

Cross-cultural adaptation of children's environmental health questionnaires for nursing students in England

Health Education Journal
2020, Vol. 79(7) 826–838
© The Author(s) 2020
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/0017896920915594
journals.sagepub.com/home/hej



Cristina Álvarez-García^a , Carmen Álvarez-Nieto^a,
Rachel Carter^b, Janet Kelsey^b, Sebastián Sanz-Martos^a
and Isabel M López-Medina^a

^aDepartment of Nursing, University of Jaén, Jaén, Spain

^bSchool of Nursing and Midwifery, University of Plymouth, Plymouth, UK

Abstract

Objectives: Children are among the most vulnerable population groups with regard to environmental risks. Nursing students must be fully educated on children's environmental health as they are in a key position to prevent and reduce the effects of environmental hazards. The main objective of this study was to adapt and validate an English language version of two questionnaires about children's health and the environment, to assess the knowledge and skills of student nurses in England.

Design: Observational cross-sectional study.

Setting: A university in Southern England.

Method: The study involves translating, adapting and validating the Children's Environmental Health Knowledge Questionnaire (ChEHK-Q) and the Children's Environmental Health Skills Questionnaire (ChEHS-Q) with nursing students in England ($N=232$).

Results: The psychometric characteristics of both questionnaires were strong. Infit and outfit values were close to 1. The reliability values for the items and people were 0.96 and 0.79 for ChEHK-Q and 0.98 and 0.89 for ChEHS-Q, respectively. Only 52 (22.41%) and 77 (33.62%) participants had at least good knowledge and skills, respectively. Higher knowledge and skills were found with respect to the vulnerability of children and identification of environmental risks in the home. Lower levels of knowledge and skills were found with respect to the effects of pesticides and the assessment of neoplastic pollutants.

Conclusion: Findings demonstrate deficiencies in nursing competencies related to children's environmental health. The use of these questionnaires will facilitate improvement in both knowledge and skills related to children's environmental health among future nurses.

Keywords

Child health, environmental health, nursing students, questionnaire, university

Corresponding author:

Carmen Álvarez-Nieto, Department of Nursing, University of Jaén, Building B3, Office 243, Campus Las Lagunillas, 23071 Jaén, Spain.

Email: calvarez@ujaen.es

Introduction

In recent years, scientific evidence has shown that climate change is a health problem of major dimensions (Landrigan et al., 2019; Sullivan-Marx and McCauley, 2017). Children are an especially vulnerable group in relation to exposure to environmental risk factors because of their physical immaturity and psychosocial dependence. They are also at risk due to their need for positive stimuli and their specific communication needs. More than two thirds of children are threatened by environmental risks in their own homes where they learn and play (McBride, 2016). The World Health Organization (WHO) estimates that approximately one third of the disease burden in developing countries is attributable to modifiable environmental factors, including indoor and outdoor air pollution, unsafe water, inadequate sanitation and hygiene (Etzel, 2015).

Health professionals have an important role to play in understanding and communicating when issues related to environmental risks are a major health threat (McBride, 2016). The International Council of Nurses and Nursing Now (2018) statement on the Sustainable Development Goals stressed the importance of nurses having a comprehensive education in children's environmental health. This should enable nurses to respond to children at different stages of growth and development to prevent and alleviate environmental hazards relevant to key developmental stages. In order for nurses to gain this knowledge and skills, it is imperative that nursing curricula address these issues; however, evidence suggests that existing teaching on this issue is somewhat limited (McDermott-Levy et al., 2019).

Identified child health competency deficits will require nurse educators to take a strong lead in ensuring that future nurses are adequately prepared to identify, prevent and treat environmental child health issues. This places nurse education in a key position to equip nurses with the knowledge and skills to pioneer innovative and creative responses to improving environmental child health (McDermott-Levy et al., 2019; Torres-Alzate et al., 2020; Walpole et al., 2019). Similarly, nurses need relevant knowledge and skills to promote children's environmental health (Álvarez-Nieto et al., 2017; Gellar, 2015; López-Medina et al., 2019).

This education should address environmental impacts and the need for effective health promotion. Additional key aspects include nutrition, smoking, the effects of passive smoking and environmental issues around food production (López-Medina et al., 2019). It should also encompass the interaction between the environment and child health at different levels (Álvarez-Nieto et al., 2017).

Nurses must develop competence in communication skills to undertake health promotion, environmental health counselling and education for children and families. It is also important for nurses to develop the ability to reflect and act upon on environmental risks and related interventions from a holistic and ethical perspective (Álvarez-Nieto et al., 2017; López-Medina et al., 2019).

