Crowdsourcing to solicit global consensus from clinicians regarding low back pain outcome indicators for older adults

Crowdsourcing for back pain outcome indicators

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Original article

This work was supported by The Hong Kong Polytechnic University Start-up fund (grant number 1-ZE4G),

There were no financial or competing conflicts of interest in relation to this work.

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ABSTRACT
Background

Low back pain is one of the most debilitating condition among older adults. Unfortunately, existing low back pain outcome questionnaires are not adapted for specific circumstances related to old age, which may make these measures less than ideal for evaluating low back pain in older adults.

Objective: To explore the necessity of developing age-specific outcome measures, crowdsourcing was conducted to solicit opinions from clinicians globally.

Methods

Clinicians around the world voted/prioritized various low back pain outcome indicators for older adults on a pairwise wiki survey website. Seven seed outcome indicators were posted for voting while respondents were encouraged to suggest new indicators for others to vote/prioritize. The website was promoted on social media of various healthcare professional organizations. An established algorithm calculated the mean scores of all ideas. A score > 50 points means that the idea has > 50% probability to beat another randomly presented indicator.

Results

Within 42 days, 128 respondents from six continents casted 2,466 votes and proposed 14 ideas. Indicators pertinent to improvements of physical functioning and age-related social functioning scored > 50 while self-perceived reduction of low back pain scored 32.

Conclusions

This is the first crowdsourcing study to address low back pain outcome indicators for older adults. The study noted that age-specific outcome indicators should be integrated into future low back pain outcome measures for older adults. Future research should solicit opinions from older patients with low back pain to develop age-specific back pain outcome measures that suit clinicians and patients alike.
INTRODUCTION
Low back pain (LBP) is the most debilitating condition [1,2] that causes functional decline in older adults [3]. The predicted percentage of older adults aged 60 or over will triple by 2050 [4], which may inevitably increase incidences of non-communicable conditions (including musculoskeletal disorders) [5]. It has been estimated that approximately 30.3% of seniors aged 65 or above in the USA suffer with LBP [6]. Since the sequelae of LBP has larger impacts on physical function and quality of life of older adults than younger individuals [7,8], it is essential to effectively treat the former. Unfortunately, the efficacy of different LBP interventions in older adults remains uncertain because many clinical trials on LBP interventions exclude older patients [9], and existing LBP outcome measures do not consider age-related physical/psychosocial changes in older adults, which may not comprehensively evaluate the impacts of LBP on them [3,10]. Although more studies have evaluated the efficacy of various LBP interventions on older adults [11,12], there is no consensus regarding the necessity of developing age-specific outcome measures for older adults with LBP. Some clinicians believe that LBP outcome indicators for older adults should not differ from those for young adults, whereas others argue that older adults need another set of LBP outcome indicators given their comorbidities and altered psychosocial conditions [13,14]. Given the controversy, it is important to broadly solicit clinicians’ opinions on the importance of various key LBP outcome indicators so as to determine the necessity of developing new or adapting existing LBP outcome measures for older adults. “Crowdsourcing” is a research approach collating information/solutions from a group of people/experts using the internet within a controlled manner. Specifically, an organization presents a complex problem to a specific group of internet users who will provide solutions to the challenge/problem on a voluntary or employee-paid basis. The organizer then analyzes the findings for further applications [15]. Crowdsourcing results are highly applicable to the
target audience/end-users because they are involved in deriving the solutions [15]. Multiple health disciplines have adopted crowdsourcing to monitor disease outbreaks, analyze gene expression data, interpret medical images, or record drug responses [16,17,18]. Collectively, crowdsourcing can facilitate knowledge translation and inform biomedical research [19].

In view of the above, the current study aimed to utilize a crowdsourcing approach to identify global clinicians’ opinions regarding the relative importance of various LBP outcome questionnaire indicators for older adults.

**METHODS**

*Creation of a pairwise wiki survey*

The current study adopted a pairwise wiki survey approach via a crowdsourcing method, which allows prioritization of ideas [20]. Briefly, a pairwise wiki survey involves a single question with multiple potential answers. Respondents contribute to the survey by: (1) making pairwise comparisons between two randomly presented answers (i.e. voting between two ideas), and/or (2) adding new ideas for future respondents to vote. This approach quantifies responses based on the relative priority of different answers from all respondents, and integrates respondents’ new ideas for prioritization (vote up or down) using an established algorithm [20]. Unlike traditional surveys, respondents do not confine their responses to the choices offered by the researchers [21]. Therefore, influences of researchers’ pre-existing knowledge or biases are minimized during data collection [20].

