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The Nottingham Health Profile: Score distribution, internal consistency and validity in asthma and COPD patients

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ABSTRACT.

This cross-sectional study among patients with asthma or Chronic Obstructive Pulmonary Disease (COPD) in general practice examined the psychometric properties of the Nottingham Health Profile (NHP). From 380 asthma patients and 170 COPD patients, data were obtained on the NHP, subjective measurements (i.e. sleep disturbances, problems in performing household activities, dyspnoea) and more objective measurements (peak expiratory flow rate, consultation rate, comorbidity). These data were used to compute score distributions, internal consistency (Cronbach's -αcoeffcient) and construct validity. Score distributions were very skewed, with more than 50% of the patients achieving the best score. The internal consistency was moderate in the asthma group (mean α= 0.68) and acceptable in the COPD group (mean α= 0.74). Acceptable construct validity was found in both groups. Correlations between the NHP and the subjective measurements were, in general, statistically significant and higher than between the NHP and the more objective measurements. In conclusion, acceptable internal consistency and construct validity implies that the NHP can be used in cross-sectional studies concerning asthma and COPD patients in general practice, and in studies comparing these patients with other patient populations. Further research on the responsiveness of the NHP is needed to justify its use in longitudinal studies.

INTRODUCTION

Asthma and Chronic Obstructive Pulmonary Disease (COPD) are chronic airway disorders which are accompanied by symptoms of breathlessness, wheezing, and coughing, and can have considerable effects on the physical, emotional and social aspects of a patient's life. In studies on the evaluation of care for asthma and COPD patients, increasing attention

has been paid to these aspects of the health of patients [1- 4], referred to as `perceived health status', in addition to conventional outcomes, such as symptoms and lung function parameters. The instruments used to asses perceived health status can be classified as generic or disease-specific. Disease-specific instruments focus on the domains specifically related to the disease under study, and are likely to be more sensitive to relevant clinical changes in a clinical trial than generic instruments. On the other hand, generic instruments measure general characteristics and consequences of diseases, and enable comparisons to be made between patients with different conditions, for example in cost effectiveness analyses. Moreover, the advantage of generic instruments is that they have been thoroughly tested in various clinical settings and populations. One of the generic instruments is the Nottingham Health Profile (NHP) [5], which is frequently used in different groups of patients throughout the world. It takes only a few minutes to complete, and is accepted and understood by most patients [5]. The NHP has proved to be reliable [5-8] and valid [6, 7, 9, 10] in various patient populations. However, the NHP has not yet been thoroughly validated in a population of asthma and COPD patients in general practice [3, 8, 11, 12].An instrument that has been validated for a specific patient population will not necessarily perform adequately when applied to other patient groups. Therefore, this study examines the following psychometric properties of the NHP in a population of asthma and COPD patients in general practice: score distribution, internal consistency and construct validity.

METHOD

Design

This cross-sectional study among asthma and COPD patients was carried out in general practice. Data were gathered on perceived health status by means of the NHP, sleep disturbances, breathing problems interfering with household activities, dyspnoea, Peak Expiratory Flow Rate (PEFR), comorbidity and the consultation rate. These data were used to compute score distributions, internal consistency (i.e. the average of the correlations among all items belonging to the same dimension) and construct validity of the NHP. Construct validity is `the extent to which a particular measure relates to other measures in a manner consistent with theoretical hypotheses concerning the concepts (or constructs) being measured' [13]. With regard to the NHP we expected that higher scores on the NHP dimensions (especially `physical mobility', `sleep', `energy' and Part 2) would be found in patients with a more severe degree of their disease (i.e. more sleep disturbances, more problems in performing household activities and more severe dyspnoea) than in patients with a less severe degree of their disease. Based on previous studies on the relationship between the NHP and lung function [3, 8, 11], we expected that a rather low correlation would be found between the NHP dimensions and the PEFR. Furthermore, we hypothesised a positive relationship between NHP scores and the consultation rate, in accordance with the findings of a previous validation study of the NHP in general practice [6]. Finally, we expected that patients with comorbidity would show higher NHP scores than patients with no comorbidity, and that asthma patients would show lower NHP scores than COPD patients.