Nurses are in a unique position to promote health as a key part of their role (López-Medina et al., 2019). However, to achieve this, it is necessary to have accurate knowledge and skills with respect to children's environmental health. Assessing this knowledge and skills can be undertaken using questionnaires that are reliable and valid. Recommendations can then be made in relation to the educational measures needed to ensure that future nurses are able to prevent, detect and eliminate environmental risks in children's lives (Richardson et al., 2014).

Felicilda-Reynaldo et al. (2018) conducted a multi-Arab country study of nursing students focusing on the knowledge, attitudes and perceptions of the health impacts of climate change and the role of nursing in addressing them. Findings revealed only a moderate knowledge of environmental health. Factors affecting this included the student's country of residence, type of community and academic year. Nigatu et al. (2014) used a questionnaire with Ethiopian health science students to assess their knowledge of the health impacts of climate change. Over three quarters of

the students were aware of the health consequences of climate change. A study by Álvarez-García et al. (2018) in Spain assessed students' knowledge and skills related to children's environmental health using the Children's Environmental Health Knowledge Questionnaire (ChEHK-Q) and the Children's Environmental Health Skills Questionnaire (ChEHS-Q), respectively. Concerningly, it identified a substantial number of students whose knowledge and skills were not adequate in this important area.

Good-quality scales and/or questionnaires should demonstrate psychometric properties of consistency in both reliability and validity (Polit and Beck, 2008). Only two of the knowledge questionnaires used had been validated in the Arab (Felicilda-Reynaldo et al., 2018) and Spanish (Álvarez-García et al., 2018) contexts. The ChEHK-Q was developed and validated to determine specific knowledge of environmental pollutants and their effects on children's health, and in relation to skills, the ChEHS-Q specifically assesses skills to manage environmental risks in nursing (Álvarez-García et al., 2018); neither of these questionnaires, however, has been validated among English-speaking students in an English context.

There appears to be an absence of adequate English language tools to determine the competencies of nursing students in relation to the major environmental issues affecting children's health. The first objective of this study, therefore, was to translate, adapt and validate an English language version of the ChEHK-Q and ChEHS-Q scales that had previously been developed and tested with students in Spain. These scales were then tested on a cohort of English student nurses studying for a BSc degree in child health nursing. The second objective was to assess the knowledge and skills related to environmental health issues relevant to children among nursing students in Southern England.

Materials and methods

The study used an observational cross-sectional design to translate, adapt and validate the ChEHK-Q and the ChEHS-Q (Álvarez-García et al., 2018) for future use among nursing students in England.

- ChEHK-Q is composed of 26 items, with *true*, *false* and *I do not know* answer options, with a maximum score of 26 points. The score range varies from *excellent knowledge* (>90% correct answers) through *very good knowledge* (80%–89%), *good knowledge* (60%–79%) and *insufficient knowledge* (40%–59%), to *poor knowledge* (<39%).
- ChEHS-Q is composed of 12 items, for which the response options range from one to five on a Likert-type scale, with a maximum score of 60 points. Items 2, 4, 6, 8, 11 and 12 are reverse-scored. The score range varies from *excellent skills* (>90% perceived skills) through *very good skills* (80%–89%), *good skills* (70%–79%) and *insufficient skills* (50%–69%) to *poor skills* (<49%).

International Test Commission (2017) guidelines were followed in translating, adapting and validating the questionnaires. As the original versions of the ChEHK-Q and the ChEHS-Q were designed as a 26-item questionnaire and a 12-item questionnaire, respectively, both are available online or on paper and can be self-administered. Scores are calculated by adding up the number of correct answers on the ChEHK-Q or by adding up the scores obtained on the Likert-type scale for the ChEHS-Q. The questionnaires are available through the website of the project that developed them (Nursing and Innovation in Healthcare, 2018). This process of translation, adaptation and validation consisted of two phases:

Phase 1: translation and adaptation process

First, the questionnaires were translated into English using a centred or asymmetric method (Polit and Beck, 2008) to ensure that all the items of the questionnaires were translated without changing their meaning, adding new items or eliminating any of the items. This method was used because the questionnaires had been used in a previous study (Álvarez-García et al., 2018) with the same objectives as the current investigation. There were distinctive and desirable features which needed to be consistent.

To achieve semantic equivalence (Polit and Beck, 2008), translation was undertaken by two bilingual English natives, a lecturer in child health nursing and a student nurse. Following this, the authors of this study and the translators discussed any disagreements to reach a consensus which produced a single version (synthesis) from both translations. This was followed by a back-translation (the translated items were translated into Spanish again) by two bilingual Spanish native speakers, two lecturers with experience in translation, and finally, a committee was formed with the translators and the authors. From this, a matrix was built to visualise the original item, the translated item and the two back-translated items (Supplemental Materials 1 and 2). Minor discrepancies between them were found, and these were adjusted to ensure that the meaning of the English language items was equivalent to the meaning of the Spanish language items. All those involved in this process were given information about the key constructs, the aim of the questionnaires and the target population to enhance consistency.

