Confirmatory factor analysis and item response theory analysis of the Whiteley Index. Results from a large population based study in Norway. The Hordaland Health Study (HUSK)

ARTICLE *in* JOURNAL OF PSYCHOSOMATIC RESEARCH · SEPTEMBER 2014

Impact Factor: 2.74 · DOI: 10.1016/j.jpsychores.2014.06.011

4 AUTHORS, INCLUDING:

Børge Sivertsen
Norwegian Institute of Public Health
111 PUBLICATIONS **1,907** CITATIONS
SEE PROFILE

Ingvard Wilhelmsen
University of Bergen
63 PUBLICATIONS **1,535** CITATIONS
SEE PROFILE

Jens Christoffer Skogen
Norwegian Institute of Public Health, Berge…
37 PUBLICATIONS **301** CITATIONS
SEE PROFILE

Journal of Psychosomatic Research 77 (2014) 213–218

Contents lists available at ScienceDirect

Journal of Psychosomatic Research

Confirmatory factor analysis and item response theory analysis of the Whiteley Index. Results from a large population based study in Norway. The Hordaland Health Study (HUSK)

Kari-Elise Frøystad Veddegjærde [a,b,c,*], Børge Sivertsen [b,d,e], Ingvard Wilhelmsen [a,c], Jens Christoffer Skogen [b,d,f]

[a] Department of Clinical Science, University of Bergen, Bergen, Norway
[b] Division of Mental Health, Norwegian Institute of Public Health, Bergen, Norway
[c] Department of Medicine, Haraldsplass Deaconess Hospital, Bergen, Norway
[d] Uni Health, Uni Research, Bergen, Norway
[e] Department of Psychiatry, Helse Fonna HF, Haugesund, Norway
[f] Alcohol and Drug Research Western Norway, Stavanger University, Hospital Stavanger, Stavanger, Norway

ARTICLE INFO

Article history:
Received 7 January 2014
Received in revised form 20 June 2014
Accepted 22 June 2014

Keywords:
Health anxiety
Hypochondriasis
Whiteley Index
Item response theory analysis
Factor structure
Population based study

ABSTRACT

Objective: The Whiteley Index (WI) is a widely used screening instrument for health anxiety/hypochondriasis. Several studies have previously explored the psychometric properties of the WI, but with mixed findings concerning both item composition and factor structure. The main aim of the current study was to examine different factor structures as identified from previous studies using data from a large general population based study. We also wanted to provide gender specific norms.
Methods: Data were taken from a large population-based study in Norway, the Hordaland Health Study (HUSK N = 7274). Confirmatory factor analysis (CFA) of several models of the WI was conducted. Item response theory (IRT) analysis was performed on the model with the best goodness-of-fit.
Results: CFA of all previously proposed factor models of the WI revealed clearly inadequate model fits. The IRT analysis suggested that a six-item model best described the data, and CFA confirmed an adequate goodness-of-fit across indices.
Conclusion: The current study found evidence for a six-item, single-factor model of the WI. Our findings suggest that this abbreviated version has the best factor structure compared to previously proposed factor models. We recommend that the factor structure identified in this study should be investigated further in independent samples.

Introduction

The clinical features of health anxiety (HA) are excessive fear and worrying about having a serious illness, or getting an illness [1]. HA is often referred to as hypochondriasis, but in most scientific literature today the term HA is used. In HA, the patients focus on physical symptoms, keep track of all bodily changes and frequently misinterpret these as signs of a serious illness [2]. HA is not uncommon in primary care, with estimates ranging from 2% to 9% when abridged HA is included [3–5]. In the general population the estimates range from 0.07% to 2% [2,6]. The worry and bodily preoccupation persist despite appropriate medical evaluation and reassurance, causing significant distress and impairment for the patient [7]. It addition to negatively affecting the patients' well-being, quality of life, occupational functioning and daily life [8], some studies have also shown HA-patients to have a near twofold increased use of health care services compared to the general population [9]. As such, in addition to the consequences for individual patients, HA also has substantial adverse socio-economical impact [10–12].