Patients

Patients were recruited from 19 general practices in the north-west of the Netherlands, including rural as well as urban areas. All known asthma and COPD patients, as well as patients who had frequently presented respiratory symptoms in the previous two years or used asthma or COPD medication, were invited to visit the practice for assessment on whether they should be diagnosed as asthma or COPD patients. The patients with a confirmed diagnosis of asthma or COPD were invited to participate if they met the following inclusion criteria: between 16 and 70 years of age, not under the care of a chest physician, no disease with expected short-term death, no other disease affecting the lung function and

capable of completing a questionnaire in the Dutch language. Data of all patients who completed the NHP were included in the analyses.

Measurements

The NHP was developed in the UK in the 1970s for use in population surveys [5]. It is a self-administered two-part questionnaire. Part 1 contains 38 statements pertaining to six dimensions of health: physical mobility (8 items), pain (8 items), sleep (5 items), energy (3 items), social isolation (5 items) and emotional reactions (9 items). Patients were asked whether or not each item applied to them. Positive answers were given the appropriate weight, according to their relative severity [14]. Each dimension score ranges from 0 (= optimal) to 100. Part 2 consists of seven aspects of life (i.e. paid employment, jobs around the house, social life, personal relationships, sex life, hobbies and interests, and holidays), for each of which the patient is asked to indicate whether or not this aspect is affected by his or her present health problems. The score for Part 2 is the number of positive answers, resulting in a range from 0 (= optimal) to 7. Dimension scores were only calculated if no data were missing on the dimension concerned. The Dutch version of the NHP was obtained after an accurate translation process, which resulted in a conceptually equivalent version [6].

The patient questionnaire containing the NHP also included the following questions: to what degree had sleep been disturbed because of breathing problems (assessed on a five-point scale, varying from `not at all' to `the whole night'), how often had sleep been disturbed and how often had breathing problems interfered with household activities, if applicable (both assessed on a five-point scale, varying from `hardly ever' to `every day'). Information on the degree of dyspnoea, PEFR, comorbidity, age, sex, educational level, age at onset of symptoms, allergy, current smoking habits and prescribed medication was obtained by the physician during the inclusion consultation. The degree of dyspnoea was assessed on a four-point scale, varying from `not at all' to `shortness of breath even when resting'. The PEFR was measured in the surgery by means of a mini Wright meter, before the above-mentioned questionnaire was completed. The highest value of a triple measurement was used to calculate the PEFR as a percentage of the predicted value [15]. Comorbidity was defined as the presence of at least one of the following diseases according to the assessment of the GP: diabetes mellitus, hypertension, myocardial infarction, angina pectoris, congestive heart failure, cerebrovascular disease, transient ischemic attack, dementia, osteoarthritis of the hip or knee, rheumatoid arthritis or any malignancy. Finally, the consultation rate in the previous year, i.e. the year before inclusion, was obtained from the medical records. The total number of consultations and the number of consultations concerning respiratory symptoms were determined. Notes regarding requests for repeat prescriptions without consulting the GP were not considered to represent a consultation.

Until recently it was commonly thought in The Netherlands that asthma and COPD should be considered as different expressions of the same disease [16]. Therefore, at the time of this study it was not common practice for Dutch GPs to make a distinction between asthma and COPD. Nowadays, the importance of making a distinction is becoming more widely recognised in view of the differences in treatment and prognosis. To diagnose asthma, information is needed on the reversibility or variability of the lung function before the prescription of medication; to diagnose COPD, more than one FEV_1 measurement is required to establish chronic obstructive lung function [17]. Since these measurements were not included in the routine practice of Dutch GPs at the time of the present study, no such data were available. As second best criterion we chose the age of onset of the disease (<40 vs. >40 years of age) to distinguish asthma patients from COPD patients [17].

Analyses

All analyses were performed separately for the asthma and the COPD group. A *p*-value of less than 0.05 was considered significant. Score distributions were analysed by calculating the mean, standard deviation and median of the scores per dimension of the NHP.
The percentage of patients achieving the best and the worst score were also computed. The

internal consistency was determined with Cronbach's α-coefficient [18]. An α-coefficient of 0.70 or higher was considered to be sufficient for the purpose of group comparisons, implying that items pertaining to the same dimension were highly correlated [18]. The construct validity was examined by calculating Spearman rank correlations between the dimensions of the NHP, on the one hand, and the degree and frequency of sleep disturbances, frequency of problems in performing household activities, degree of dyspnoea, PEFR and consultation rate, on the other hand. Furthermore, non-parametric Mann-Whitney tests were used to determine whether the differences between patients with and without comorbidity were statistically significant.