A pairwise wiki survey was created on a free open-source website, “All Our Ideas” (www.allourideas.org), to let respondents vote on ideas about “*Which outcome measures/improvements can indicate significant low back pain improvement in elderly?*” A brief description of the research objective alongside the research question and seven seed answer items were posted on the website for voting on June 12, 2016 (Figure 1a, Table 1). The seven seed answers were determined by a panel of clinicians with 7 to 22 years of
relevant clinical experience. The panel comprised a physiotherapist specialized in spinal pain management, a physiotherapist specialized in geriatric rehabilitation, an orthopedic surgeon, and a geriatrician. These seed answers were aligned with the core set of outcome domains (physical functioning, pain intensity, and health-related quality of life) derived from a Delphi study for measuring and reporting non-specific LBP in clinical trials [22] (Table 1). To evaluate the relevance of age-related outcome indicators in assessing LBP improvements of older adults, an age-specific outcome indicator (i.e. being able to take care of grandkids) was added as one of the seven seed answers. Only seven clinically relevant seed answers were included because they were used as catalysts to stimulate constructive contributions from respondents and to minimize biases from the panel. Respondents were encouraged to contribute their new ideas about potential LBP outcome indicators for older adults on the website (Figure 1a). The primary investigator would determine the appropriateness of the ideas submitted by respondents. Respondent-contributed answers would be deactivated for voting if they were duplicates of existing answers/ideas, irrelevant to the question of interest (i.e., LBP outcome indicators for older adults), or comments/questions about the appropriateness of the study design, website, answers or research objectives. This study was approved by an ethics board committee and was conducted according to the Declaration of Helsinki.
Figure 1. The screenshot of the wiki survey [23]

Table 1. Various answer items created by the researchers.

<table>
<thead>
<tr>
<th>Answer or idea items</th>
<th>Score (0 - 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Being able to walk independently with or without a walking aids</td>
<td>72</td>
</tr>
<tr>
<td>Being able to do grocery shopping without significant increase in pain</td>
<td>69</td>
</tr>
<tr>
<td>No longer requires the support from caregivers</td>
<td>64</td>
</tr>
<tr>
<td>Being able to keep well</td>
<td>65</td>
</tr>
<tr>
<td>No longer requires the support from caregivers</td>
<td>66</td>
</tr>
<tr>
<td>Being able to go to the bathroom alone</td>
<td>67</td>
</tr>
<tr>
<td>Being able to take care of grandkids</td>
<td>57</td>
</tr>
<tr>
<td>Being able to meet friends independently</td>
<td>57</td>
</tr>
<tr>
<td>Don’t need to see physicians/clinicians because of low back pain</td>
<td>53</td>
</tr>
<tr>
<td>At least 2 point decreases in pain on visual analogue scale</td>
<td>44</td>
</tr>
</tbody>
</table>
To advertise the survey to targeted clinicians (i.e. physiotherapists, occupational therapists, chiropractors, osteopaths, physicians, nurses, physicians, gerontologists and general practitioners), three strategies were adopted. Firstly, standardized messages together with the survey hyperlink were posted on the Facebook accounts of multiple healthcare professional organizations (Appendix 1) identified using various key words: chiropractic, chiropractors, general practice, general practitioners, geriatric, geriatricians, gerontological, gerontology, manual therapists, manual therapy, medical, medicine, nurses, nursing, orthopaedics, orthopedics, physical therapists, physical therapy, physiotherapists, physiotherapy, osteopathic, osteopathy, occupational therapists or occupational therapy. Briefly, the Facebook message explained that a group of researchers were conducting a survey to solicit clinicians’ opinions regarding various LBP outcome indicators for older adults with LBP, and that respondents could contribute to the online survey by selecting their preferred outcome indicators or suggesting new outcome indicators (Table 2). Secondly, similar key words were used to identify various target groups, and a standardized Tweet message alongside the hashtag of these groups was used to advertise the survey (Appendix 1). The second round of advertisement on the same social media was repeated on July 3, 2016. Thirdly, the primary investigator sent personal messages through Facebook messenger to invite 15 lead clinicians/clinician-scientists (orthopedic specialists, physiotherapists, chiropractors, and nurses) in Australia, Canada, Hong Kong, Denmark, Norway, and the USA to cast their votes and to share the survey hyperlink on their personal Facebook pages or the Facebook pages of their respective local professional organizations. Only a small number of personal messages were sent because this pilot study mainly aimed to use social media to promote the survey.
Table 2. Standardized Facebook and Twitter messages that were posted or linked to various physiotherapy, chiropractic, osteopathic, occupational therapy, medical and gerontology professional groups