There are several screening tools for HA; the "Hypochondriasis Yale–Brown Obsessive–Compulsive Scale" [13], "Illness Behavior Questionnaire" [14], the "Illness Attitude Scale" [15], "Health Anxiety Questionnaire" [16], "The Reassurance Questionnaire" [17], "The Somatosensory Amplification Scale" [18], the "Health Anxiety Inventory" [19], and the "Whiteley Index" (WI) [20]. The latter screening tool, WI, was introduced by Pilowsky in the 1960s [20] as a 14-item self-report measure (originally dichotomous items (true/false)) to screen for hypochondriasis. It was originally developed as a screening tool for hypochondriasis, and it is the most widely used. Although several previous studies have explored the psychometric properties of the WI, the instrument's factor structure remains debated and unresolved. Pilowsky [20] originally divided WI into three factors, "bodily preoccupation", "disease phobia" and "conviction of the presence of disease with non-response to reassurance" ("disease conviction") [20]. Also in

* Corresponding author at: Department of Clinical Science, University of Bergen, Bergen, Norway.
E-mail address: karielisev@gmail.com (K.-E.F. Veddegjærde).

http://dx.doi.org/10.1016/j.jpsychores.2014.06.011
0022-3999/

more recent studies, three dimensions have been described in the factor analysis of WI [21–23], although others have concluded that only one [23–25] or two [8,26] factors may be more appropriate. The majority of studies have used exploratory principal component analysis (EPCA) [20–22,25,27], while some have employed latent structure analysis (LSA) [24,26]. Although latent structure analysis and item response theory analysis (IRT) share many similarities, they also differ in some important aspects. EPCA is generally considered to be less appropriate for handling dichotomous or ordinal responses, resulting in an underestimation of item inter-correlations, inconsistent estimates of parameters and standard errors [28,29]. Despite this, there are few studies which have used confirmatory factor analysis (CFA) [23]. Furthermore, most studies have used WI in patient populations or student populations, although it was developed as a screening tool for general populations.

Based on these considerations, the main aim of the current study was to examine different factor structures as identified from previous studies using data from a large general population based study. Specifically, we investigated the dimensionality, adequate levels of item difficulty and item-scale discrimination of the Norwegian translation of WI in a general population using CFA and item response theory analysis (IRT).

Methods

Participants and procedures

This study used data obtained from the Hordaland Health study (HUSK). HUSK was a joint epidemiological research project carried out from 1997 to 1999 in collaboration between the National Health Screening Service, the University of Bergen and local health services [24].

The base population included 29,400 individuals in Hordaland County in western Norway, who were born 1953 to 1957, and aged 40 to 47 years at the time of the data collection. Data were collected by questionnaires and clinical examinations. A total of 18,581 (8598 men and 9983 women) answered both the first questionnaire and attended the clinical examinations, yielding a participation rate of 63% (57% for men and 70% for women). On attending the clinical examinations, a second questionnaire which included the WI for health anxiety was distributed to a random 50% of the participants and prompted for return by mail. A total of 7274 individuals (3779 men and 3495 women) returned this questionnaire. Of these, 107 were excluded, as they had not provided valid responses, which gave a sample that consisted of a total of 7167. 52% (3723) were men, while 48% (3444) were women.

Ethics

The study protocol was cleared by the Regional Committee for Medical Research Ethics of Western Norway and approved by the Norwegian Data Inspectorate. Informed consent in writing was obtained from all subjects included in this study.

Measures

The WI consists of 14 items which originally were used dichotomously (true/false). A 5-point Likert scale version was later established, with the response options labelled as follows: 1 = 'not at all', 2 = 'to some extent', 3 = 'moderately', 4 = 'to a considerable extent', and 5 = 'to a great extent'. The dichotomous version of WI is still mostly used, although the Likert scale version is claimed to differentiate better than the dichotomous version [26,30]. The version employed in the current study includes the Likert scaled response options. The WI was translated into Norwegian following standard practice: a native speaking Norwegian first translated all the questions from English to Norwegian and then the Norwegian version was translated back to English by a native English speaking person. All the translations were checked again by the research group to ensure that the questions did not lose their meaning in the transition process.

CFA was conducted on several previously suggested factor structure solutions for the WI. As detailed in Table 1, the models tested in the current study were: model 1, Pilowsky's original 10 item, 3 factor model [20], model 2, a 13 item, 3 factor model [21,23,27], model 3, a unitary model with 14 items [25], model 4, a 13 item single factor model [25], model 5, an 11 item, single factor model[25], model 6, a 7 item, 1 factor model [23,24], model 7, an 11 item, 3 factor model, model 8, an 11 item, 2 factor model[31], model 9, an 8 item, 2 factor model [26], model 10, a 6 item, 2 factor model [8], and model 11, another 6 item 2 factor model [32].

