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ORIGINAL ARTICLE

Development and psychometric evaluation of a health questionnaire on back care knowledge in daily life physical activities for adolescent students

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Abstract
Purpose The most relevant musculoskeletal problems are related with back health. Study instruments have been designed for adult patient population but not for school-aged children. The aim of this study was to develop and evaluate the psychometric properties of a questionnaire to assess adolescents' level of back care knowledge in daily life physical activities.
Methods Participants were 171 adolescents from secondary schools. The questionnaire was made up of 24 questions. A Delphi method was used for test validation. Cronbach's alpha, test–retest, Wilcoxon signed-rank and Bland–Altman graph were used to evaluate the instrument reliability.
Results Cronbach's alpha ($\alpha = 0.82$) showed a strong internal consistency. Test–retest was excellent for total score (0.76) and moderate to excellent (0.54–0.76) for seven score conceptual categories with good results of standard error of the mean and minimal detectable change. No differences were found between test 1 and test 2 except for the standing posture scores.
Conclusion The questionnaire showed acceptable psychometric values. Results showed that this questionnaire is a good instrument to assess adolescent's back care knowledge.

Keywords Health education · Knowledge · Back pain · Adolescent · Daily life physical activity

Introduction

Epidemiological studies [1] have pointed out that musculoskeletal disorders are one of the main problems causing a high percentage of people taking time off work and a great economic expenditure among the European Union countries [2]. Among the musculoskeletal problems the most recurrent ones are back problems [3], the most frequent being low back pain or non-specific low back pain [4].

Medication, rehabilitation, physiotherapy and surgery are the most researched areas for the prevention and treatment of low back pain. Educational intervention programmes have been less considered even though some studies have pointed out that they could be the way to increase people's knowledge and to change their behaviour and, consequently, improve patients' quality of life [5–7].

Educational programmes for the prevention and treatment of low back pain have been mainly conducted with adults, and with patients in health contexts using questionable methodologies [8]. Several authors have suggested to study in-depth the actual incidence of non-specific low back pain in adolescents, and to develop intervention programmes in school-aged children, because the acquisition of health habits becomes more relevant in this stage of life [9, 10]. Including back care within the educational curriculum is very important to interiorize the patterns of

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movement and postural habits, so that they become part of the regular school-aged children behaviour [11].

At the same time, the studies on the evaluation of intervention programmes in the educational context have shown that changing children's knowledge, attitude and abilities regarding back care may bring significant improvement in public health [11]. Parents and teachers have an essential role in education for back care, and teachers have to be specifically prepared to bring about changes in their students' habits [11].

Although there are many studies about back education programmes developed in educational contexts [6, 11–14], a recent systematic review has shown controversial results about the effectiveness of these programmes to prevent low back pain [15]. The studies analysed develop programmes that include mainly three topics: physical exercise, physical therapy and knowledge on back health. However, they use heterogeneous methodologies with non-concluding results [15]. To overcome this situation it is necessary to review and develop more advanced and homogeneous methods to research on the effects of educational programmes.

Researchers on educational programmes have taken into account theoretical knowledge on anatomy as well as the function of the spine to elaborate the topic under consideration. However, few of them accounted for knowing-how or practical knowledge on back care, even in daily life activities [10, 16, 17]. Moreover, none of them have developed a complete process to test the psychometric properties of the health measuring instruments used [18]. There is only one study [19] which includes a suitable validity and reliability analysis, even though the target population was adults with pathologies. Moreover, as the questionnaire used in that study was addressed to patients, it included technical terminology and questions about pain, which are not familiar to young people. It did not include wrong beliefs and questions about back care related to the use of body posture in daily life activities.

Research objective

The objective of this study is to develop and assess the psychometric properties of a measuring instrument to analyse adolescents' level of knowledge on health and back care during the performance of daily life physical activities.

Methodology

Instrument design

A Health questionnaire on back care knowledge in daily life physical activities (HEBACAKNOW).

To study the level of knowledge on health and back care, an ad hoc four-phase questionnaire was elaborated using a validity criteria based on the Delphi method [18].