<table>
<thead>
<tr>
<th>Social Media</th>
<th>Messages</th>
</tr>
</thead>
<tbody>
<tr>
<td>The wiki survey website</td>
<td>Dr. Arnold Wong from The Hong Kong Polytechnic University is conducting a study to solicit clinicians’ opinions on various low back pain outcome indicators for older adults. Your participation is voluntary. After choosing your answer, a new pair of answers will be shown. You can add your ideas for others to vote. Your answers will be kept private.</td>
</tr>
<tr>
<td>Facebook</td>
<td>A group of researchers is conducting a crowdsourcing research project to understand clinicians’ opinions regarding the key outcome indicators that represent low back pain improvements in older adults aged 65 years or above. The results can help develop tailored outcome measures for older adults. If you are willing to help, please click on the link and cast your votes. Your participation is voluntary. When you click on the link, you will see two potential answers that indicate significant improvements of low back pain in older adults. You are requested to pick the best answer from the two options. Once you submit your answer, another two random outcome options will be shown for comparison. The procedure will be repeated until you quit. Your answers will be kept strictly confidential. You can also add new ideas of outcome indicators for others to vote. Please feel free to share the link with your colleagues. Thanks in advance for your help. allourideas.org/olderpeoplewithlowbackpain</td>
</tr>
<tr>
<td>Twitter</td>
<td>Please cast your vote to help develop a new low back pain outcome measures for the elderly allourideas.org/olderpeoplewithlowbackpain</td>
</tr>
</tbody>
</table>

**Data analysis**

The website uses a published algorithm to estimate the chance of a given answer item in beating another randomly presented item for a randomly chosen respondent [20]. Briefly, a binomial model was chosen to estimate the probability of a win for each answer item. Assuming a uniform prior probability for a binomial variable, the resulting posterior probability to a win follows a beta distribution [24]. By multiplying the expected value of that beta distribution by 100, the resulting estimated score (ranging from 0 to 100) would represent the winning percentage of a given item. If a given item scores 0, it implies that it is expected to lose for all pairwise comparisons. Conversely, if an item scores 100, it indicates that it is always anticipated to win. The resulting scores of all the answer items are displayed on the website (Figure 1b).
Additionally, raw data (e.g., the number of responses of each respondent, actual responses of each respondent, time spent on each comparison, number of new ideas from each participant, and response time of each respondent) were downloaded from the website for descriptive analysis using SPSS 20.0 (IBM SPSS Statistics). The binomial confidence interval of the mean score of each answer was also calculated [25].

RESULTS

Number of respondents and responses

During 42 days, 128 respondents contributed 2,466 responses. During the same period, 179 visitors visited the website without casting any vote (a response rate of 41.7 %). Respondents came from 60 cities in 22 countries on 6 continents (Table 3). The United States, China (Hong Kong), Australia, Canada and Great Britain were the top five countries that had the highest number of responses (range: 239-541) and respondents (range: 10-31) (Table 3).

The median number of responses per respondent was 17 (ranging from 1 to 142) (Figure 2). The median time spent on each comparison by the respondent was 4.7 seconds (ranging from 0.4s to 314.9s). Fourteen new ideas were proposed by the respondents (Table 4). Five respondents suggested a single idea while two respondents proposed two and six new ideas, respectively. Nine out of 14 new ideas were proposed within the first 3 days of the survey but the last active idea (i.e. If trunk flexion is indicated as a significant factor increasing LBP in the first assessment, then SLR would be one of the indicators) was proposed on the 35th day. Three contributed ideas were not activated for voting because they were deemed to be inappropriate or duplicated (Table 4). Given the respondent-contributed ideas, the number of active ideas in the current survey increased from 7 to 18 (Table 4). Sixteen activated ideas were self-reported outcome indicators, while the other two were
related to physical examinations. The median number of times each activated idea being presented to respondents for comparison was 585 (ranging from 55 to 686).