It was important to achieve conceptual equivalence as suggested by Polit and Beck (2008) so as to ensure that the concepts of children's environmental health knowledge and children's environmental skills were understandable in the target culture. Two of the lecturers undertaking the research at the university in England were asked to amend the English language grammar and syntax. This was appropriate as they were familiar with the target culture.

Phase 2: validation process

A sample size of at least 222 was required to align with the recommendations for the validation of questionnaires proposed by Streiner and Kottner (2014) and also to achieve a statistical power of 80% based on the previous study undertaken by Álvarez-García et al. (2018). This was achieved with a sample size of 232 undergraduate nursing students registered in the first, second and third years of a BSc programme in child health nursing (Table 1). The questionnaires were sent by email to the students, who completed them individually rather than in groups or pairs, using SurveyMonkey. Data collection took place between May and September 2018. Students who completed the questionnaire inadequately or incompletely were excluded. The response rate was 88%.

A psychometric analysis of the questionnaires was carried out using item response theory (Navas, 1994). First, the one-dimensionality of the questionnaires was assessed through an exploratory factor analysis (EFA) of each one. Both questionnaires were found to be one-dimensional as in the original Spanish versions. Second, local independence was checked using Yen's Q3 statistic; the item correlations ranged from $-.25$ to $.24$ for the ChEHK-Q and from -0.35 to 0.41 for the ChEHS-Q (these values are near to the recommended values ± 0.2 ; Meyer, 2014). Third, a one-parameter model was used to enable separate evaluation of students' ability (θ) and item difficulty (β). Students' differing abilities in the knowledge or skills items of differing complexities were colocated on a single hierarchical linear scale. This was represented on an item map. Infit (weighted mean square fit) and outfit (standardised weighted mean square fit) statistics were used to fit the data to the model (optimal fit values ranged from 0.7 to 1.3; Prieto and Delgado, 2003). Departures

Table 1. Participants' characteristics ($n = 232$).

Characteristics	<i>n</i>	%
Age (<i>M/SD</i>)	23.44/5.59	
Gender		
Men	4	1.70
Women	228	98.30
Year of course		
First	75	32.30
Second	92	39.70
Third	65	28.00
Have attended a session on sustainability and nursing		
Yes, within 3 months	69	29.74
No	101	43.53
Yes, but over 3 months ago	62	26.72

from acceptable fit statistical parameters alerted the researcher to survey answers that might not be indicative of the construct being measured.

The ChEHK-Q was analysed using the Rasch model. This calculated the difficulty of the items, with 0 being the mean level of difficulty; this statistic classified the item with the highest score as the easiest and the item with the lowest score as the most difficult. The model also considered the separation index which identifies whether participants answered all items with the same rating category and avoided answering with other rating categories at either end of the scale. Separation values should ideally be larger than 2 (Meyer, 2014). An internal consistency value of 0.70 or higher (Nunnally and Bernstein, 1995) was considered acceptable for the reliability analysis; these values were calculated for items and subjects. The ChEHS-Q was analysed using Andrich's rating scale model which is based on similar assumptions and parameters as the Rasch model. In addition to item (mis)fit, this model was used to analyse threshold ordering by checking estimated threshold locations along the latent trait (skills in children's environmental health). The thresholds should range from negative to positive values, and a change in this order may indicate the inappropriate functioning of response categories. These analyses were performed with jMetrik software using a joint maximum likelihood method.

Descriptive analysis

The total addition of the number of items with correct answers was used to calculate the knowledge score, and the total addition of the points on the Likert-type scales was used to calculate the skills score. So, the descriptive values of the questionnaire scores were correct answers and ignorance index for knowledge items and means for skills items. The number of participants with excellent, very good, good, insufficient or poor knowledge and skills was calculated using the instruments' guidelines (Álvarez-García et al., 2018). The relationship between knowledge and attitudes was determined using the Pearson's correlation coefficient. The rule of thumb (Mukaka, 2012) was used for interpreting the size of the correlation coefficient. Tests of differences of means were also used to compare questionnaire scores according to gender, year of study and attendance at sessions on sustainability and nursing, to detect any statistically significant differences between scores. The normality of the data distribution was tested using the Kolmogorov–Smirnov test. A value of $p < .05$ was estimated to be significant. Data were entered into SPSS version 24 for analysis.

Ethics

This study was granted ethical approval by the Institutional Review Board of University of Plymouth. An information sheet was given to participants and, if they wanted to proceed, they were required to sign a written consent form. We followed university policy on safe storage, transport, access and use of data. Students were not obliged to fill out the questionnaires and not doing so did not affect their grade for any course. The confidentiality of any personal data that might identify participants was guaranteed.