- Phase I: collecting evidence. Searching for references. Selecting evidence indicators.
- Phase II: development of version I. Item elaboration. Experts' evaluation.
- Phase III: development of version II. Pilot administration. Evaluation by adolescents.
- Phase IV: development of final version. First administration. Second administration.

To design the questionnaire several sources were considered. First (Phase I), a search for suitable previous work on low back pain, back care, and the use of questionnaires on back care, was made in the specialized literature. We took into account results from studies on basic and applied knowledge to the comprehension of the body mechanics [20], knowledge on backpack book load [21], the correct way to carry the backpack [22], the sitting posture and classroom furniture [23], and the spine load in different positions [12, 24].

From this previous research work a first true/false 38-item version of the questionnaire was designed (Phase II). Then, six independent experts (two in medicine and biomechanics, two in physical education and two in educational research methods) were selected. The selection was made according to the following criteria: they should be outside the study, have the PhD or MD grade, work at university and have published a research paper in an impact international journal on back care and health. Experts were asked to judge each item according to: their relevance and suitability for the back care and health in daily life activities, the kind of language used and its adequacy for the sample characteristics. Most of the experts' suggestions were addressed to the instrument design and the information provided by each item. First, they agreed with the shortening of the questionnaire: true/false questions could be replaced by multiple-choice questions (one correct answer out of a four options). In that way, extra information about the same topic could be provided in the options. Thus, four items of the initial version of the questionnaire regarding aesthetic topics, misconceptions and correct knowledge were reduced to one, without losing information. For instance, four items such as 'The function of the trunk musculature is control back stability and support the viscera', 'The trunk musculature supports fat from the abdomen and the waist', 'The trunk musculature is to embellish the body' and 'The trunk musculature is to get a flatter abdomen', were finally reduced to one item: 'The function of the trunk musculature is:' (Electronic supplementary material Appendix, v7).

Second, the experts pointed out the need of making language more comprehensible for adolescents, avoiding the use of the double negative in writing.

After the changes were made from the experts' suggestions, the questionnaire contained 24 items. This second version (Phase III) was evaluated by a set of participants by means of a group analysis session. Ten representative students of different age groups evaluated the comprehensibility, the ease of use of the questionnaire and they were asked about their beliefs on the body use in daily life physical activity. Two researchers presented the questionnaire to the students and the most important suggestions were registered. They were addressed to: topics about spine knowledge (such as form, function and body posture), language used and the comprehensibility of the questions. These suggestions were especially useful to improve the instructions for the administration session and to re-consider some of the alternative wrong answer options in the questionnaire. For instance, one of the wrong beliefs students had and which we included in the questionnaire was: "When standing for a while without moving, I should remain as steady as possible" (Electronic supplementary material Appendix, v10, option d).

The information provided by these ten users motivated the final version (Phase IV) of the *HEBACAKNOW* questionnaire (Electronic supplementary material Appendix). The resulting 24 multiple choice items were associated with one of the following categories according to conceptual knowledge: topographical-anatomical knowledge (items 1, 2, 3 and 6); functional–anatomical knowledge (items 4, 5 and 7); habits in standing posture (items 8–10); or seated (items 11–13); or lying (items 23 and 24); habits in carrying heavy objects in a backpack (items 14–18); and how to move heavy loads (items 19–22). The score for each item was 0 (wrong option) or 1 (correct option). The scores for each category and for the total questionnaire were obtained computing the mean value of the items involved. All the items had the same weight.

Procedure

The questionnaire administration took place in the IT classrooms using the web Moodle platform. Participation was optional. One of the researchers introduced the questionnaire to the students, explained the procedure to fill in, and solved the participants' doubts. After a 4-week delay the second administration of the questionnaire was made. For this second session the items were presented in a different order to the same participants.

Participants

The study sample was made up of 230 students from four state secondary schools of Valencia (Spain). Only 171 students (82 male and 89 female), aged 14–17 (*M* 15.23, SD 1.33), completed the two rounds of the questionnaire. Students belonged to intact groups in several schools. These schools were selected by a simple random sampling method. The school headmasters, the tutor teachers from each group, and parents were informed and they gave written consent to students' participation in the study. The project of this paper was sent to the ethics committee of the authors' University and the approval was obtained.