**Table 3. Number of responses and respondents in different countries.**

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of responses</th>
<th>Number of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>541</td>
<td>31</td>
</tr>
<tr>
<td>China &amp; Hong Kong</td>
<td>433</td>
<td>21</td>
</tr>
<tr>
<td>Australia</td>
<td>420</td>
<td>19</td>
</tr>
<tr>
<td>Canada</td>
<td>320</td>
<td>15</td>
</tr>
<tr>
<td>Great Britain</td>
<td>239</td>
<td>10</td>
</tr>
<tr>
<td>Japan</td>
<td>98</td>
<td>4</td>
</tr>
<tr>
<td>Singapore</td>
<td>51</td>
<td>2</td>
</tr>
<tr>
<td>Netherlands</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>Rwanda</td>
<td>44</td>
<td>3</td>
</tr>
<tr>
<td>New Zealand</td>
<td>43</td>
<td>3</td>
</tr>
<tr>
<td>Brazil</td>
<td>37</td>
<td>2</td>
</tr>
<tr>
<td>Norway</td>
<td>34</td>
<td>2</td>
</tr>
<tr>
<td>Romania</td>
<td>31</td>
<td>2</td>
</tr>
<tr>
<td>Greece</td>
<td>28</td>
<td>2</td>
</tr>
<tr>
<td>Denmark</td>
<td>26</td>
<td>2</td>
</tr>
<tr>
<td>Colombia</td>
<td>25</td>
<td>1</td>
</tr>
<tr>
<td>Belgium</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>India</td>
<td>17</td>
<td>2</td>
</tr>
<tr>
<td>Switzerland</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Trinidad &amp; Tobago</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Portugal</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>2,466</strong></td>
<td><strong>128</strong></td>
</tr>
</tbody>
</table>

**Figure 2.** Number of responses per respondent
Table 4. Various answer items created by the researchers and respondents/users.

<table>
<thead>
<tr>
<th>Answer or idea items</th>
<th>Source</th>
<th>Status</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Being able to walk independently with or without a walking aids</td>
<td>Seed</td>
<td>Activated</td>
<td>69</td>
</tr>
<tr>
<td>Being able to do grocery shopping without significant increase in pain</td>
<td>Seed</td>
<td>Activated</td>
<td>66</td>
</tr>
<tr>
<td>No longer requires the support from caregivers</td>
<td>Seed</td>
<td>Activated</td>
<td>60</td>
</tr>
<tr>
<td>Being able to take care of grandkids</td>
<td>Seed</td>
<td>Activated</td>
<td>57</td>
</tr>
<tr>
<td>Being able to meet friends independently</td>
<td>Seed</td>
<td>Activated</td>
<td>53</td>
</tr>
<tr>
<td>Don’t need to see physicians/clinicians because of low back pain</td>
<td>Seed</td>
<td>Activated</td>
<td>44</td>
</tr>
<tr>
<td>At least 20-point decreases in pain on visual analogue scale</td>
<td>Seed</td>
<td>Activated</td>
<td>32</td>
</tr>
<tr>
<td>Being able to perform 80% of the daily activities prior to the current episode of LBP</td>
<td>Respondent</td>
<td>Activated</td>
<td>72</td>
</tr>
<tr>
<td>Being able to sleep well</td>
<td>Respondent</td>
<td>Activated</td>
<td>65</td>
</tr>
<tr>
<td>Being able to garden</td>
<td>Respondent</td>
<td>Activated</td>
<td>57</td>
</tr>
<tr>
<td>Being able to do the maintenance work at home</td>
<td>Respondent</td>
<td>Activated</td>
<td>57</td>
</tr>
<tr>
<td>Being able to socialize with friends</td>
<td>Respondent</td>
<td>Activated</td>
<td>46</td>
</tr>
<tr>
<td>Being able to go to exercise classes (e.g. yoga, Tai Chi)</td>
<td>Respondent</td>
<td>Activated</td>
<td>46</td>
</tr>
<tr>
<td>If trunk flexion is indicated as a significant factor increasing LBP in the first assessment, then SLR would be one of the indicators</td>
<td>Respondent</td>
<td>Activated</td>
<td>44</td>
</tr>
<tr>
<td>QALY (Quality-adjusted life year)</td>
<td>Respondent</td>
<td>Activated</td>
<td>35</td>
</tr>
<tr>
<td>Being able to take care of pets</td>
<td>Respondent</td>
<td>Activated</td>
<td>28</td>
</tr>
<tr>
<td>Being able to go to churches or temples, or to do meditation</td>
<td>Respondent</td>
<td>Activated</td>
<td>25</td>
</tr>
<tr>
<td>Actually improvement in straight leg raise (more than 20 degrees) is quite good</td>
<td>Respondent</td>
<td>Activated</td>
<td>18</td>
</tr>
<tr>
<td>I get the question but the semantics aren’t clear. Why should SLR be an outcome measure for LBP without mention of radiculopathy or sciatica</td>
<td>Respondent</td>
<td>Deactivated</td>
<td>NA</td>
</tr>
<tr>
<td>QALY (Quality-adjusted life year)</td>
<td>Respondent</td>
<td>Deactivated</td>
<td>NA</td>
</tr>
<tr>
<td>The survey is overly repetitive. It will likely reduce your response rate. I have addressed the same issues more than 10 times</td>
<td>Respondent</td>
<td>Deactivated</td>
<td>NA</td>
</tr>
</tbody>
</table>

