Author's response to reviews

Title: Domestic water carrying and its implications for health: a review and mixed methods pilot study in Limpopo Province, South Africa

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Version: 3 Date: 16 August 2010

Author's response to reviews: see over
Dear Sir,

Please find below our further responses to referees comments, in blue. As you say many of the comments from Moe were made previously by the other two referees and have already been addressed in our previous revision.

Reviewer's report
Title: Domestic water carrying and its implications for health: a review and mixed methods pilot study in Limpopo Province, South Africa
Version: 2 Date: 9 July 2010
Reviewer: Christine Moe

Reviewer's report:
General Comments: Although it is widely recognized that manual water collection and transport imposes a physical burden, it is difficult to find systematic studies that attempt to describe and quantify this burden. This study is a useful example of this type of work and appears to be novel. The implications of domestic water carrying are usually considered in terms of time spent by women and children for collecting water and absenteeism from school that results from water collection responsibilities. However, this study attempts to examine two different aspect of water carriage – perceived exertion and self-reported pain. Data collection methods included semi-structured interviews, video recordings of water collection and carrying by individual study subjects, GPS measurements of the distance between the water source and the home, the height and weight measurements of the study subjects and the weight of the filled water container.

Overall, this is an interesting and generally well-written paper, but it leaves the reviewer with several questions:
Major Compulsory Revisions/Comments:
1) Are the methods sound?
   • Perceived exertion appears to be measured by a standard method but this should be explained more.

Dealt with in response to point 5 of Dave Hemson initial comments: The following text has been added to explain RPE and a reference to further information on the method provided:

‘The modified Borg scale (RPE) [49] was used to gain insight into the intensity of work performed by study participants. The modified Borg scale is a twelve grade category rating scale with ratio properties, which combines verbal and numerical descriptors that can be used to measure a person’s rating of their perceived exertion during a specific task.[49]. A numeric score of 0 equates to a verbal descriptor of ‘nothing at all’, 10 to ‘very, very strong’ and 12 to ‘maximal’. It has been validated for used in diverse populations and used with Xhosa speaking women carrying containers of water in a laboratory setting [43]. In this study participants were presented with a printed Venda version of the scale which was verbally explained to them by the RA. They were asked to estimate the sensation of the effort required for carrying water immediately on completion of a water carrying trip and to point to or choose the verbal descriptor or number most closely matching their sensation of effort.’
• The calculation of Newtons of force for head loading needs to be explained.
Deal with in response to point 3 of Dave Hemson: The following has been added to the
text under data analysis;
‘Force in Newtons (N) is equal to mass (kg) multiplied by gravity (9.8m/s^2) such that 1kg
is approximately equal to 9.81N [11]. The force generated by an object of a known
weight carried on the head can therefore be calculated using a simple biomechanical
model as described by Oatis [50], if the container is assumed to be in static equilibrium.
The forces generated during head loading are simplified in this study and assumed to be
the force generated purely by the weight of the water and container carried, directed
vertically downward onto the head and spine, with no moment arm.’

• The description of the analyses of the video recordings does not explain if the
observer was trained in evaluating muscular-skeletal movements, body postures, etc.
The following has been added to the text:
‘The video material was analysed by a musculoskeletal physiotherapist (JG) with 21
years of experience in the clinical assessment of human movement and musculoskeletal
function, including task and postural analysis.’

These analyses were done twice, but by the same investigator. So this does
not really provide a quality check or reduce the potential bias by the observer.
The analysis was repeated to reduce the likelihood of simple typo’s or miscalculation.

2) Are the data and results correctly interpreted?
• Is it scientifically justifiable to attribute the self-reported back, neck and shoulder
pain to water carrying practices?
We report an association between some aspects of the task of water carrying (incline
and container weight) which were measured in this study and rating of perceived
exertion, and some borderline differences between aspects of water carrying among
participants reporting pain versus those not reporting pain (distance walked, weight of
water carried and RPE). We do not claim this to be evidence of a causal relationship;
indeed we highlight that there is insufficient evidence to attribute the reports of pain to
water carrying and acknowledge that further research is needed. It is plausible that
regular physical loading as occurs during water carrying may be associated with self
report of pain if it causes adverse tissue strain or degenerative changes.
What about the impact of other activities and manual labor that this study
population may engage in, such as hoeing, weeding, carrying goods to and from
the marketplace, and carrying young children?
The authors are aware that other manual labor activities are commonly performed by this
population, which we believe makes the associations which were found in this
exploratory study worth investigating further. The following is added to the text:
‘Water carrying is not the only manual work performed by women and children in
developing countries and future research should also investigate the additional burden
from other physical tasks.’