Data analysis

The scores of each category and the total questionnaire were obtained. Calculating the mean value of the items were involved. Different statistical analyses were made for these scores using SPSS (v.19) software for Mac.

Cronbach's alpha was used to test internal consistency.

Test–retest reliability was expressed according to several indicators: the differences observed between the readings (test1–test2) and the standard deviation of the differences, intraclass correlation coefficient [25], 95 % confidence intervals for intraclass correlation coefficient, coefficient of repeatability and standard error of the mean and minimal detectable change [26]. A 95 % confidence level for the minimal detectable change (corresponding to a z value of 1.96) was established. Intraclass correlation coefficient of less than 0.40, 0.40 to 0.75, or greater than 0.75 was associated to poor, moderate, and excellent agreement respectively [27].

Non-parametric tests were used when the variables were not normally distributed. The Wilcoxon signed-rank test was selected to analyse systematic differences between the two administrations of the test. The mean value and standard deviation of the test1–test2 differences were calculated and tested for significance using a one-sample t test (i.e. testing differences against zero). In addition, using the Bland–Altman graph, a plot of the differences between tests 1 and 2 against the mean value of the total score of the HEBACAKNOW questionnaire was used to obtain the agreement between the reported values at the individual level (95 % limits of agreement). The association between the difference and the magnitude of the total score of HEBACAKNOW questionnaire (i.e. heteroscedasticity) was examined by regression analysis.

Floor/ceiling effects were calculated from the percentage of adolescents showing the highest [1] or lowest (0)

value in total score at test 1. These effects were considered present when more than 15 % of the participants achieve the lowest/highest values [28].

Results

Internal consistency

The Cronbach's alpha for the 24 items was $\alpha = 0.82$, supporting the hypothesis of a single underlying conceptual construct. The pairs of scores corresponding to the different categories correlated significantly. According to these results, the questionnaire showed a good internal consistency in the single factor scale (one-dimensional scale).

Test–retest reliability

The results of the test–retest reliability for the total and category scores are presented in Table 1. The intraclass correlation coefficient (ICC) was excellent for the total score (0.76), and it varied from moderate to excellent (from 0.54 to 0.76) for the 7 scores corresponding to the conceptual categories. The standard errors of the mean (SEM; varying from 0.08 to 0.19 points) and the minimal detectable changes (varying from 0.21 to 0.51 points) were satisfactory for the total score as well as the score for each category. Mean differences between test and retest were not significantly different from zero, except for the 'standing posture' category ($p = 0.001$). Mean differences were lower than the SEM. In addition the coefficient of repeatability was less than 2 standard deviations for all scores of the questionnaire, except for the 'standing posture' category ($p = 0.001$). No systematic differences were observed for assessments that were completed in two different occasions for all scores of the questionnaire, except for the 'standing posture' category ($p = 0.001$). Figure 1 shows the Bland–Altman plot and the limits of agreement for the total score of the questionnaire (0.28–0.30 points). The test–retest differences in the total score increased as the amount of score obtained decreased (Beta coefficient $= -0.18$; $p = 0.021$).

Operational qualities

The average time per adolescent required to complete the HEBACAKNOW questionnaire was $9' 49'' \pm 2' 06''$ (range 7–11 minutes). None of the adolescents needed external help to complete the questionnaire. No floor/ceiling effects were present for the total score of HEBACAKNOW questionnaire in test 1 (0.6 % ceiling effect and 0 % floor effect).

Table 1 Test–retest reliability of the health questionnaire on back care knowledge in daily life physical activities in adolescents ($n = 171$)