Statistics

The descriptive statistical analyses were conducted in STATA, version 13.1, whereas the CFA and IRT were conducted in Mplus Version 7.0 (Muthén & Muthén, 1998–2010) using the mean- and variance-adjusted weighted least square (WLSMV) estimator for categorical indicators. To evaluate different aspects of model fit, three goodness-of fit indices were used across the analyses: the Tucker–Lewis index (TLI) [33], the comparative fit index (CFI) [34], and the root mean square error of approximation (RMSEA) [35]. The results were examined according to Hu and Bentler's suggestion that models with TLI and CFI values of 0.95 or higher represent an acceptable fit, RMSEA values less than 0.08 are an acceptable fit, and RMSEA values less than 0.06 are representative of a close fit of the model [36]. We interpreted fit indices collectively, with good fit being a TLI and CFI >.95 together with an RMSEA <.06.

IRT methods provide a means of scaling both items and persons along a theorized underlying latent continuum [37–40]. The threshold for an item is the point on the latent continuum where there is a 50% probability that the item will elicit an affirmative response. Individuals above this threshold are more likely to display the symptoms of the tested illness (HA in the current study), than those below the threshold [37,38,40]. The basic concepts of IRT rest upon the individual items of a test rather than upon some aggregate of the item responses such as a test score.

CFA was conducted to examine the different proposed factor structures of WI. Data were converted from the Likert scale to dichotomous response categories for the IRT-analysis. The construction of the binary variables was informed by the combination of two factors. The first factor was based on the wording and meaning of the different response options ("Not at all", "To some extent", "Moderately", "To a considerable extent" and "To a great extent"), where we wanted the category of "1" (yes) in the binary variable to reflect a symptom level which had a substantial impact on the individual (as opposed to "Not at all", "To some extent" and "Moderately"). We consider this a reasonable approximation of the "no" and "yes" in the binary version of the Whiteley Index. The other factor was related to the distribution of responses, where we aimed to make the category of "1" (yes) in the binary variable to at least be in the top 10% of the distribution, indicating a substantial deviation from the most common responses. By using the cut-off 3/4 this was achieved for most of the items (see Table 2). Also, we wanted to use the same cut-point for all of the variables, in order to make interpretation of the binary values more readily understood, and comparable with each other. This reduction to a dichotomous format was thought to aid interpretation without losing important information about the latent trait such as a nonlinear relationship between health anxiety and the probability of endorsing a particular response category [41]. By first using CFA and then IRT, it is possible to identify health anxiety as an underlying latent variable. Its relationship with each item on the scale will then, by using IRT, be described as a logarithmic function—the 'item characteristic curve' [42]. The location of this curve indicates the difficulty of the item, and its steepness indicates

Table 1
Overview of models and items identified from previous studies of the Whiteley Index

Model	1	2		3	4	5	6		7	8	9	10	11
Study	Pilowsky (1967)	Rief et al. (1994)	Hiller et al. (2002)	Speckens et al. (1996a)	Speckens et al. (1996b)	Speckens et al. (1996c)	Fink et al. (1999)	Conradt et al. (2006)	Hinz et al. (2003)	Schwarz et al. (2007)	Welch et al. (2009)	Asmundson et al. (2008)	Lee et al. (2011)
Sample	200 psychiatric inpatients	135 psychosomatic inpatients	570 psychosomatic inpatients	130 medical outpatients, 113 general practice patients, 204 general population	130 medical outpatients, 113 general practice patients, 204 general population	130 medical outpatients, 113 general practice patients, 204 general population	99 primary care, 100 neurological inpatients	1929 primary care patients	1996 general population	1302 students	287 under-graduate students	300 students	3014 community sample
Nationality	American	German	German	Dutch	Dutch	Dutch	Danish	Australian	German	German	Canadian	Canadian	Hong Kong
Method	EPCA	EPCA	EPCA	EPCA	EPCA	EPCA	CLTA	CFA	EPCA	SES/CLTA	PAF	PAF	CFA
WI item													
1.	–	I	I	I	I	I	I	I	II	I	–	II	I
2.	II	II	II	I	I	I	I	I	II	II	II	–	II
3.	II	–	–	I	–	–	–	–	–	–	–	–	–
4.	–	I	I	I	I	I	I	I	I	I	II	II	I
5.	–	II	II	I	I	I	–	–	II	II	I	I	–
6.	I	I	I	I	I	I	I	I	I	I	II	–	I
7.	III	III	III	I	I	–	–	–	III	–	–	–	–
8.	II	II	II	I	I	I	I	I	II	II	–	I	II
9.	I	III	III	I	I	–	–	–	–	–	–	–	–
10.	–	III	III	I	I	I	I	I	III	II	I	–	II
11.	III	III	III	I	I	I	–	–	III	II	I	–	–
12.	I	I	I	I	I	I	–	–	–	–	–	–	–
13.	III	I	I	I	I	I	I	I	II	II	I	I	–
14.	I	I	I	I	I	I	–	–	I	I	II	II	–