Results

Children's Environmental Health Knowledge Questionnaire

In the Rasch model, the items showed central values of 1 for infit and outfit (Table 2). To check the correct item functioning, θ and β were represented on an item map (Figure 1). Most of the items were in the central area where the greatest load of student ability was represented, although there were some items in the high and the low part of the student density to classify participants with high and low knowledge, respectively.

Item 5 'Nitrogen oxide from fossil fuels in the home and tobacco smoke causes redness and burns on the skin' surpassed the set outfit value, 1.83, but its infit value was adequate and was functioning correctly in the item map. The global mean for the infit was 0.995 (0.857–1.156), and the global mean for the outfit was 0.997 (0.749–1.837); these values are in the average of the setting values for infit and outfit. The difficulty values ranged from –1.48 to 1.67, ranging from negative to positive values, so that in this broad spectrum, students could be properly classified according to their knowledge.

The item separation index was 4.96, and the student separation index was 1.99; so, the adequacy of the items to classify the students according to their knowledge was shown. The reliability value for the items was 0.96 and for the students was 0.79. These values show the strength of the items to adequately rank students on the latent trait.

Children's Environmental Health Skills Questionnaire

In the ChEHS-Q Andrich's rating scale model (Table 3), item 3, 'I am able to identify the environmental risks that can cause neoplastic diseases in a child', showed a slight overfit (1.32 for infit and 1.31 for outfit) as did item 4, 'I am NOT able to identify the environmental risks that can cause neurological disorders in a child' (1.31 for infit and outfit).

To assess the items' functioning, they were displayed on an item map (Figure 2). Most of the items were in the central region, as were most of the students. This means that the range of test items presented to the students was appropriate for this group of respondents. The mean infit value was 0.996 (0.723–1.313), and mean outfit value was 1.001 (0.712–1.302). Difficulty values ranged from –0.85 to 1.51, ranging from negative to positive values, so that students could be properly classified according to their skills. The item separation index was 6.98 and the student separation index was 2.85. Demonstrated by the value surpassing 2, the number of items was sufficient to classify students according to their skills. Reliability for the set of items was 0.98, and for students, it was 0.89, being acceptable in both cases. The values identified demonstrate the capacity of the items to adequately rank students on the latent trait as well.

Table 2. Parameters of the ChEHK-Q Rasch model.

Item	Difficulty (SE)	Infit ^a	Outfit ^b
1. The paediatric population is more susceptible to environmental threats due to their biological immaturity.	-1.48 (0.17)	1.07	1.06
2. The increased energy and metabolic consumption of the paediatric population protects children from environmental hazards.	0.01 (0.15)	0.91	0.89
3. The higher rate of cell growth during the paediatric age increases the risk of health effects caused by environmental factors.	-0.59 (0.15)	1.01	0.97
4. Environmental factors do not influence hormonal secretion during puberty.	-0.89 (0.15)	0.91	0.84
5. Nitrogen oxide from fossil fuels in the home and tobacco smoke causes redness and burns on the skin.	1.37 (0.18)	1.09	1.83
6. Particles from animals exacerbate asthma crisis.	-1.37 (0.16)	1.09	1.08
7. Increased humidity at home improves respiratory diseases in children.	0.15 (0.15)	1.08	1.30
8. Passive smoking is associated with the development of acute leukaemia in children.	-0.10 (0.15)	1.01	0.97
9. Childhood leukaemia incidence rates are higher in the areas most exposed to radon.	-0.46 (0.15)	0.97	0.94
10. Overexposure to solar ultraviolet radiations can damage the skin of adults more severely than that of children.	-0.80 (0.15)	0.98	0.95
11. During childhood more than half of the expected lifetime solar ultraviolet radiation is absorbed.	0.34 (0.15)	0.91	0.82
12. Lead accumulates in the body affecting the nervous system.	-0.36 (0.15)	0.94	0.90
13. Chronic dietary exposure to mercury (fish and shellfish) is less toxic to children's central nervous system than to adults.	-0.46 (0.15)	0.95	0.92
14. Exposure to pesticides increases the risk of developing attention deficit problems in school-aged children.	0.26 (0.15)	0.93	0.88
15. Children born to smoking mothers during pregnancy are at risk of lower intellectual capacity.	-0.76 (0.15)	1.01	1.06
16. Exposure to organic solvents during foetal development can cause learning disabilities in children.	0.09 (0.15)	1.00	0.95
17. Water containing nitrates can only cause intoxication during childhood.	0.15 (0.15)	0.95	0.92
18. Chlorination of water forms subproducts from the disinfection process that have been classified as carcinogenic.	0.96 (0.16)	0.88	0.78
19. The major source of childhood exposure to pesticides is through ambient air.	1.67 (0.19)	1.06	0.94
20. The main route of exposure to mercury is through cereal intake.	0.03 (0.15)	0.96	0.95
21. Exposure to lead through diet occurs mainly through fish intake.	1.44 (0.18)	1.00	1.01
22. Food colourings and preservatives are associated with central nervous system problems.	0.91 (0.16)	0.86	0.75
23. Genetically modified foods cause fewer allergic reactions in children.	-0.01 (0.15)	1.02	1.00
24. Schools and nurseries are environmentally safe places.	-0.18 (0.15)	0.99	0.95
25. Children are exposed to higher concentrations of air pollutants at home than outdoors.	0.07 (0.15)	1.15	1.09
26. Parks and gardens are the areas with the least environmental pollutants where children can play.	0.03 (0.15)	1.11	1.15