Total and categories scores	Median (25th–75th percentiles) Test 1 (points)	Median (25th–75th percentiles) Test 2 (points)	Difference mean (SD) (points)	Intraclass correlation coefficient	95 % Confidence interval	Coefficient of repeatability (points)	Standard error of the mean (points)	Minimal detectable change (points)
Total score	0.74 (0.63–0.79)	0.74 (0.58–0.79)	0.01 (0.15)	0.76	0.67, 0.82	0.29	0.08	0.21
Topographical-anatomical category	0.75 (0.50–0.75)	0.50 (0.50–0.75)	0.02 (0.22)	0.54	0.38, 0.66	0.43	0.13	0.36
Functional-anatomical category	1.00 (0.67–1.00)	1.00 (0.67–1.00)	0.03 (0.30)	0.56	0.41, 0.67	0.59	0.17	0.48
Standing posture category	0.67 (0.33–0.67)	0.67 (0.33–0.67)*	−0.07 (0.28)	0.65	0.52, 0.74	0.56	0.16	0.43
Sitting posture category	0.67 (0.33–0.67)	0.67 (0.33–0.67)	0.01 (0.32)	0.58	0.43, 0.69	0.63	0.19	0.51
Lying posture category	0.50 (0.50–0.50)	0.50 (0.50–1.00)	−0.01 (0.28)	0.76	0.68, 0.83	0.56	0.16	0.44
Carrying weight in a schoolbag category	0.60 (0.40–0.80)	0.60 (0.40–0.80)	0.01 (0.24)	0.72	0.62, 0.79	0.47	0.12	0.35
Lifting weight category	0.75 (0.50–0.75)	0.75 (0.50–0.75)	0.04 (0.26)	0.72	0.62, 0.79	0.51	0.13	0.36

Significant differences between Tests 1 and 2 using Wilcoxon signed-rank test * $p = 0.001$

SD standard deviation

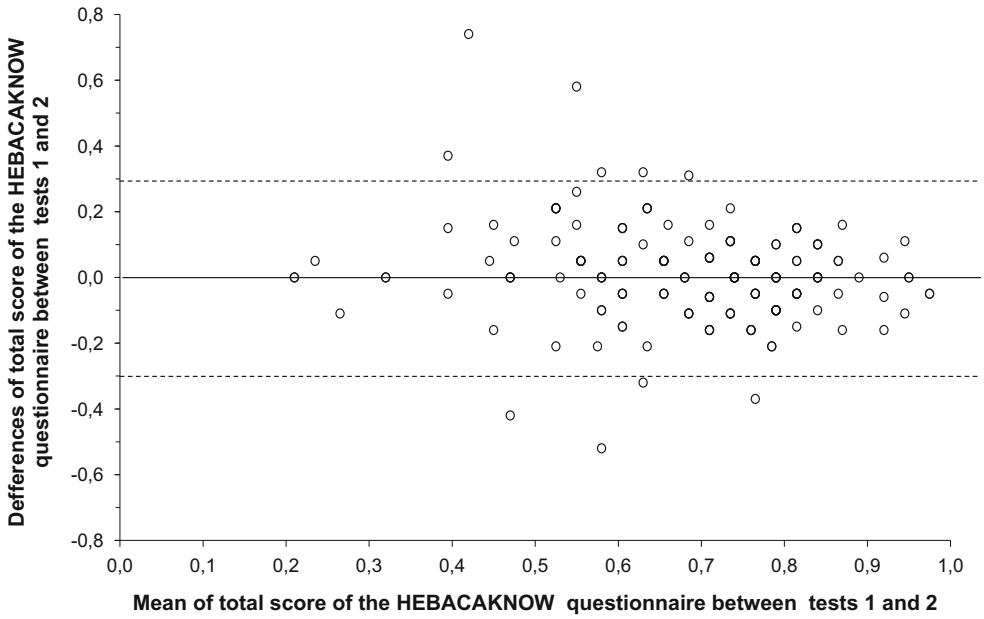

Fig. 1 Bland–Altman plot of the differences between tests 1 and 2 for the total score of the HEBACAKNOW questionnaire. The means of the differences (*solid lines*) and limits of agreement (*dashed lines*) within ±2 standard deviations are shown

Discussion

Up to our knowledge, HEBACAKNOW is the first validated one-dimensional instrument to assess students' knowledge on back care in daily life physical activities. Previously, Méndez and Gómez-Conesa [17] developed a questionnaire to assess back care knowledge in students from 9 to 12 years old and Maciel et al. [19] developed another questionnaire to assess the disease-specific knowledge among patients with non-specific low back pain. However, HEBACAKNOW is the only questionnaire validated by professionals of health-care and education, as well as by young healthy secondary students. It means that HEBACAKNOW is a questionnaire adapted to the school population, which takes into account secondary students' knowledge on beliefs and habits about the use of the body in their daily life activities.

