

BMJ Open Development and cross-validation of a short questionnaire to evaluate self-reported positive health: a cross-sectional panel study of structural validity among a general Dutch population

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ABSTRACT

Objectives This study aimed to further develop and cross-validate a short questionnaire to measure self-reported Positive Health in general (Dutch) populations for evaluative purposes, stemming from the original 42 items of the My Positive Health (MPH) dialogue tool. Positive Health refers to 'health from the perspective of patients and citizens' following the concept of Huber *et al.*

Design and setting A cross-sectional study was performed among a panel representative for the general adult Dutch population living at home.

Participants The response rate was 76%, 1327 of a total of 2457 respondents were female, and mean age (years) was 53.3±17.8.

Methods First, item reduction was carried out through content discussions following statistical output retrieved from factor structures and loadings, inter-item correlations and internal consistency (Cronbach's alpha). Next, among the other half of the study population, measurement properties for the developed short questionnaire were calculated using goodness of fit indices from confirmatory factor analysis (CFA).

Results The item reduction process (n=1199) resulted in a questionnaire of 22 items (PH22) with a four-factor structure and explained variance of 62.4%. Cronbach's alpha values were 0.84, 0.92, 0.81 and 0.78 for the renamed factors 'Physical fitness' (5 items), 'Contentment with self, others and life' (nine items), 'Daily life management' (5 items) and 'Future perspective' (3 items), respectively. Cross-validation (n=1258) showed adequate goodness-of-fit indices of the PH22, based on both first-order and second-order CFA. The scores of the PH22 were normally distributed. No floor or ceiling effects were present.

Conclusions A short 22-item questionnaire to measure self-reported Positive Health in a general (Dutch) population for evaluative purposes such as scientific or policy research at Positive Health or patient-centred interventions was developed and cross-validated, named PH22. This study supports its structural validity. To use this questionnaire in practice, its test-retest reliability and responsiveness should also be known. Future research has to reveal this.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The study is robust in terms of its large sample size, high response rate and representativeness of the general Dutch population.
- ⇒ The short Positive Health questionnaire was founded on the original items of the My Positive Health dialogue tool, which is based on health indicators retrieved from a large study among various stakeholders.
- ⇒ The selection of items for the short Positive Health questionnaire was based on cyclical statistical analyses combined with thorough content discussions.
- ⇒ The results of the content discussions were thematised and each step of the item reduction process thoroughly reported.
- ⇒ The final short Positive Health questionnaire might have been more support-based if more representatives were included in the content discussions, that is, if also focus groups were organised.

INTRODUCTION

Since the concept of Positive Health was introduced in the Netherlands, a mind shift has unfolded among healthcare workers and beyond. The approach of health as a state of complete physical, mental and social well-being as formulated in the constitution of the WHO¹ changed to a more dynamic approach of health focusing on self-management and the ability to adapt to physical, mental and social challenges during life.² This new vision on health is being integrated among all kinds of domains and political agendas within the Netherlands and abroad.³

To support the applicability of this vision on health in daily healthcare practice, the dialogue tool My Positive Health (MPH)⁴ was developed. The content of this dialogue tool was derived from a large mixed methods study with interviews into the perceptions

about health among different stakeholder groups such as patients, citizens and healthcare professionals.⁵ This inductive, bottom-up approach enabled the researchers to gain a thorough insight into the perceptions about health. From these perceptions, 32 aspects emerged, representing indicators for (positive) health.⁵ Accordingly, these aspects were thematised among six dimensions, namely, bodily functions, mental functions and perception, spiritual existential dimension, quality of life, social and societal participation and daily functioning. This operationalisation of health was called *Positive Health*, and from here, the 42-item MPH dialogue tool was developed. This MPH tool aims to support the conversation about Positive Health between patient and care worker and stimulate self-reflection.⁴

At an individual, organisational, community, regional and national level, the concept (broad and dynamic vision on health) and method (MPH tool and dialogue) are increasingly integrated. The Dutch government considers Positive Health a promising approach to promoting well-being and handling the increasing burden of disease.⁶ To assess the effectiveness of working with this Positive Health approach, the need for an instrument to measure self-reported Positive Health has been arising.^{7,8} Although the MPH is a relevant dialogue tool for the conversation about health,³ it should be emphasised that the MPH is not obviously useful for measuring purposes; the item grouping among the six dimensions of the MPH tool was not the result of a study aiming to assess structural validity in order to develop an outcome measure instrument.