Note that some of the studies have concluded on the same factor solution/model (Model 2: Rief et al. 1994 and Hiller et al. 2002; and Model 6: Fink et al. 1999 and Conradt et al. 2006) And some studies have suggested several possible factor solutions (Speckens et al. 1996a, 1996b, 1996c).
EPCA = exploratory principal component analysis; CLTA = confirmatory latent trait analysis; CFA = confirmatory factor analysis; PAF = principal axis factoring.

Table 2
Distribution of responses to the 14-item Whiteley Index/endorsement frequency

		1 "Not at all"	2 "To some extent"	3 "Moderately"	4 "To a considerable extent"	5 "To a great extent"
Item 1:	"Do you often worry about the possibility that you have got a serious illness?"	60.5%	30.5%	6.0%	2.4%	0.7%
Item 2:	"Are you bothered by many aches and pains?"	39.6%	35.2%	11.5%	10.2%	3.5%
Item 3:	"Do you find that you are often aware of various things happening in your body?"	19.7%	48.8%	20.8%	9.1%	1.5%
Item 4:	"Do you worry a lot about your health?"	21.1%	50.2%	21.0%	6.4%	1.3%
Item 5:	"Do you often have the symptoms of very serious illnesses?"	85.3%	10.6%	2.7%	1.0%	0.4%
Item 6:	"If a disease is brought to your attention (through the radio, television, newspapers, or someone you know), do you worry about getting it yourself?"	61.8%	32.1%	4.3%	1.4%	0.4%
Item 7:	"If you feel ill and someone tells you that you are looking better, do you become annoyed?"	74.3%	20.0%	3.9%	1.5%	0.3%
Item 8:	"Do you find that you are bothered by many different symptoms?"	73.0%	19.6%	4.7%	2.1%	0.5%
Item 9:	"Is it easy for you to forget about yourself and think about all sorts of other things?"	63.7%	22.2%	8.8%	4.2%	1.0%
Item 10:	"Is it hard for you to believe the doctor when he tells you there is nothing for you to worry about?"	76.8%	17.0%	4.1%	1.6%	0.5%
Item 11:	"Do you get the feeling that people are not taking your illness seriously enough?"	81.5%	11.4%	4.4%	2.0%	0.8%
Item 12:	"Do you think that you worry about your health more than most people?"	78.6%	10.7%	8.9%	1.6%	0.2%
Item 13:	"Do you think there is something seriously wrong with your body?"	65.7%	23.9%	7.2%	2.5%	0.6%
Item 14:	"Are you afraid of illness?"	22.2%	52.1%	17.0%	6.4%	2.3%

how well it discriminates between different levels of the latent construct [40,43].

Results

Response distribution of the WI

As detailed in Table 2, the endorsement frequencies of each of the 14 items show an expected right-skewed distribution, with the majority of the participants reporting no or few symptoms of HA.

Factor structure solution of the WI

The psychometric properties based on CFA of the different factor structure solutions of the WI are presented in Table 3. The original version of the WI by Pilowsky's did not have an acceptable fit (CFI: 0.939, TLI: 0.914 and RMSEA: 0.086). As also detailed in Table 3, none of the previously suggested models had RMSEA-values below .06, although several had acceptable CFIs and TLIs. The best goodness of fit values were obtained for Model 6, the 7-item one factor WI, with a CFI of 0.987, TFI of 0.976, and RMSEA of .066.