RESULTS

Study population The data of 380 asthma patients and 170 COPD patients were available for the analyses. Patient characteristics of the study population are presented in Table 1.

[TABLE 1]

Score distributions

The score distributions of the NHP dimensions are shown in Table 2. The distributions were skewed for all dimensions of Part 1 of the NHP. In the asthma group the distribution of the NHP scores of Part 1, with 61% to 88% of the patients achieving the best score (=0), were more skewed than in the COPD group, with 46% to 81% of the patients achieving the best score. In addition, the percentages of patients with the worst scores (=100) were very low in both groups. The dimensions `pain' and `social isolation' showed the lowest scores and had high percentages of patients achieving the best score. Exclusion of patients with comorbidity (99 patients) resulted in expectedly lower scores, especially in the COPD group.

[TABLE 2]

Internal consistency

The internal consistency estimates are also presented in Table 2. The asthma group showed consistently lower Cronbach's α-coefficients (means α= 0.68; range 0.59-0.79) than the COPD group (mean α= 0.74; range 0.66-0.88). In the asthma group the α-coefficients of only two NHP dimensions exceeded the value of 0.70; in the COPD group this was the case for all but two dimensions. Exclusion of patients with comorbidity barely influenced the internal consistency estimates.

Construct validity

Table 3 shows the correlations between the NHP and the other measurements. The correlations between the NHP dimensions and the subjective measurements (i.e. sleep disturbances, problems in performing household activities, dyspnoea) were rather low ($r \leq 0.43$), but, in general, statistically significant at the 0.05 level. The exception was the dimension `social isolation' in the asthma group, which showed no relationship with sleep disturbances or problems in performing household activities. In both groups the NHP dimension `energy' and Part 2 of the NHP showed the highest correlations with the subjective measurements. No correlation was found between the NHP dimensions and the PEFR, except for the dimension `energy' in the asthma group, which showed a low, but statistically significant correlation. There were also no statistically significant correlations found between the NHP dimensions and the number of consultations concerning respiratory symptoms. With regard to the total number of consultations, low correlations were found with the NHP dimensions ($r \leq 0.25$), which were statistically significant for only three dimensions in the asthma group and for six dimensions in the COPD group. Correlations between the NHP and the subjective measurements were higher than between

the NHP and the more objective measurements. As can be seen from Table 4, patients with comorbidity showed significantly higher scores on the NHP dimensions `physical mobility', `pain' and `energy'. For asthma patients with comorbidity this also applied to Part 2 of the NHP. Furthermore, COPD patients showed significantly higher scores on all dimensions of Part 1 of the NHP than asthma patients.

[TABLE 3] [TABLE 4]

DISCUSSION

The NHP is a generic instrument that is used to assess perceived health status. The aim of the present study was to determine some psychometric properties of the NHP in a population of asthma and COPD patients in general practice and, consequently, to provide recommendations about its possible use in studies concerning these patients.

Psychometric properties

The *score distributions* of the NHP dimensions were very skewed, which is in line with the findings of previous studies among asthma and COPD patients [8, 12]. As stated by the designers of the NHP, the items represent rather severe problems [5]. This means that the NHP is less sensitive in detecting health-related problems in patients whose health is only slightly compromised, as is the case with most asthma and COPD patients in general practice. *Internal consistency* was found to be moderate in the asthma group and acceptable in the COPD group. This difference may be partly attributed to the fact that the COPD group showed a greater variation in NHP scores. The Cronbach's α-coefficients in the COPD group are comparable to those reported in a previous study among COPD patients (mean α= 0.72; range 0.52-0.84) [8], and in two studies using the Dutch version of the NHP, one among a sample of patients from general practices (mean α= 0.78; range 0.70-0.85) [6] and one among patients with migraine (mean α= 0.72; range 0.62- 0.82) [7]. In both the asthma and COPD group an acceptable *construct validity* of the NHP was found, the correlation pattern between the NHP and the other measurements being generally consistent with the initial expectations. In general, correlations between the NHP and the subjective measurements were statistically significant and higher than between the NHP and the more objective measurements, as could be expected, since the NHP measures perceived health status, which is also a subjective measurement. The highest correlations were found between the NHP and the degree of dyspnoea, showing correlations which are consistent with the findings of a previous study among Spanish COPD patients [8]. A low correlation between the NHP and the PEFR was confirmed in this study. However, contrary to the expectations, there is no relationship between the NHP and the number of consultations concerning respiratory symptoms. It should, however, be kept in mind that especially asthma has an episodic nature. As a consequence, the NHP scores reported in this study are only indications of the perceived health status at a given moment in time, which could have changed in the period during which the number of consultations was assessed.