ChEHK-Q: Children's Environmental Health Knowledge Questionnaire.

Values exceeding the limits set for infit and outfit (0.80–1.20) are in boldface.

^aInfit = weighted mean square fit.

^bOutfit = unweighted mean square fit.

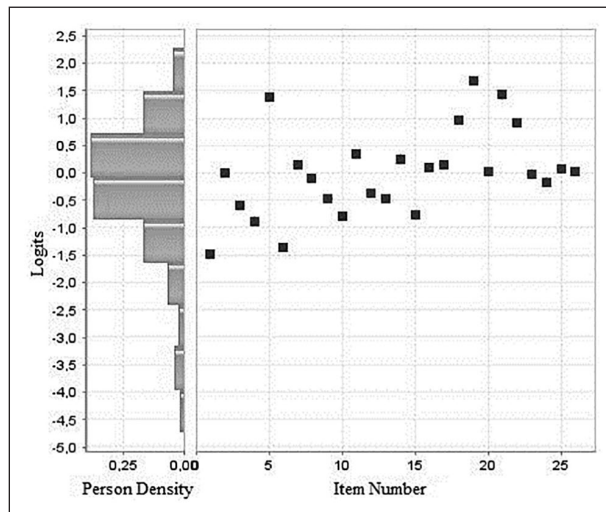


Figure 1. ChEHK-Q item map. The left side shows the distribution of the scores obtained by students, expressed in logit units and known as person density (θ). The right side shows the distribution of items according to their difficulty (β). The horizontal axis shows the items ordered from 1 to 26. The vertical axis shows the difficulty index of the items; higher values indicate more difficult items. Values higher than 0 denote high knowledge; values lower than 0 indicate low knowledge.

Table 3. Parameters of the ChEHS-Q rating scale model.

Item	Difficulty (SE)	Infit ^a	Outfit ^b
1. I am able to assess the main environmental risks to which a child is exposed.	-0.23 (0.09)	0.94	0.98
2. I am NOT able to identify the environmental risks that can cause respiratory diseases in a child.	-0.71 (0.09)	0.99	0.97
3. I am able to identify the environmental risks that can cause neoplastic diseases in a child.	1.51 (0.09)	1.32	1.31
4. I am NOT able to identify the environmental risks that can cause neurological disorders in a child.	0.52 (0.09)	1.31	1.31
5. I am able to provide health education to parents about the main contaminants in their child’s food.	0.73 (0.09)	1.23	1.24
6. I am NOT able to identify the environmental risks in playgrounds.	-0.37 (0.09)	1.18	1.22
7. I am able to provide health education to parents about actions to minimize environmental risks to which a child is exposed when playing outdoors.	0.05 (0.09)	0.72	0.71
8. I am NOT able to identify the environmental risks in a child’s home.	-0.85 (0.09)	0.85	0.81
9. I am able to provide health promotion to parents about environmental risks at home.	-0.43 (0.09)	0.75	0.73
10. I am able to identify the environmental risks in a child’s school.	-0.26 (0.09)	0.73	0.73
11. I am NOT able to identify the actions needed to combat environmental risks in a child’s school.	-0.09 (0.09)	0.75	0.71
12. I do NOT feel able to do my job as a nurse in a paediatric environmental health speciality unit.	0.14 (0.09)	1.16	1.28

ChEHS-Q: Children’s Environmental Health Skills Questionnaire.
 Values exceeding the limits set for infit and outfit (0.70–1.30) are in boldface.
^aInfit = weighted mean square fit.
^bOutfit = unweighted mean square fit.