NA, not applicable. Note: Activated answer items were shown on the wiki survey page for respondents to vote. Three answers were deactivated: one was a duplicated submission and two were irrelevant to the research question.

Prioritization of answers

Nine out of 18 activated answer items scored more than 50, implying that these answers had more than 50% chance of beating other answers in pairwise comparisons. The top three high-scoring ideas like “being able to perform 80% of the daily activities prior to the current episode of LBP”, “being able to walk independently with or without a walking aids”, and “being able to do grocery shopping without significant increase in pain” had mean scores of 72, 69 and 66, respectively. Two of the top five high-scoring ideas were suggested by respondents (Table 3, Figure 3). As hypothesized, outcome indicators related to pain and...
physical impairments only yield low scores. Specifically, the item entitled “at least 20-point decreases in visual analogue scale” and “actually improvement in straight leg raise (more than 20 degrees) is quite good” only scored 32 and 18, respectively.

![Figure 3](image)

**Figure 3.** Rank scores of various potential low back pain outcome indicators for geriatric patients as estimated by the established algorithm on the website.

**Twitter vs Facebook**

Ninety-four out of 128 respondents were referred to our wiki survey website from Facebook, while 34 respondents were referred from Twitter accounts. Most of the respondents (60.7%) used a cell phone or a computer tablet to participate in the survey, while the rest of them (39.3%) completed their surveys on their computers.
DISCUSSION

This is the first online crowdsourcing research to collect global clinicians’ opinions regarding the relative importance of different LBP outcome indicators for older adults. As hypothesized, the majority of the respondents (clinicians) deemed that functional improvements were more important than improvements of pain or physical examinations. While some self-reported LBP outcome indicators identified in the current study (e.g. being able to perform 80% of the daily activities prior to the current episode of LBP) might be true for other age groups, our respondents generally agreed that the age-specific functional outcome indicator (e.g. being able to take care of grandkids) was an important self-reported LBP outcome indicator for older adults with LBP. These findings highlight that age-specific LBP outcome indicators, which have been ignored in existing self-reported LBP outcome measures, should be considered in the future development of new LBP outcome measures for older adults with LBP.

Interestingly, five out of seven seed answers derived from a panel of health care experts were deemed to be important by respondents. In fact, seed answers contribute to 56% of the answers scored more than 50 points (Table 4). These results indicate that many clinicians around the world agreed on using certain seed answers to be the key LBP outcome indicators for older patients. Since several respondent-contributed outcome indicators were also rated as important, the current study substantiates the feasibility and value of using a pairwise wiki survey to identify LBP outcome indicators for older people with LBP.