Item response theory (IRT) analyses

IRT was performed on the 7-item WI, to examine which item(s) yielded the most information, and to investigate if any of the items were less good questions, giving less information (with a gentle slope distributed across several SDs). The results from the IRT-analyses are depicted in Fig. 1. As shown in Fig. 1, item 2 ("Are you bothered by many aches and pains?") had a low factor loading, as evidenced by the non-sharp s-curve. The error terms of this item also had error terms correlated with the error terms of items 1 and 8, a correlation of 0.15 for item 8, and −.51 for item 1. Item 2 was therefore removed. Based on these IRT-analyses, CFA was then performed on the new 6-item version of the WI (model 11 in Table 3), yielding a satisfactory goodness of fit (CFI: 0.993, TLI: 0.987 and RMSEA: 0.054.

Psychometric properties of the 6-item version of the WI

Table 4 shows the item discriminations and item difficulties for the six-item solution of WI. All items discriminated well. The distribution of the mean and sum scores on different percentiles of the 6-item version of the WI is presented in Table 5. Distribution of percentiles, means, and sum is presented in Table 5, stratified by gender. There were no significant gender differences.

Random split analyses

We also did a random split (creating random groups of equal size), and performed CFA in group # 1 and IRT in group # 2. Overall, there were only small differences between the sub-groups and the total sample, for both the CFA and the IRT (see Supplement for details).

Table 3
Goodness-of-fit indices of the different factor structure solutions of the Whiteley Index

Model	Study	CFI	TLI	RMSEA (CI90%)
1	Pilowsky et al. (1967)	.939	.914	.086 (.082, .089)
2	Rief et al. (1994) & Hiller et al. (2002)	.942	.927	.086 (.083, .088)
3	Speckens et al. (1996a) (All 14 items)	.926	.913	.090 (.088, .092)
4	Speckens et al. (1996b)	.922	.906	.097 (.095, .099)
5	Speckens et al. (1996c)	.924	.905	.112 (.109, .115)
6*	Fink et al. (1999) & Conradt et al. (2006)	.987	.976	.066 (.060, .072)
7	Hinz et al. (2003)	.935	.912	.101 (.098, .105)
8	Schwartz et al. (2007)	.941	.922	.105 (.101, .108)
9	Welch et al. (2009)	.917	.878	.127 (.122, .131)
10	Asmundson et al. (2008)	.977	.956	.113 (.106, .120)
11	Lee et al. (2011)	.958	.921	.108 (.101, .115)
12**	Current study	.993	.987	.054 (.047, .061)

CFI = comparative fit index; TIL = Tucker-Lewis index; RMSEA = root mean square error of approximation.
* Correlated items: 6 with 1, 1 with 2, 2 with 8.
** Correlated items: 6 with 1.

Discussion

The purpose of the current study was to explore the factor structure of the WI using data from a large population based study. In short, we found no satisfactory fit for either the original 14-item version, or the more recently proposed and commonly used 7-item factor solution using CFA. The IRT analyses showed that a 6-item factor solution had better psychometric properties, which was also confirmed by CFA yielding acceptable goodness of fit. This is one of the first studies on the WI conducted in the general population, and the results show that previous factor solutions of the WI used in clinical settings might not be applicable to the general population.

The WI was originally developed as a screening tool for hypochondriasis, and it remains the most widely used tool for this purpose. A range of studies has explored the structural validity of the WI with mixed findings regarding both number of factors and item composition. The current study adds to these contradictory findings, as our data found none of the 11 previously suggested models could be considered a good fit of the data. There might be several explanations for this. First, most of the previous studies reporting on the psychometrics of WI have been done in clinical populations and/or small samples, varying from in-patients at psychiatric clinics to students. To the best of our knowledge, only one large population-based study has previously investigated the factor structure of WI [22]. That study found an 11-item, 3 factor