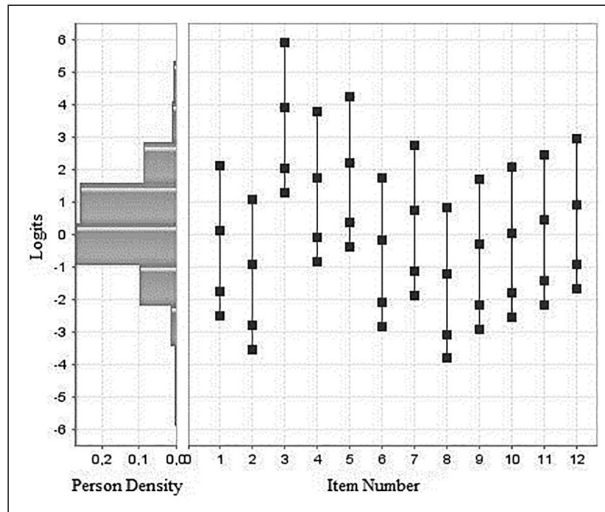


Figure 2. ChEHS-Q item map. The left side shows the distribution of the scores obtained by students, expressed in logit units and known as person density (θ). The right side shows the distribution of items according to their difficulty (β). The horizontal axis shows the items ordered from 1 to 12. The vertical axis shows the difficulty index of the items; higher values indicate more difficult items. Values higher than 0 denote high skills; values lower than 0 indicate low skills.

Table 4. Statistics of Likert-type categories for the ChEHS-Q rating scale model.

Likert category	Threshold (SD)	Infit	Outfit
0			
1	-2.00 (0.09)	0.97	0.96
2	-1.24 (0.06)	0.82	0.84
3	0.62 (0.05)	0.85	0.83
4	2.63 (0.08)	1.17	1.11

ChEHS-Q: Children's Environmental Health Skills Questionnaire.

Table 4 shows that the thresholds on the ChEHS-Q Likert-type scale range from a low of -2.00 to a high of 2.63 , increasing their value progressively on the scale; there were no reversals. This would suggest that the Likert-type scale was working correctly with five response options.

Descriptive analysis

For the ChEHS-Q, the mean score was 11.59 ± 5.09 . Item 1, 'The paediatric population is more susceptible to environmental threats due to their biological immaturity', was the item that had the highest percentage of correct answers (72.8%), while item 19, 'The major source of childhood exposure to pesticides is through ambient air', had the lowest (15.1%). The most unknown item was 18, 'Chlorination of water forms subproducts from the disinfection process that have been classified as carcinogenic', with an ignorance index of 68.50%. For the ChEHS-Q, the mean score was 38.36 ± 7.86 . Item 8, 'I am able to identify the environmental risks in a child's home', was the item with the highest perceived skills (3.73 ± 0.90), while item 3, 'I am able to identify the environmental risks that can cause neoplastic diseases in a child', was the one with the lowest perceived

skills (2.17 ± 0.99). Only 52 (22.41%) participants had at least good knowledge, and the number of participants with at least good skills was 77 (33.62%). There was a weak positive correlation between knowledge and total attitude scores ($p < .001$, $r = .31$).

With respect to knowledge, there were statistically significant differences between male (14.50 ± 1.29) and female students (11.54 ± 5.12), $t(230) = -4.06$, $p = .010$, $d = 0.79$, but there were no statistically significant differences between the different years of the course: first year (11.36 ± 5.03), second year (11.72 ± 5.14) and third year (11.68 ± 5.17), $F(2, 231) = 0.11$, $p = .892$. There were no statistically significant differences in attendance at sessions on sustainability and nursing: yes (11.99 ± 5.64) and no (11.42 ± 4.86), $t(230) = -0.77$, $p = .443$. In relation to skills, there were no statistically significant differences in gender: male (40.00 ± 2.45) and female students (38.33 ± 7.93), $t(227) = -0.42$, $p = .675$; in years of the course: first year (37.50 ± 7.98), second year (38.72 ± 8.05) and third year (38.80 ± 5.52), $F(2, 228) = 0.625$, $p = .536$; or in attendance at sessions on sustainability and nursing: yes (38.40 ± 8.33) and no (38.34 ± 7.68), $t(227) = -0.06$, $p = .654$.

Discussion

The first objective of this study was to adapt and validate among nursing students an English language version of knowledge and skills questionnaires concerning children's environmental health which had already been developed and tested with Spanish students. Both questionnaires showed reasonable psychometric characteristics in the English-speaking context.

The study was developed using item response theory, as it has certain advantages compared over classical test theory (Navas, 1994). The intention was to assess the validity of the ChEHK-Q and ChEHS-Q to measure the latent traits of 'knowledge of children's environmental health' and 'skills in children's environmental health' among English-speaking nursing students in an English context. Item response theory techniques allowed nonlinear raw data to be converted to a linear scale, which can then be evaluated through the use of parametric statistical tests, showing that the questionnaires were valid within this context. This linear scale ranged from the most simplistic to the most difficult children's environmental health knowledge and skills, and this was then plotted against the students' abilities, ranging from least to most able participant. There was only one item which demonstrated misfit in the ChEHK-Q model and two items which did so in the ChEHS-Q model, but they were functioning properly in the linear scale shown in the item maps.