Differences between asthma and COPD

The psychometric properties of the NHP were found to be somewhat better in the COPD group than in the asthma group, indicated by a greater range in NHP scores, a lower percentage of patients achieving the best score (i.e. smaller ceiling effects) and a high erinternal consistency. The construct validity was comparable in both groups. The NHP scores in the COPD group were higher than in the asthma group. However, it remains unclear whether these differences are related to differences in the nature of the disease or whether they reflect differences in the mean age of the patients in both groups. Since the distinction between asthma and COPD has been based on the age of onset of the disease, the mean age of the patients in the COPD group was much higher than the mean age of the patients in the asthma group. A higher age was also related to higher scores on all

dimensions of Part 1 of the NHP. As mentioned before, only a rough distinction could be made between asthma and COPD, based on the age of onset of the disease. Almost half of the patients in the COPD group appeared to have a normal PEFR, which is contrary to expectations, since COPD is an obstructive disease. However, the PEFR might underestimate the degree of obstruction in COPD patients; obstruction is determined most reliably by FEV^1 [17]. It is not likely that a small number of patients who might have been allocated to the wrong patient group would have changed the overall conclusions regarding the psychometric properties of the NHP in asthma and COPD patients. In general, the NHP scores in this study were somewhat better than those reported in earlier studies on asthma [3, 12] and COPD patients [3, 8, 11, 12], probably because the present study population was younger, or had a less severe degree of their disease than the populations in other studies. Compared with the NHP scores in a healthy population [19], asthma patients showed higher scores only on the dimensions `energy' and `physical mobility'; contrary to expectations, the score on the dimension `sleep' was not higher. COPD patients showed higher scores on all dimensions except `pain' and `sleep'.

Recommendations for use of the NHP

Its acceptable internal consistency and validity implies that the NHP can be considered as an appropriate instrument for use in cross-sectional studies, to compare the perceived health status between different groups of patients with asthma or COPD, and also to compare them with other patient populations. The NHP, which was initially developed for use in populations surveys [5], is currently also used to evaluate effects in intervention studies, although its responsiveness (i.e. the ability to detect changes over time) has scarcely been examined. For the assessment of responsiveness, the availability of an external criterion for a clinically relevant change is needed. Since no good external criterion was available in this study, it was not possible to determine the responsiveness of the NHP in a population of asthma and COPD patients. However, the high percentage of patients achieving the best scores, which means that there is little room for improvement, and the small range of the NHP scores suggest a low responsiveness of the NHP in this population. In conclusion, the internal consistency and construct validity of the NHP in a population of asthma and COPD patients in general practice are proven to be satisfactory, implying that the NHP can be used to measure perceived health status in cross-sectional studies concerning asthma and COPD patients, and also in studies comparing these patients with other patient populations. Further research on the responsiveness of the NHP is needed to justify its use in longitudinal studies.

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TABLES

Table 1. Patient characteristics of the study population

	Asthma (n = 380)	COPD (n = 170)
Age (mean (SD))	36 (12)	57 (8)
Sex (% men)	37	43
Educational level		
Low (%)	7	24
Moderate (%)	78	67
High (%)	15	9
Allergy (%)	69	42
Smoking (%)	33	35
Prescribed medication		
No medication (%)	19	17
Bronchodilators only (%)	24	19
Anti-inflammatory agents (%)	57	64
Comorbidity (%)	11	34

Table 2. Score distributions and internal consistency (Cronbach's α) of the NHP dimensions for patients with asthma and COPD, respectively