To our knowledge, two instruments were developed for this measuring purpose; the Positive Health measurement scale with 17 items (PH17)^{9,10} and the Positive Health measurement tool using all 42 dialogue items (PH42).¹¹ These two instruments face some limitations. Although measurement properties for the PH17 seemed adequate,¹⁰ the initial item selection of the PH17 took place among citizens in just one part of the Netherlands, and the response rate was low (25%),⁹ questioning the generalisability of their results. Even more important, the methodological approach for item reduction included judgement of factor loadings, but without, simultaneously, content discussion and judgement of inter-item correlations and maintaining acceptable internal consistencies as recommended by others.¹² Without these steps, relevant items might be deleted, and short change its content and discriminant validity. The other instrument, the PH42, was developed among a representative general population,¹¹ but consists of 42 items which might not be preferable for all practices. From practical and methodological perspectives, it is preferable to use a shorter questionnaire, which requires less effort and results in higher response rates, especially important during repeated measurements needed to evaluate (positive) health or patient-centred interventions.

The aim of this study was to develop a short and valid questionnaire to measure self-reported Positive Health in general populations. This questionnaire is meant for

evaluation purposes among groups to assess the effectiveness of working with the person-centred Positive Health approach. For example, scientific or policy research at Positive Health promoting or patient-centred interventions. The conditions set for the short questionnaire were that the questionnaire had to contain the original items of the MPH dialogue tool to retain its recognisability with daily practice and with Positive Health as operationalised by Huber *et al*,⁵ referring to 'health from the perspective of patients and citizens'. To optimise its content and discriminative validity, the more extensive method for item reduction using statistical output combined with content discussions was applied among a representative study population. Finally, its structural validity was investigated.

METHODS

Study design and participants

In this paper, we make use of data from the LISS panel (Longitudinal Internet studies for the Social Sciences) managed by the non-profit research institute Centerdata (Tilburg University, the Netherlands). The LISS panel consists of a representative sample of approximately 7000 individuals from 5000 households from the general Dutch population. The panel is based on a true probability sample of households drawn from the population register by Statistics Netherlands.¹³ LISS panel members complete monthly online questionnaires and are paid for each completed questionnaire. To become a LISS panel member, at least one person in the household has to be proficient in the Dutch language. To minimise selection bias, households were provided with a computer and internet connection if they could otherwise not participate. Response rates for this panel are high (>80%). More information about the LISS panel can be found at their website (www.lissdata.nl).¹⁴

To answer our research question, a cross-sectional study was performed among a random selection of members from the LISS panel. From this panel, 2500 adults (≥18 years), one per household, were randomly selected to participate. The process of item reduction and cross-validation were carried out in two randomly split samples of this study population.

This study was reported according to the COSMIN Reporting Guideline¹⁵ recommended for studies that evaluate the measurement properties of patient-reported outcome measures and the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) statement for cross-sectional studies.¹⁶ The terms dimension and factor are used interchangeably.