• Please see my comments below about the discussion.

3) How is this paper significantly different from what appears to be a similar
Abstract

Background

Nearly 50% of South African children lack access to clean safe water and many regularly carry water loads. The health effects of carrying water have not been well researched or considered when estimating the burden of disease due to suboptimal water supply. Improved access to safe water has potential to create important health and economic benefits, by reducing childhood exposure to risk factors for injury or disease. The aim of this study was to identify which domains of health children perceive as affected by water carrying.

Methods

Qualitative research was used within a broader mixed methods design to investigate children's perceptions about health and water carrying in Limpopo Province, South Africa. Qualitative data from eight semi-structured interviews and three 'natural group meetings', involving a sample of 30 children, were analysed using the framework approach of Ritchie and Spencer. The results were mapped to the International Classification of Functioning Disability and Health (ICF).

Results

Children broadly conceptualize and describe health to include the functions they perform and activities in which they participate. They perceived water carrying as impacting upon health in various ways, for example to make life better by facilitating water usage, or to make life worse through accidents and pain. Children's accounts demonstrate that they can identify and explain complex interactions between activities, participation and health.

Conclusions

The ICF framework facilitates the communication of children's perceptions of health and of relationships between health and water carrying. The model thus derived from their views incorporates not only commonly accepted conceptualizations of health condition, body structure and physiological function, but also of functioning through activities and social participation. Children's accounts suggest a possible association between water carrying and symptoms typical of musculoskeletal disorders. However, further research into the strength of association between water carrying and musculoskeletal disorders is needed.

This paper differs significantly from the one cited above as it reports the quantitative data collected from both children and adults especially on health effects. The above paper was also focused exclusively on children and concerned itself with qualitative analyses. We have included some of the output of the qualitative research in the paper we are submitting to you, but only from adults. We attach the other paper so the editor can make his own judgment.

In addition to these major comments, there are a number of specific issues that need to be further explained – please see specific comments below.

Methods:

4. Pg 8, 2cd para explains that video recording captured data on “body postures
adopted during lifting and handling as well as while carrying containers”. How was this data used in the analyses?

The video data was used for simple visual observation and analysis (performed by JG) of the whole body postures and movements occurring during water carrying subtasks as well as for calculation of time taken for subtasks. OWAS software was also used to support detailed analysis of body postures adopted by three participants. The following text has been added:

‘The analysis was performed to distinguish between sub-tasks and for simple visual observation of the whole body postures and movements commonly occurring during water carrying.’

The analysis informed the statements made in the results section, as well as later discussion:

‘Communal taps were most often positioned at a low height and usually required awkward body posture, such as full spinal bending, to lift a filled container up onto the head from ground level. Use of awkward posture was also evident when containers were stored at ground level, or placed inside dwellings with low doorways.’

The results only distinguish between those who carried the water container on their head and those who did not. Were there any subjects who carried the weight on their shoulders by using a type of yoke to balance two containers?

The methods observed in this study are described: ‘Three methods of carrying water were observed. These were 1) head loading of water-filled containers (n = 30), 2) rolling a water-filled drum (n =2) and 3) pushing a wheelbarrow weighted with filled water containers (n = 7).’

5. Pg 9, 2cd para: The description of the analyses of the video recording explains that each of the four subtasks was timed twice and an average subtask time was calculated for each study subject. However, it is not clear why this level of detail was necessary because the results only report carrying time.

Times were calculated for all of the sub tasks and the authors wish to give an accurate description of the analysis process as it was performed. However carrying time is included in the results because it indicates the period for which compressive loading forces were sustained. Inclusion of the time taken for other sub-tasks would not add information relevant to or significantly alter the findings reported in this paper.

6. Pg 11, 3rd para: It is not clear how Newtons and “compressive force” were calculated or their significance.

See response to point 3 of Dave Hemson: The following has been added to the text under data analysis;

‘Force in Newtons (N) is equal to mass (kg) multiplied by gravity (9.8m/s^2) such that 1kg is approximately equal to 9.81N [11]. The force generated by an object of a known weight carried on the head can therefore be calculated using a simple biomechanical model as described by Oatis [50], if the container is assumed to be in static equilibrium. The forces generated during head loading are simplified in this study and assumed to be the force generated purely by the weight of the water and container carried, directed vertically downward onto the head and spine, with no moment arm.’