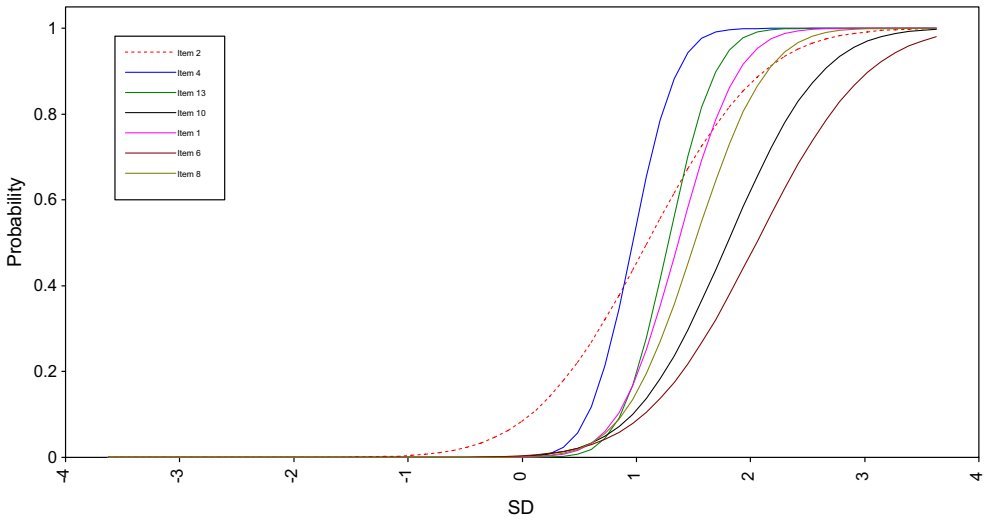

Fig. 1. Item response theory (IRT) analysis of 7-item Whiteley Index.

model using EPCA, but still recommended the full 14-item version for differential analysis. In contrast, we found that this 11-item model did not produce acceptable goodness of fit indices when tested on our data. Also, while the Hinz-study reported higher levels of HA for women, in the current study we found no significant gender differences. Second, the current study used the Likert scale version of the WI for the CFA, which provides a wider response range than the original dichotomous version. While more response options might better reflect the continuous scale along which HA is found, it may also help to partly explain why the factor structure differs from studies in which a dichotomous version of the WI was employed. A third explanation as to why the current study failed to confirm the findings from previous studies could also be the limited age span (range: 40–46 years). Still, we are not aware of strong evidence supporting the notion that factor structures are significantly influenced by participants' age across the adult population.

Of the eleven existing models we tested with CFA, the one-factor, 7-item WI [23,24] had the best goodness of fit collectively. However, the fit was not thoroughly convincing (CFI: 0.987, TLI: 0.976, RMSEA: 0.066), and when we performed IRT analysis on this model, item 2, "Are you bothered by many aches and pains?" stood out by discriminating poorly, as indicated by a less steep s-curve. This means that the specific item also had a low factor loading in the CFA. In fact, Fink et al. [24] also found the same item to have a low factor loading, but he nevertheless included it in his final 7-item version. As the error terms of this item also correlated with the error terms of two other items, we chose to remove it from further analyses. Ultimately, conducting CFA on this 6-item version of the WI, yielded satisfactory psychometric values, with better goodness of fit indices (CFI: 0.993, TLI: 0.987 and RMSEA: 0.054). It has to be taken into consideration that some information may get lost when removing as much as 8 items from a 14-item questionnaire. Yet, if the purpose of WI is to be a tool to screen for hypochondriasis, and a 6-item WI does that as well as a 14-item, this information may not be necessary. As this is the first study to identify a 6-item single factor structure of WI, we recommend that further studies in different samples should investigate this model. Additionally, there were no measures included in the Hordaland Health Study which could be used to assess the external validity of WI. Ideally, an investigation of the external validity of the suggested factor structure should be compared to other previously suggested factor structures in future research.

In addition to Fink et al. [24] who examined the WI using latent trait analysis, the current study is the first to use IRT on the WI. IRT gives us the opportunity to investigate which items that fit and do not fit well in an instrument. For the current study, it provided valuable information on the discriminative abilities on each item with regard to HA as continuous latent construct.

Conclusion

HA is a condition that severely affects the quality of life. Despite lack of somatic findings confirming a physical illness, the condition is a heavy burden to individuals who are affected [2]. In addition to the individual patient's effects of HA, the condition is also associated with a range of socio-economic consequences. HA is strongly linked with increased use of health care services, and untreated HA has been linked to increased sickness absence from work [10,11]. It is therefore important that HA is taken seriously by health care providers. The WI can be

Table 4
Item characteristics of the final 6-factor solution of the Whiteley Index

		Item difficulty	Item discrimination
Item 1:	"Do you often worry about the possibility that you have got a serious illness?"	2.248	1.487
Item 4:	"Do you worry a lot about your health?"	1.605	1.788
Item 6:	"If a disease is brought to your attention (through the radio, television, newspapers, or someone you know), do you worry about getting it yourself?"	3.226	0.855
Item 8:	"Do you find that you are bothered by many different symptoms?"	2.499	1.226
Item 10:	"Is it hard for you to believe the doctor when he tells you there is nothing for you to worry about?"	2.957	0.939
Item 13:	"Do you think there is something seriously wrong with your body?"	2.136	1.788