Participants’ responses were highly related to the advertising strategy. Since the current study was mainly promoted on Facebook/Twitter accounts of various healthcare professional associations in the USA, Hong Kong, Australia, Canada and Great Britain, greater response rates were attained from these regions. Interestingly, although our advertisements were posted on Facebook and Twitter accounts, 72.3% of the respondents
were referred from Facebook. It indicates that Facebook was a more effective social media for recruiting clinician respondents in similar research as compared to Twitter.

It is noteworthy that the confidence interval of one LBP outcome indicator (i.e. *If trunk flexion is indicated as a significant factor increasing LBP in the first assessment, then straight leg raising test could be one of the indicators*) was relatively large. This was attributed to the fact that this idea was received seven days before the completion of data collection. Since this idea was only presented 55 times to respondents for comparison, its confidence interval was wide. Although this might affect the relative ranking of this outcome indicator, it would not affect the conclusion on the top priority outcome indicators because the most important outcome indicators should have been suggested at the early stage of the survey.

As with any clinical-based or survey-type of research, inherent study limitations exist. Since the current study did not involve older patients with LBP, our findings are limited to clinicians’ perspective. Future research is warranted to solicit opinions from the target patient population during the process of developing a new LBP outcome measure for older adults.

Like many internet-based surveys, the current study was limited by sample representativeness [26] because it did not collect participants’ detailed demographic information (e.g. age, gender, years of education and clinical experience, healthcare disciplines). However, our respondents were highly likely to be clinicians because the survey was: (1) not searchable on common search engines (e.g. Google) unless the exact survey web address was used; (2) only openly advertised on the Facebook and Twitter accounts of relevant professional bodies; and (3) promoted by personal emails sent to clinicians/clinician-scientists. This notion was further corroborated by the fact that the respondent-contributed ideas and voting results demonstrated high face validity to the research topic from the clinicians’ perspective.
The response rate of the current study was 39.5%. In comparison, the response rate for Delphi studies that evaluated core outcome set for LBP was between 45% to 52% [22]. This slight discrepancy might be attributed to the recruitment methods (open advertisements on social media vs personal invitations). Previous studies have found that response rates of internet surveys for clinicians are usually lower than traditional paper surveys [27],[28],[29]. While multiple reasons may explain the low response rate among clinicians (e.g. lack of time, perceived low priority of surveys and concerns about confidentiality) [29] response rates can be improved by sending repetitive reminders or personalized letters [29],[30]. Future studies should adopt multiple strategies (e.g. incentives [31], personalized invitations [32], repetitive reminders [30]/advertisements [33] or endorsements from professional associations [34]) to improve response rates and total number of respondents.

Since traditional surveys require researchers to determine all the details (e.g. questions, the orders of questions, and multiple plausible answers) prior to data collection, this top-down approach may introduce investigator biases and may limit the knowledge that can be learned from respondents [20]. Conversely, our pairwise wiki survey used an ongoing collaborative approach to encourage respondents to create knowledge that was not anticipated by the researchers. Similar to a focus group that allows participants to react to others’ responses [35], user-contributed ideas collected from the current wiki survey were continuously evaluated by future respondents. The success of this bottom-up interactive approach is reflected from our findings that respondents from all continents (except Antarctica) contributed more than 2 folds of new LBP outcome indicators within a short period of time, and that some of the proposed indicators were ranked as highly relevant LBP outcome indicators for older adults.

The current survey collected information based on the respondents’ eagerness to participate. While some respondents contributed to a single vote, other contributed heavily to
the voting and/or new idea suggestions (Figure 2) [36]. Unlike traditional surveys that prohibit high contributors from answering extra questions and discard incomplete questionnaires from data analysis, a pairwise wiki survey collects as much and as little information as the respondent is willing to offer. Since wiki surveys value contributions from all respondents equally regardless of their time or effort spending on answering the surveys, wiki surveys may solicit more useful information from respondents than traditional surveys [20].