Overall reliability of the HEBACAKNOW conceptual categories and total scores were good enough. The mean differences were low, the ICC were moderate to high for conceptual categories and high for the total scores. The SEM provided a low index of error and the limits of the agreement ranged from 0.28 to 0.30 points for the HEBACAKNOW total score. Therefore, in our setting, a within-adolescent change in HEBACAKNOW total score of at least 0.30 points can be interpreted as a real change, exceeding measurement error. An examination of the Bland–Altman plot (Fig. 1) and coefficients of repeatability suggested that the HEBACAKNOW scores were repeatable. However, the heteroscedasticity observed in the Bland–Altman plot suggested that the reproducibility of the HEBACAKNOW total score decreased as the amount of score obtained decreased. This is a possible effect of learning the correct answers. Maciels' study [19] analyzed the reproducibility of knowledge differences between patients and professionals but he did not analyze the validity of the knowledge included in his questionnaire.

Our questionnaire has not got more than one-dimensional structure like in Maciel et al.'s [19] and Méndez and Gómez-Conesa's [17] studies. Results from ICC, SEM and Bland–Altman limits revealed good behaviour of the scores. Therefore, HEBACAKNOW can be used as an instrument to measure the level of students' knowledge in any conceptual category, except for the standing posture category. Comparing these results with others, the present study can be considered as the first one to assess the psychometric properties of a questionnaire [17, 19].

Conclusions and future studies

According to our results, we can say that the questionnaire is useful for detecting the students' knowledge differences on daily life physical activity and it could be important to assess the effect of intervention programmes on the evolution of school population's knowledge. In this sense, it could be interesting to determine if that knowledge can help prevent back problems and what kind of knowledge is essential for it. The present work has considered a kind of knowledge related with know-how in adolescents' daily lives.

The effect of specific knowledge on health [29] suggests the necessity of research on the selection of relevant knowledge and its adaptation to the school context. The use of this questionnaire in future studies could help establish relationships between knowledge on back care and the prevalence of back pain in adolescents. Moreover, this instrument could help analyse the evolution of this kind of knowledge from adolescence to adulthood, as well as in

populations at risk. However, the relationship between back pain and the level of this knowledge remains unexplored, as well as the relative importance of each category to explain this relationship. It.is necessary to replicate these results with a representative sample of adolescents and also to establish a causal relationship between these results and other factors by means of longitudinal studies.

The fact that the questionnaire can be self-administered and completed quickly makes it a suitable instrument for longitudinal studies in bigger and broader samples. Therefore, HEBACAKNOW can be considered a fairly reliable and valid instrument to assess the level of knowledge on back care of Spanish adolescents between 14 and 17 years old in daily life physical activities.

However, the instrument can be improved in several aspects. For instance, future improved versions of HEBACAKNOW could include items testing students' knowledge and corporal postures when they use tablets, mobiles and other portable devices.

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Compliance with ethical standards

Conflict of interest The author declares that they have no conflict of interest.