Data collection and administration

During November 2020, the selected study population was asked to complete the original 42 items of the My Positive Health questionnaire (MPH) (see online supplemental file A), receiving one reminder after 2 weeks. The same as the original MPH dialogue tool, the items

were introduced per dimension using the original introduction, answer options and icons of the dialogue tool.⁴ In contrast to the original tool, the respondents did not see their results among a spider web. The respondents completed the electronic questionnaire at home using the regular internet platform of LISS receiving a private link. Characteristics of the study population such as gender, age, level of education and healthcare use were available from the regular LISS panel HEALTH survey (<https://www.lissdata.nl/research/liss-core-study>).¹⁴

MPH dialogue tool

The MPH consists of 42 statements about Positive Health, representing the 32 indicators for (positive) health as assessed by Huber *et al.*⁵ For practical use, they were formulated to a simple language level (B1). The statements are scored on an 11-point Likert scale ranging from 0 'completely disagree' to 10 'completely agree'. Higher scores indicate better health. Also, the six dimensions (bodily functions, mental functions and perception, spiritual existential dimension, quality of life, social and societal participation and daily functioning) are visualised in a spider web, with six axes representing the dimensions and ranging from value 0 (in the centre for poor) to 10 (on the periphery, for excellent). The self-reported MPH questionnaire takes 10–20 min to complete. Over the last few years, it has been shown by various users (citizens, patients and professionals) that the MPH was a relevant dialogue tool including comprehensiveness and comprehensibility of the items, response options and instructions.³

Preconditions for the short Positive Health questionnaire to be developed

Preconditions formulated by the research team for a useful self-reported questionnaire to measure Positive Health were (1) a multidimensional structure was held to ensure a broad representation of health conforming to literature,^{5 17} (2) items were not reformulated to keep recognisability with the specific Positive Health dialogue approach according to MPH,⁴ (3) to hold model stability each dimension contained at least three items¹² and (4) the short questionnaire contained a maximum of about 20 items to be user-friendly.

Statistical analyses

Development: process of item reduction

Prior to this study, van Druten *et al* developed the measurement tool PH42.¹¹ They assessed the factor structure of the 42 original items of the dialogue tool MPH. This resulted in a model with a six-factor structure including all 42 items with an explained variance of 68%, no inter-item correlations >0.9, factor loadings ranging from 0.36 to 0.94, Cronbach's alpha ranging from 0.74 up to 0.97 and acceptable fit indices. This study of van Druten *et al* was based on the same dataset as our study. Their results (see online supplemental files B and C) were the starting point for the item reduction process of our study. We

used the same settings to assess dimensionality during the process of item reduction: extraction method; principal component analysis (PCA),^{18–20} rotation method; Oblimin with Kaiser normalisation, and eigenvalue >1.0 using SPSS V.27.0. Analyses were performed on similar randomly split halves of the study population (n=1199).

The following steps of the item reduction process taken conform with the methodology published by de Vet and Terwee.^{12 15} Content discussions initiated through statistical output were performed in different rounds with experts taking part in the research team. First, the items of the PH42 were assessed per factor on low (<0.2; ie, possibly unrelated to the construct) and high (>0.7; ie, possibly overlapping and thus redundant in the construct) inter-item correlations.¹² Based on content discussion, low or highly correlated items were held or removed. Then, PCA was performed. Items that hardly loaded at all on any of the factors were considered for deletion. A minimum factor loading (FL) of 0.5 was taken as the threshold.¹² Also, items loading >0.32^{12 21} on more than one factor were discussed. Based on content discussion, items were held or removed. Content was leading, meaning that for some items, high correlations or low factor loadings might be accepted. Items were deleted one by one, repeating PCA at every step, because the deletion of one item might change structures or loadings of other items.¹² Final decisions to delete an item were combined with judgement of consequences for internal consistencies (Cronbach's alpha) aimed between 0.7 and 0.9.¹²

Crossvalidation

To assess the goodness of fit of the developed short Positive Health questionnaire, confirmatory factor analysis (CFA) was performed in the second half of the study population (n=1258). CFA for normal continuous data with maximum likelihood as estimation method was used (R Lavaan 0.6.14).²² Goodness-of-fit indices included the following: χ^2 (a non-significant χ^2 is desirable, however, in a large sample, the χ^2 is usually significant), comparative fit index (CFI), root mean square error of approximation (RMSEA) and standardised root mean square residual (SRMR). Indicators of model fit were as follows^{12 23}: CFI values between 0.90 and 0.95, with >0.95 indicating superior model fit; RMSEA values <0.05 represent good fit, 0.05–0.08 acceptable fit, >0.08 medium fit and >0.1 poor fit; and SRMR value of <0.08 representing good fit. To assess if the item scores of the questionnaire fit the factor sum scores, first-order CFA was executed. To investigate if the factor sum scores fit the total sum score of the questionnaire as well, second-order CFA was executed.^{12 22}