Table 5
Percentiles, means and sum scores of the six-factor solution of the Whiteley Index (WI) stratified by gender

	Women (n = 3723)		Men (n = 3443)	
Percentiles	WI mean	WI sum	WI mean	WI sum
Mean	1.57	9.43	1.54	9.27
25th	1.17	7	1.17	7
50th (median)	1.50	9	1.33	8
75th	1.83	11	1.83	11
90th	2.33	14	2.33	14
95th	2.67	16	2.67	16
99th	3.33	20	3.33	20

a valuable tool in this respect, and the present study provides preliminary evidence for a 6-item model with good overall fit in a Norwegian general population-based sample.

Conflict of interest statement

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.jpsychores.2014.06.011.

References

[1] World Health Organization. The ICD-10 classification of mental and behavioural disorders: diagnostic criteria for research. Geneva: World Health Organization; 1994.
[2] Wilhelmsen I. Hypochondriasis and health anxiety. In: Ramachandran V, editor. Encyclopedia of human behavior. Oxford: Elsevier Inc.; 2011.
[3] Barsky AJ, Wyshak G, Klerman GL, Latham KS. The prevalence of hypochondriasis in medical outpatients. Soc Psychiatry Psychiatr Epidemiol 1990;25:89–94.
[4] Gureje O, Ustun TB, Simon GE. The syndrome of hypochondriasis: a cross-national study in primary care. Psychol Med 1997;27:1001–10.
[5] Escobar JI, Gara M, Waitzkin H, Silver RC, Holman A, Compton W. DSM-IV hypochondriasis in primary care. Gen Hosp Psychiatry 1998;20:155–9.
[6] Gureje O, Simon GE, Ustun TB, Goldberg DP. Somatization in cross-cultural perspective: a World Health Organization study in primary care. Am J Psychiatry 1997;154:989–95.
[7] Looper KJ, Kirmayer LJ. Hypochondriacal concerns in a community population. Psychol Med 2001;31:577–84.
[8] Asmundson GJG, Abramowitz JS, Richter AA, Whedon M. Health anxiety: current perspectives and future directions. Curr Psychiatry Rep 2010;12:306–12.
[9] Fink P, Ornbol E, Christensen KS. The outcome of health anxiety in primary care. A two-year follow-up study on health care costs and self-rated health. PLoS One 2010;5:e9873.
[10] Mykletun A, Heradstveit O, Eriksen K, Glozier N, Overland S, Maeland JG, et al. Health anxiety and disability pension award: the HUSK study. Psychosom Med 2009;71:353–60.
[11] Savikko A, Alexanderson K, Hensing G. Do mental health problems increase sickness absence due to other diseases? Soc Psychiatry Psychiatr Epidemiol 2001;36:310–6.
[12] Barsky AJ, Ettner SL, Horsky J, Bates DW. Resource utilization of patients with hypochondriacal health anxiety and somatization. Med Care 2001;39:705–15.
[13] Greeven A, Spinhoven P, van Balkom AJ. Hypochondriasis Y-BOCS: a study of the psychometric properties of a clinician-administered semi-structured interview to assess hypochondriacal thoughts and behaviours. Clin Psychol Psychother 2009;16:431–43.
[14] Pilowsky I, Spence N, Cobb J, Katsikitis M. The Illness Behavior Questionnaire as an aid to clinical assessment. Gen Hosp Psychiatry 1984;6:123–30.
[15] Kellner R, Abbott P, Winslow WW, Pathak D. Fears, beliefs, and attitudes in DSM-III hypochondriasis. J Nerv Ment Dis 1987;175:20–5.
[16] Lucock MP, Morley S. The health anxiety questionnaire. Br J Health Psychol 1996;1:137–50.
[17] Speckens AEM, Spinhoven P, Van Hemert AM, Bolk JH. The Reassurance Questionnaire (RQ): psychometric properties of a self-report questionnaire to assess reassurability. Psychol Med 2000;30:841–7.
[18] Barsky AJ, Wyshak G, Klerman GL. The Somatosensory Amplification Scale and its relationship to hypochondriasis. J Psychiatr Res 1990;24:323–34.
[19] Salkovskis PM, Rimes KA, Warwick HM, Clark DM. The Health Anxiety Inventory: development and validation of scales for the measurement of health anxiety and hypochondriasis. Psychol Med 2002;32:843–53.