The second objective was to assess students' knowledge and skills related to environmental health issues relevant to children. Descriptive analysis showed that most of the students did not have high levels of knowledge and skills, which is a major cause for concern; the percentage of students with at least good knowledge and skills was low. Students knew about children's vulnerability to environmental pollutants, but they did not know about the effects of pesticides or of the chlorination of water on childhood. They perceived that they had good skills with which to identify environmental risks in the home but they did not perceive that they were capable of identifying neoplastic disease caused by environmental pollutants.

There were no statistical differences between different years of the course or between attendance and nonattendance at the sustainability session. This may be because the current nursing curriculum does not include a focus on environmental issues, and students who attended the sustainability session did so on a voluntary basis. Moving forward, environmental issues could be introduced using an infusion model whereby sustainability issues are woven into the existing curriculum (McDermott-Levy et al., 2019).

However, male students' skills were higher than those of the female students, although this may not be significant as the number of men was so low. This may need to be studied with a valid sample size to draw firm conclusions.

If the results from Spanish undergraduate nursing students enrolled in their first, third and fourth years (Álvarez-García et al., 2018) are compared with these most recent results, the Spanish students achieved higher mean scores: 15.19 for the ChEHK-Q and 41.10 for the ChEHS-Q. This aside, although there were a higher number of Spanish students with insufficient or poor knowledge and skills, the percentage of students with at least good knowledge and skills was higher at 47.73% and 44.81%, respectively, for knowledge and skills among the Spanish students.

In the study conducted in Arab countries, the mean score for undergraduate nursing students with respect to their level of knowledge regarding the potential health-related impact of climate change using a 0–10 scale was 6.23, thus indicating a moderate level of knowledge (Felicilda-Reynaldo et al., 2018), whereas in the present study, the score was lower (at 4.46) and did not even reach the midpoint of the scale. In this study, nursing students were enrolled in their second, third and fourth years, with none enrolled in the first year, and so, this may account at least in part for the results. However, it is also possible that the Arab countries have been more affected by climate change; hence, student nurses' knowledge of its effects may be greater. These findings might be related to the presence of environmental legislation, which has become a key part of countries' development plans.

With respect to the future, it is important to ensure that future nurses are fully conversant with environmental health issues and that they are prepared to respond to them in a proactive manner. It is fundamental that universities strive towards curricula that fully endorse environmental health as a key theme, particularly in the health arena. One previous study (Álvarez-García et al., 2019) undertaken in the UK and Spain found that the attitudes of nursing students towards children's environmental health were generally favourable and this can provide a foundation for the future development of appropriate curricula (Junyent and Geli de Ciurana, 2008) addressing these issues together with the continuing use of the e-NurSus Children intervention (Álvarez-García et al., 2019).

Limitations

The first limitation was due to social desirability bias since the questionnaires were self-reported. The second limitation was that the ChEHS-Q only measured students' confidence in their skills, and this was not confirmed by an objective observation of the skills in practice. The third limitation was that the sample was derived without randomisation, and therefore, the results could be an overestimate as since an unrandomised sample has been used, there is the possibility that the more highly motivated students who were more confident and knowledgeable were the ones who self-selected to complete the survey. The fourth limitation was that the role of race and ethnicity of the students was not clarified in the sample, and this may have affected the results. In addition, significantly more women were participants, so the learning patterns may reflect a gender bias.

Conclusion

The ChEHK-Q and ChEHS-Q have been shown to be valid and reliable tools for measuring knowledge and perceived skills, respectively, among nursing students in England. Findings show that the nursing students who took part in the study in England were not adequately prepared to identify and act upon environmental problems and related child health issues. It is important to increase, improve and develop child environmental health education for student nurses in the future to address some of the identified weak areas. It will be important to evaluate the success of doing this in due course.

Acknowledgements

We thank the staff who helped to collect the data and make this research possible. We also like to thank the translators who helped to adapt the questionnaires and the nursing students who agreed to participate in the study.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was financially supported by the University of Jaén.

ORCID iD

Cristina Álvarez-García  <https://orcid.org/0000-0003-1381-7207>

Supplemental material

Supplemental material for this article is available online.