The significance of the forces generated by water carrying is now discussed more fully:
‘Frequent loading beyond capacity for adaptation or repair may also lead to early degenerative changes in bone and soft tissues [12]. A threshold of 250N of sustained cyclic loading (15% of failure stress, approximately 6MPa) applied to articular cartilage in vitro has been reported as a threshold above which cell death occurs and increases in proportion to the applied load [59]. Cell death in mature cartilage can lead to degradation of the tissue and is associated with onset of osteoarthritis [59]. Although the actual forces sustained by the cervical spine during water carrying have not been directly quantified, this study indicates that they are likely to exceed 250N for many individuals, when the weight of the head and effects of muscle contraction are added to the weight of water carried.’

The use of the term “compressive force through the cervical spine” should be explained in this context. Is this a standard medical term or musculoskeletal term? What is the significance of “compressive force through the cervical spine”? What is the normal range and what is dangerous?

This is a very commonly used term in the medical and experimental biomechanical literature; additional information addressing the above points is added in the text with reference to relevant literature, see response to Dave Hemson point 7:

‘Frequent loading beyond capacity for adaptation or repair may also lead to early degenerative changes in bone and soft tissues [12]. A threshold of 250N of sustained cyclic loading (15% of failure stress, approximately 6MPa) applied to articular cartilage in vitro has been reported as a threshold above which cell death occurs and increases in proportion to the applied load [59]. Cell death in mature cartilage can lead to degradation of the tissue and is associated with onset of osteoarthritis [59]. Although the actual forces sustained by the cervical spine during water carrying have not been directly quantified, this study indicates that they are likely to exceed 250N for many individuals, when the weight of the head and effects of muscle contraction are added to the weight of water carried. Whilst pain, stiffness and functional impairment are clinical features of osteoarthritis, the correlation between symptoms such as pain and radiographically observed degenerative changes is not clearly established. Therefore future research should investigate the relationships between loading intensity, frequency and duration, history of physical loading exposure and symptoms such as neck or back pain and functional disability, rather than radiographic examination findings alone.’

7. It is surprising that the investigators did not calculate kcal of energy expended on water collection. It seems likely that they have the data to do this calculation, and it would be another interesting result.

This was beyond the scope and aims of this exploratory study

Results:
8. There are an excessive number of tables and figures in this paper given the amount of data that was collected. Some of these are not necessary

We have reduced the number of tables by deleting some and concatenating tables 3 and 4.

9. Table 1 – it would be more interesting to see the age distribution of the water carriers than the mean, sd, min and max.

The numbers of participants are too small to make this meaningful
10. Table 2 and 3 – it would be more interesting to see the variables “Distance” and “total weight carried” graphed as distributions rather than reporting the mean, sd, min and max. 
The numbers of participants are too small to make this meaningful

11. Table 4 – what is the utility of the frequency ratio column? Isn’t it sufficient to give the total number of respondents and the point prevalence? 
This refers to the earlier version and has already been changed

12. The data in Table 5 could simply be reported in the text in a single sentence. 
Done

13. The significance of the data in Figure 2 is not explained. The only sentence about this figure states “Of the children observed carrying water, older children tended to carry high container weights and therefore higher loading forces.” This seems like a pretty obvious finding and does not require a graph. 
We have amended the title to show this. We do think the figure adds as it is the easiest way to give an indication of what forces children of different ages have to cope with.

Discussion:
14. The Discussion Section is too long given the nature and size of this study and the results. It gives the impression that the authors are over-interpreting their results. Also the literature review both in the introduction and the discussion is generally weak. 
The authors have taken a cautious approach in interpreting the results and have highlighted the limitations of this exploratory study. The length of the paper has increased through development of the literature review and discussion in response to comments made by Hemson and Rother. To indicate this we had already altered the title by adding ‘a review and mixed methods pilot study’ to better reflect the changes made.

15. Page 15, first para: The authors explain that “how and why pain is reported will vary in different cultural and social contexts…” but then they start this paragraph with the findings from a Danish study that found women are more likely to report pain than men. This seems like a very inappropriate citation because the lives of women are very different in these two cultures. 
We include reference to the Danish study to highlight that gender has been found to be a variable significantly affecting self report of pain, however we do go on to discuss the potential for differences between different cultural groups and indicate the lack of research into gender differences in pain reporting among Venda people. We prefer not to change this section of text.