	Mean	SD	Median	% Best score[a]	% Worst score[b]	Cronbach's α
Asthma (n = 380)						
NHP Part 1 (score 0–100)						
Physical mobility	5.2	10.3	0	72	0	0.59
Pain	3.2	11.0	0	88	0	0.79
Sleep	10.5	19.6	0	66	1	0.65
Energy	22.1	30.1	0	57	5	0.64
Social isolation	4.2	13.4	0	88	0	0.67
Emotional reactions	8.2	14.7	0	61	0	0.73
NHP Part 2 (score 0–7)	1.2	1.6	1	49	0	0.72
COPD (n = 170)						
NHP Part 1 (score 0–100)						
Physical mobility	13.3	17.5	9	47	1	0.71
Pain	9.3	21.0	0	70	1	0.88
Sleep	17.1	24.4	13	49	2	0.66
Energy	29.9	34.2	24	46	10	0.69
Social isolation	7.6	18.4	0	81	1	0.74
Emotional reactions	11.8	18.7	0	50	1	0.78
NHP Part 2 (score 0–7)	1.3	1.7	1	46	1	0.74

[a] % Best score, percentage of patients with best score (=0).
[b] % Worst score, percentage of patients with worst score (=100 in Part 1 and 7 in Part 2).

Table 3. Correlations between the dimensions of the NHP and the other measurements, for patients with asthma and COPD, respectively. Figures in bold indicate statistically significant correlations ($p < 0.05$)

	NHP dimensions						
	Physical mobility	Pain	Sleep	Energy	Social isolation	Emotional reactions	Part 2
Asthma (n = 380)							
Frequency of sleep disturbances	**0.15**	**0.23**	**0.30**	**0.24**	0.09	**0.22**	**0.28**
Degree of sleep disturbances	0.06	0.10	**0.23**	**0.18**	0.07	**0.14**	**0.21**
Frequency of problems in performing household activities	**0.33**	**0.25**	**0.19**	**0.32**	0.07	0.10	**0.40**
Degree of dyspnoea	**0.29**	**0.15**	**0.12**	**0.29**	**0.13**	**0.18**	**0.26**
PEFR as % predicted value	−0.09	−0.11	−0.07	−0.12	0.09	−0.07	−0.11
Consultation rate for respiratory symptoms	0.10	−0.01	0.10	0.08	−0.05	−0.03	0.04
Total consultation rate	**0.18**	0.03	**0.13**	**0.19**	0.03	0.09	0.05
COPD (n = 170)							
Frequency of sleep disturbances	0.14	**0.25**	**0.20**	**0.37**	**0.18**	**0.17**	**0.38**
Degree of sleep disturbances	0.06	**0.24**	0.15	**0.32**	**0.18**	**0.17**	**0.33**
Frequency of problems in performing household activities	**0.22**	**0.22**	**0.23**	**0.36**	**0.26**	**0.25**	**0.31**
Degree of dyspnoea	**0.25**	**0.30**	0.15	**0.43**	**0.23**	**0.30**	**0.29**
PEFR as % predicted value	−0.02	−0.15	0.08	−0.10	−0.16	−0.04	0.04
Consultation rate for respiratory symptoms	0.06	0.05	0.02	0.04	0.10	0.12	−0.01
Total consultation rate	**0.24**	**0.25**	**0.22**	**0.22**	**0.18**	**0.21**	0.10

Table 4. Mean (SD) scores of NHP dimensions in patients with and without comorbidity in the asthma and COPD group, respectively

	No comorbidity	Comorbidity	*p*-value[a]
Asthma (n = 380)	n = 339	n = 41	
NHP Part 1 (score 0–100)			
Physical mobility	4.5 (9.5)	11.0 (14.5)	<0.01
Pain	2.8 (10.2)	6.4 (16.3)	0.03
Sleep	10.4 (19.9)	11.2 (17.8)	0.43
Energy	20.8 (29.7)	32.7 (31.8)	0.01
Social isolation	4.1 (12.8)	4.9 (18.2)	0.63
Emotional reactions	7.7 (13.8)	12.3 (20.0)	0.12
NHP Part 2 (score 0–7)	1.1 (1.5)	1.7 (1.8)	0.03
COPD (n = 170)	n = 112	n = 58	
NHP Part 1 (score 0–100)			
Physical mobility	11.3 (17.8)	17.1 (16.5)	<0.01
Pain	6.3 (17.5)	15.4 (25.6)	<0.01
Sleep	15.2 (22.4)	21.2 (27.9)	0.34
Energy	24.8 (33.0)	39.1 (34.6)	<0.01
Social isolation	7.8 (18.0)	7.1 (19.4)	0.79
Emotional reactions	10.5 (18.3)	14.2 (19.5)	0.08
NHP Part 2 (score 0–7)	1.3 (1.7)	1.3 (1.8)	0.78

[a] Mann–Whitney test.