References

1. Cardon G, Van Cauwenberghe E, De Bourdeaudhuij I (2011) What do we know about physical activity in infants and toddlers: a review of the literature and future research directions. Sci Sports 3:127–130
2. Dupré D (2001) Work-related health problems in the EU 1998–1999. Statics in focus. Eurostat, Luxembourg
3. King S, Chambers CT, Huguet A, MacNevin RC, MacGrath PJ, Parker L, MacDonald AJ (2011) The epidemiology of chronic pain in children and adolescents revisited: a systematic review. Pain 152:2729–2738
4. Hoy D, Brooks P, Blyth F, Buchbinder R (2010) The epidemiology of low back pain. Best Pract Res Clin Rheumatol 24:769–781
5. Dionne CE, Von Korff M, Koepsell TD (2001) Formal education and back pain: a review. J Epidemiol Community Health 55:455–468
6. Dolphens M, Cagnie B, Danneels L, De Clercq D, De Bourdeaudhuij I, Cardon G (2011) Long-term effectiveness of a back education programme in elementary schoolchildren: an 8-year follow-up study. Eur Spine J 20:2134–2142
7. Steele EJ, Dawson AP, Hiller JE (2006) School-based interventions for spinal pain: a systematic review. Spine 31:226–233
8. Nentwig CG (1999) Effectiveness of the back school. A review of the results of evidence-based evaluation. Orthopade 28:958–965
9. Leboeuf-Yde C, Kyvik KO (1998) At what age does low back pain become a common problem? A study of 29,424 individuals aged 12–41 years. Spine 23:228–234
10. Miñana-Signes V, Monfort-Pañego M (2015) Knowledge on health and back care education related to physical activity and exercise in adolescents. Eur Spine J. doi:10.1007/s00586-015-3953-7
11. Boulton-Davies IM (1979) Physiotherapists–teachers of the public. Physiotherapy 65:280
12. Cardon G, De Bourdeaudhuij I, De Clercq D (2001) Back care education in elementary school: a pilot study investigating the complementary role of the class teacher. Patient Educ Couns 45:219–226
13. Dockrell S, Earle D, Galvin R (2010) Computer-related posture and discomfort in primary school children: the effects of a school-based ergonomic intervention. Comput Educ 55:276–284
14. Ainpradub K et al (2015) Effect of education on non-specific neck and lowback pain: a meta-analysis of controlled trials. Man Therapy. doi:10.1016/j.math.2015.10.012
15. Heyman E, Dekel H (2009) Ergonomics for children: an educational program for elementary school. Work 32:261–265
16. Cardon G, De Clercq D, Geldhof E, Verstraete S, Bourdeaudhuij M (2007) Back education in elementary schoolchildren: the effects of adding a physical activity promotion program to a back care program. Eur Spine J 16:125–133
17. Mendez FJ, Gomez-Conesa A (2001) Postural hygiene program to prevent low back pain. Spine 26:1280–1286
18. Mokkink LB, Terwee CB, Patrick DL, Alonso J, Stratford PW, Knol DL, Bouter LM, de Vet HCW (2010) The COSMIN checklist for assessing the methodological quality of studies on measurement properties of health status measurement instruments: an international Delphi study. Qual Life Res 19(4):539–549
19. Maciel SC, Jennings F, Jones A, Natour J (2009) The development and validation of a low back pain knowledge questionnaire—LKQ. Clinics 64:1167–1175
20. Adams MA, Mannion AF, Dolan P (1999) Personal risk factors for first-time low back pain. Spine 24:2497–2505
21. Mohd AK, Zailina H, Shamsul BMT (2010) Neck, upper back and lower back pain and associated risk factors among primary school children. J Appl Sci 10:431–435
22. Whittfield J, Legg SJ, Hedderley DI (2005) Schoolbag weight and musculoskeletal symptoms in New Zealand secondary schools. Appl Ergon 36:193–198
23. Milanese S, Grimmer K (2004) School furniture and the user population: an anthropometric perspective. Ergonomics 47:416–426
24. Cardon G, De Clercq D, De Bourdeaudhuij I, Breithecker D (2004) Sitting habits in elementary schoolchildren: a traditional versus a moving school. Patient Educ Couns 54:133–142
25. Shrout P, Fleiss J (1979) Intraclass correlations: uses in assessing rater reliability. Psychol Bull 86:420–428
26. Bland JM, Altman DG (1996) Measurement error. Br Med J 313:744
27. Landis JR, Koch GG (1977) The measurement of observer agreement for categorical data. Biometrics 33:159–174
28. Terwee CB, Bot SD, de Boer MR, van der Windt DA, Knol DL, Dekker J, Bouter LM, de Vet HCW (2007) Quality criteria were proposed for measurement properties of health status questionnaires. J Clin Epidemiol 60:34–42
29. Keating XD, Harrison L, Chen L, Xiang P, Lambdin D, Dauenhauer B, Rotich W, Castro-Piñero J (2009) An analysis of research on student health-related J. fitness knowledge in K-16 physical education programs. J Teach Phys Educ 28:333–349