampling?

Page 10, Paragraph 3 You report significant differences between the baseline posture measurements. What represents a true baseline measure? What causes the variances? If this variance is reflective of individual differences (gender, height, size, etc), will these contributing factors also influence the book load carriage analysis? With baseline postural differences in the unloaded condition, should a MANOVA be used to interpret the change when wearing a load in different back positions? If the differences are reflective of the error of the measurement, then you should not interpret values within this error term as being significant

Page 10, Line 25 You should not report "marginal effect" at p=0.06. Researchers sometimes report a trend when the statistical analysis approaches significance. However, some suggest this inappropriate while others contend it is reasonable if you did not have the effect size in your analysis. In your case, you have set the "p" value at 0.05 and have run a power analysis. You needed 225 subjects and used 250. Therefore, true differences between variables would have met your critical value criteria.

Discussion:

Page 12, Paragraph 1 This is not the first reporting nor first scientific evaluation of adolescent posture. A thorough literature review is required prior to making this statement. The authors also need to state that this data ONLY presents static, standing postural changes.

Page 12, Paragraph 2 You had 100% participation is year 8 and 49.5% in year 9. It would be difficult to
suggest that "growing bodies" accounted for this large change in participation over the one-year span. Years 10, 11, and 12 are fairly consistent.

Page 12, Paragraph 3 The lack of year and gender influences do not provide evidence of an adequately controlled study. It may simply suggest no differences in these test variables within this sample. Again, a bias in the sampling (39% or better than one of three) was evident in all groups and only 49.5 (less than one of every two) in the 9 year participated. If this occurred as a result of body image, one might suggest that those not participating may represent a unique group that would have provided age and/or gender differences. In contrast, if no year and gender differences occurred, then why would one need to investigate adolescent versus adult differences.

Page 12, Paragraph 3 Your data does not support nor allow you to make loading recommendations.

Page 13, Paragraph 2 The authors suggest that an "extrapolation of the linear responses" suggest a different horizontal position for loaded conditions. An extrapolation is not necessary for this observation and this response can be documented in numerous literature articles related to backpack loads.

Page 13, Paragraph 2 The authors discuss linear responses but also suggest that it is implausible to consider this relationship at all anatomical points. Does this suggest a plateau or curvilinear response? Do they have evidence of the response relationship? A change in the response relationship MAY suggest a critical load or posture.

Page 13, Paragraph Your data neither supports or questions the "rule of thumb" for load carriage.

Page 14, Paragraph 2 Significant differences in unloaded baseline measures need to be understood prior to their use as a standard for loaded comparison. You suggest that it is unlikely that is technical problem, then proceed to offer several procedural (technical) problems. These technical problems include: 1) a lack of familiarization with test protocol. Was a reliability test performed on your procedures? 2.) Load and unloading procedures should be checked for test and re-test reliability. 3.)Testing anxiety would have strong physiological influences on both baseline and experimental conditions. How did researchers interpret test anxiety in the unloaded versus loaded conditions? 4) Why was the test environment "uncertain". Was there an ordered effect to your testing procedures?

Page 15, Paragraph 2 If backpacks provide a variety of " sophisticated load carrying systems and/or load reduction features, can you make any recommendations or is your data specific to your "typical" defined pack?

Conclusions: What conclusions does your data support? What guidelines? How is efficiency defined or measured? How can a non-scientist locate T7? How should pack be worn (strap adjustment, curvature of back, type of pack)? How is centre of pack defined? Do pack recommendations differ between various pack designs and features?

References
The www.unisa.edu.au/alliedhealth/manuals does not take the reader to the referenced material. The material is located at www.unisa.edu.au/alliedhealth/report1998.html. One must purchase these reports from your web site. This should be stated to the readers as commercially available source.

Reference 15: This article is in volume 24 not 21.
This article does not reference many of the journal articles related to children carrying bookbag backpacks.

Several authors have argued that children carrying loads cannot be accurately represented by the literature available on adult load carriage. However, this study did not find any differences that could be related to age or gender, thus ALL load carrying articles should be applied to their interpretations. This being the case, the article does not provide the current literature available on posture and loads.

**Competing interests:**

None declared.