[20] Pilowsky I. Dimensions of hypochondriasis. Br J Psychiatry 1967;113:89–93.
[21] Hiller W, Rief W, Fichter MM. Dimensional and categorical approaches to hypochondriasis. Psychol Med 2002;32:707–18.
[22] Hinz A, Rief W, Brahler E. Hypochondriasis in the general population: psychometric properties and norm values of the Whiteley Index. Diagnostica 2003;49:34–42.
[23] Conradt M, Cavanagh M, Franklin J, Rief W. Dimensionality of the Whiteley Index: assessment of hypochondriasis in an Australian sample of primary care patients. J Psychosom Res 2006;60:137–43.
[24] Fink P, Ewald H, Jensen J, Sorensen L, Engberg M, Holm M, et al. Screening for somatization and hypochondriasis in primary care and neurological in-patients: a seven-item scale for hypochondriasis and somatization. J Psychosom Res 1999;46:261–73.
[25] Speckens AE, Spinhoven P, Sloekers PP, Bolk JH, van Hemert AM. A validation study of the Whitely Index, the Illness Attitude Scales, and the Somatosensory Amplification Scale in general medical and general practice patients. J Psychosom Res 1996;40:95–104.
[26] Welch PG, Carleton RN, Asmundson GJ. Measuring health anxiety: moving past the dichotomous response option of the original Whiteley Index. J Anxiety Disord 2009;23:1002–7.
[27] Rief W. Hypochondrie: Erfassung und erste klinische Ergebnisse. Z Klin Psychol Psychoth 1994;23:34–42.
[28] Floyd FJ, Widaman KF. Factor analysis in the development and refinement of clinical assessment instruments. Psychol Assess 1995;7:286–99.
[29] Hoijtink H, Rooks G, Wilmink FW. Confirmatory factor analysis of items with a dichotomous response format using the multidimensional Rasch model. Psychol Methods 1999;4:300–14.
[30] Barsky AJ, Cleary PD, Wyshak G, Spitzer RL, Williams JB, Klerman GL. A structured diagnostic interview for hypochondriasis. A proposed criterion standard. J Nerv Ment Dis 1992;180:20–7.
[31] Schwarz D, Witthoft M, Bailer J. Critical testing of the factoral structure and construct validity of the Whiteley-Index—an established screening instrument to assess hypochondriasis. Z Klin Psychol Psychoth 2007;36:128–36.
[32] Lee S, Ng KL, Ma YL, Tsang A, Kwok KP. A general population study of the Chinese Whiteley-7 index in Hong Kong. J Psychosom Res 2011;71:387–91.
[33] Tucker LR, Lewis C. Reliability coefficient for maximum likelihood factor-analysis. Psychometrika 1973;38:1–10.
[34] Bentler PM. Comparative fit indexes in structural models. Psychol Bull 1990;107:238–46.
[35] Steiger JH. Structural model evaluation and modification—an interval estimation approach. Multivar Behav Res 1990;25:173–80.
[36] Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. Struct Equ Model 1999;6:1–55.
[37] Morris GA, Harshman N, Branum-Martin L, Mazur E, Mzoughi T, Baker SD. An item response curves analysis of the Force Concept Inventory. Am J Phys 2012;80:825–31.
[38] Palm KM, Strong DR. Using item response theory to examine the White Bear Suppression Inventory. Personal Individ Differ 2007;42:87–98.
[39] Reise SP, Ainsworth AT, Haviland MG. Item response theory—fundamentals, applications, and promise in psychological research. Curr Dir Psychol Sci 2005;14:95–101.
[40] Baker FB. The basics of item response theory. 2nd ed. USA: ERIC Clearinghouse on Assessment and Evaluation; 2001.
[41] Embretson SE, Reise SP. Item response theory for psychologists. New Jersey: Lawrence Erlbaum Associates, Inc., Publishers; 2000.
[42] Baker JG, Rounds JB, Zevon MA. A comparison of graded response and rasch partial credit models with subjective well-being. J Educ Behav Stat 2000;25:253–70.
[43] Edelen MO, Reeve BB. Applying item response theory (IRT) modeling to questionnaire development, evaluation, and refinement. Qual Life Res 2007;16:5–18.