References

- Álvarez-Nieto C, López-Medina IM, Linares-Abad M, et al. (2017) Curriculum nurse and strategies training on environmental sustainability and climate change. *Enfermería Global* 16(3): 651–664.
- Álvarez-García C, Álvarez-Nieto C, Kelsey J, et al. (2019) Effectiveness of the e-NurSus children intervention in the training of nursing students. *International Journal of Environmental Research and Public Health* 16(21): 4288.
- Álvarez-García C, Álvarez-Nieto C, Pancorbo-Hidalgo PL, et al. (2018) Student nurses' knowledge and skills of children's environmental health: Instrument development and psychometric analysis using item response theory. *Nurse Education Today* 69: 113–119.
- Etzel RA (2015) Environmental hazards that matter for children's health. *Hong Kong Journal of Paediatrics* 20: 86–94.
- Felicilda-Reynaldo RFD, Cruz JP, Alshammari F, et al. (2018) Knowledge of and attitudes toward climate change and its effects on health among nursing students: A multi-Arab country study. *Nursing Forum* 53(2): 179–189.
- Gellar MC (2015) An environmental clinical experience in a RN-BS program. *Journal of Community Health Nursing* 32(4): 212–217.
- International Council of Nurses and Nursing Now (2008) *Astana Declaration on Primary Health Care: From Alma-Ata towards Universal Health Coverage and the Sustainable Development Goals*. Available at: <https://www.icn.ch/sites/default/files/inline-files/PHC%20statement%20ICN-NN.pdf> (accessed 16 February 2020).
- International Test Commission (2017) *The ITC Guidelines for Translating and Adapting Tests*. 2nd ed. Available at: https://www.intestcom.org/files/guideline_test_adaptation_2ed.pdf (accessed 29 August 2019).
- Junyent M and Geli de Ciurana AM (2008) Education for sustainability in university studies: A model for reorienting the curriculum. *British Educational Research Journal* 34(6): 763–782.
- Landrigan PJ, Fuller R, Fisher S, et al. (2019) Pollution and children's health. *Science of the Total Environment* 650(Pt 2): 2389–2394.
- López-Medina IM, Álvarez-Nieto C, Grose J, et al. (2019) Competencies on environmental health and pedagogical approaches in the nursing curriculum: A systematic review of the literature. *Nurse Education in Practice* 37: 1–8.
- McBridge DL (2016) How climate change affects children's health. *Journal of Pediatric Nursing* 31: 350–352.
- McDermott-Levy R, Jackman-Murphy KP, Leffers JM, et al. (2019) Integrating climate change into nursing curricula. *Nurse Educator* 44(1): 43–47.
- Meyer JP (2014) *Applied Measurement with Jmetrik*. New York: Routledge.

- Mukaka MM (2012) A guide to appropriate use of correlation coefficient in medical research. *Malawi Medical Journal* 24: 69–71.
- Navas MJ (1994) Teoría clásica de los tests versus teoría de respuesta al ítem [Classical test theory versus item response theory]. *Psicológica* 15: 175–208.
- Nigatu AS, Asamoah BO and Kloos H (2014) Knowledge and perceptions about the health impact of climate change among health sciences students in Ethiopia: A cross-sectional study. *BMC Public Health* 14: 587.
- Nunnally JC and Bernstein IH (1995) *Teoría Psicométrica*. 2nd ed. Mexico City, Mexico: McGraw-Hill.
- Nursing and Innovation in Healthcare (2018) Children's environmental health. Available at: <http://cuidosalud.com/en/inv/children-environmental-health/> (accessed 29 August 2019).
- Polit DF and Beck CT (2008) Developing and testing self-report scales. In: Polit DF and Beck CT (eds) *Nursing Research, Generating and Assessing Evidence for Nursing Practice*. 8th ed. Philadelphia, PA: Lippincott Williams & Wilkins, pp.474–505.
- Prieto G and Delgado AR (2003) Análisis de un test mediante el modelo de Rasch [Analysis of a test using the Rasch model]. *Psicothema* 15(1): 94–100.
- Richardson J, Grose J, Doman M, et al. (2014) The use of evidence-informed sustainability scenarios in the nursing curriculum: Development and evaluation of teaching methods. *Nurse Education Today* 34(4): 490–493.
- Streiner DL and Kottner J (2014) Recommendations for reporting the results of studies of instrument and scale development and testing. *Journal of Advanced Nursing* 70(9): 1970–1979.
- Sullivan-Marx E and McCauley L (2017) Climate change, global health, and nursing scholarship. *Journal of Nursing Scholarship* 49(6): 593–595.
- Torres-Alzate HM, Law-Wilson L, Harper DC, et al. (2020) Essential global health competencies for baccalaureate nursing students in the United States: A mixed methods Delphi study. *Journal of Advanced Nursing* 76(2): 725–740.
- Walpole SC, Barna S, Richardson J, et al. (2019) Sustainable healthcare education: Integrating planetary health into clinical education. *The Lancet Planetary Health* 3(1): e6–e7.