The current study reveals a novel method to solicit opinions from clinicians around the globe during the process of developing a new clinical outcome measure. Traditionally, the development of a new self-administered clinical outcome questionnaire involves a process of literature review, conduction of multiple focus groups or meetings among content experts (e.g., clinicians, patients, scholars) to determine relevant items and/or domains in a questionnaire as well as further modifications of items after pilot testing on target populations [37]. A pairwise wiki survey can be implemented as a low-cost adjunct survey tool to solicit ideas from a large population of clinicians/patients globally following the initial draft of item pooled from a panel of content experts. The survey results not only can broaden the perspectives to inform further panel discussion but also allow rapid preliminary feedback from target users. However, further studies are warranted to evaluate the effectiveness of such an approach in improving the psychometric properties of the resulting questionnaires (e.g. whether the inclusion of crowdsourcing identified items would improve the internal consistency or responsiveness of questionnaires).

While the current approach has revealed the relative importance of different LBP outcome indicators perceived by clinicians, the respondents’ rationales for choosing/prioritizing their answers remains unclear. Future qualitative research (e.g. interviews or focus groups) should investigate clinicians’ reasons for prioritizing various LBP
outcome indicators and to solicit information from older adults regarding their perceived important LBP outcome indicators. Collectively, our findings can be incorporated with patients’ and experts’ opinions obtained from qualitative and/or Delphi research to develop a new outcome measure for geriatric patients with LBP. The current study has laid the foundation for developing better outcome measures for older patients with LBP. Such knowledge has the potential to ultimately contribute to better clinical management or treatment algorithm for older adults with LBP.

Overall, this is the “first” global crowdsourcing study to address LBP outcome questionnaire indicators for older adults. The study found that clinicians deemed functional improvements as more important LBP outcome indicators for older adults with LBP than pain reduction or improvements of physical examinations. Clinicians generally perceive age-specific social functioning as an important outcome assessment domain for older adults with LBP. While further studies are warranted to compare our findings with the opinions obtained from older adults with LBP and/or leading spine experts, the current study has laid the foundation for developing better outcome measures for older adults with LBP. In addition, the current proof of concept study has also provided a framework to illustrate that global crowdsourcing approaches in spine research are viable and achievable, hopefully providing impetus for other investigators to adopt such an approach for future spine research.
References


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Appendix 1. The list of professional organizations on Facebook and Twitter that the current project had advertised.

### Target groups on Facebook

- American Occupational Therapy Association
- American Physical Therapy Association
- Australian Association of Gerontology
- Australian & New Zealand Society for Geriatric Medicine
- Australian Medical Association
- Australian Physiotherapy Association
- British Columbia Chiropractic Association
- Canadian Chiropractic Association
- Evidence based chiropractic
- Gerontological Advanced Practice Nurses Association
- Gerontology institute of Georgia state university
- Global Health Division – Canadian Physiotherapy Association
- Hong Kong Chiropractors Association Ltd
- International osteopathy
- International osteopathic Association
- Japanese Association of Chiropractors
- McKenzie Institute Australia
- McKenzie Institute New Zealand
- McKenzie Institute USA
- McKenzie Mexico
- National Academy of Osteopathy
- North American Spine Society
- Occupational Therapy Australia
- Physiotherapy DPT Community
- Physiotherapy.Fisioterapia (European Region World Confederation for Physical Therapy)
- Physiotherapy Research Society - UK
- Royal Australian College of General Practitioners RACGP
- The American Geriatrics Society
- The Gerontological Society of America
- The Mckenzie Institute Japan
- The Physiotherapy Association of Trinidad and Tobago

### Target groups on Twitter

- Academy of Geriatric Physical Therapy @AGPTtweets
- American Chiropractic association @ACAtoday
- American Geriatrics Society @AmericanGeriatricsSociety
- American Physical Therapy Association @PTAtweets
- Australian Academy of Orthopaedic Manual Physical Therapists @AAOMPT
- Australian Association of Gerontology @gerontologyau
- Australian & New Zealand Society for Geriatric Medicine @anzsgm
- Australian Doctor @australiandr
- Australian physiotherapy association @apaphysio
- British Columbia Chiropractic Association @bcchiro
- British Geriatrics Society @GeriSoc
- Canadian Chiropractic Association @canadianchiropracticassociation
- Chartered Society of Physiotherapy @CharteredPhysios @thecsp
- European Region of World Confederation for Physical @ERWCPT