16. The discussion focuses quite a bit on the young water carriers but little mention is made about elderly water carriers. Table 1 indicates a maximum age of 64 years. It is likely that the cumulative effects and injuries from water carrying will be more obvious in the older water carriers.
We agree that this may be the case but it would be a speculative claim to make at this point and is not a conclusion which can be drawn from our pilot study.

Minor Essential Revisions:
17. Pg. 5: The first two bullets seem to be about the same and are stated in a circuitous manner. Please rephrase to be more direct and consider combining these two bullets.
   The two bulleted points are different and should remain stated as they are for accuracy; the first concerns determining whether a correlation exists between variables, the second whether there are significant differences between subgroups.

18. Pg. 5, 2cd para, first sentence: specify Limpopo Province, South Africa
   This has been added

19. Pg. 8, 2cd para: change “principle” to “principal”. Spell out “WSP”
   This has been done

20. Top of pg 13: the p-value is reported as p>0.0000. This must be a typographical error.
    This is corrected.

21. Pg 15, first para: This is a VERY LONG sentence! “It may be relevant that women ….significant psychological and functional morbidity” Also note typographical error of the word “morbidity”.
    This is shortened and typo corrected.

22. Pg 16, 2cd para: Another VERY LONG sentence! “Compression forces generated…carry the heavier loads.”
    This is restructured.

23. Pg 17, first sentence: The term “developed country settings” is usually not used because it is considered biased. Consider replacing with “high-income country settings” or similar terminology.
    This has been changed

    This is restructured.

25. Table 2 – spell out “DWC” used in the title
    This is done (now table 3)

26. The abbreviations “TDCT”, “CW/BW%” and “RPE” should be explained in footnotes for Tables 6 and 7.
    This is done (now table 7 and 8)

Discretionary Revisions:
27. Figure 1 is not necessary. The other photos illustrate typical water containers.
We prefer to keep this figure. It visually demonstrates that buckets previously used to contain other substances are used for water collection.

Quality of written English: Needs some language corrections before being published
Statistical review: No, the manuscript does not need to be seen by a statistician.
Declaration of competing interests:
-I declare that I have no competing interests.

Reviewer's report
Title: Domestic water carrying and its implications for health: a review and mixed methods pilot study in Limpopo Province, South Africa
Version: 2 Date: 26 June 2010
Reviewer: Andrea Rother

Reviewer's report:
Minor Essential Revisions:
1. Paper still needs to be edited – e.g., remove contraction “don’t” on pg 7 and spell out; spaces between full stops and words to be removed; one sentence paragraphs to be removed, add full stops after all in et al., put e.g., instead of “for example” in brackets, etc).
   It has been checked and edited

2. Table 5 data would be better presented in the text.

3. Table 6 data would be better presented in the text as percentages.
   Done

4. On page 21, “I’s” second and third question are leading. Suggest removing the interviewer’s questions and the corresponding responses as these weaken the other quotes which are good.
   The 2nd and 3rd interviewer’s questions are removed

5. Are there any relevant quotes from the interviews for the equipment and environmental factors section and the weight of the water carried section? This would strengthen the paper.
   The following has been added:

   I: ‘can you tell me about your experiences of carrying water?’
   T: ‘The bad thing might be accidents that happen when you have carried the water and you just hit the road and the stone on the road they have possibility that you might fall with the container on your head, that’s something that is very bad by carrying water.’ (T: translated response, participant 2, 39 year old woman; I: interviewer question)

   ‘What I can say is that the containers are heavy to me, when it is raining we slip on the way when we come back, we’ve gotten a problem of the knees when we walk down the hill that it’s painful, the necks also are painful too, even though you have (gotten)
container on top of the head, the shoulders become painful because they have to lean on that container and it become painful too’ (translated response, participant 37, 55 year old woman)

6. pg. 22 – “In keeping with a phenomenological approach, open questions about the health effects of water carrying were asked during semi-structured interviews to capture the potentially varied impacts which people who carry water might perceive the task to have.” Did respondents list other health effects besides pain? This is not clear in the results section. These have been reported previously for the data collected from children and will be also be reported separately as in depth analysis of the adult qualitative data.

7. The conclusion is too long. Perhaps the limitations and strength of the study should be moved to the end of the discussion section. We prefer to keep the conclusion as it is to ensure that all key messages are highlighted.

Level of interest: An article whose findings are important to those with closely related research interests
Quality of written English: Needs some language corrections before being published
Statistical review: No, the manuscript does not need to be seen by a statistician.
Declaration of competing interests: I declare I have no competing interests.