Scores of the developed questionnaire

Lastly, the distribution of the total and factor sum scores of the developed questionnaire were described; mean, median, SD, minimum, maximum, skewness and kurtosis (<–1 and >1), and floor and ceiling effects (≥15% of the

respondents' scores lowest or highest possible scores, respectively²⁴).

Sample size calculation

The size of both randomly split subgroups ($n=1199$, $n=1259$)¹¹ was adequate to apply PCA and CFA; the rule of thumb is that 4–10 respondents per item of the questionnaire are included, with a minimum of 100.²⁵

Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting or dissemination plans of our research.

RESULTS

Participants

The response rate was 76%, with 777 respondents not responding. Twelve respondents not completing the questionnaire completely were excluded, leaving 2457 respondents for the analyses; 54% female, mean age (years) 53.3 ± 17.8 , 39.9% high level of education, and 39.8% visited a medical specialist at the hospital, psychiatrist, psychologist or psychotherapist in the last 12 months. Next, the study population was randomly split: $n=1199$ and $n=1258$, in which the process of item reduction and cross-validation was carried out, respectively.

Development: process of item reduction

LMWNvV, BCvdZ, MJM and MvV participated in six research meetings of an hour between May and August 2023 concerning the item reduction process; content discussion and interpretation of the statistical output. During *round 1*, inter-item correlations were explored for the six-factor structure of the PH42 (see online supplemental file C). From all factors, four contained half or more items that were too highly (>0.7) correlated to another item: factor 1 (11 out of 13), factor 2 (4/8), factor 3 (2/7), factor 4 (5/8), factor 5 (0/3) and factor 6 (2/3), respectively. Two of all items correlated low (<0.2) with each other but adequately with the other items; factor 2 (2/8). First, the items with inter-item correlations >0.8 were discussed on their content, next those items with correlations >0.7 . Initiated by these high correlations, content discussion led to choices for deletion of an item for various reasons such as inadequate formulation of the statement, not being inclusive or (not) being specific. In [table 1](#), detailed information about the choices made per item is shown.

For the factor 'Cognition', the content discussion resulted in only one item being retained. It was accepted by the research team that this factor would not continue to exist as a dimension of Positive Health. In total, in *round 1*, 12 out of 42 items, originating from each of the six factors, were deleted. For the remaining items ($n=30$), PCA was applied.

In *round 2*, PCA with 30 items resulted in a four-factor structure with explained variance of 60.7%

(see online supplemental file D for factor loadings). Kaiser-Meyer-Olkin (KMO) and Bartlett's test were statistically significant (0.96; $p \leq 0.001$). Factor loadings ranged from 0.369 to 0.780. A new factor with 15 items arose from the former factor 'Acceptance, meaningfulness and satisfaction with life' and the factor 'Social network and societal roles' of the PH42. Based on the content of these items, this new combined factor was renamed by the research team and further called 'Contentment with life' (15 items). The other factors were comparable to round 1 (ie, to the PH42 model), except that the factor Cognition was no longer part of the model. Also, one item, IPH41 about 'being able to work', loaded highest, but low (0.495) on the factor 'Self-management' instead of the factor 'Physical health and functioning'. The item about concentration (IPH9), kept from the former factor Cognition, loaded highest, but low (0.369) on the new factor 'Contentment with life'. Five items had a FL <0.5 , and five items loaded also high on another factor (FL >0.32). Of these items, three items were retained based on the content discussion (see [table 1](#)). For example, the items about sleeping pattern (IPH4) and having no pain or complaints (IPH3), both part of the factor 'Physical health and functioning', were judged to be specific content that should be held for the measurement tool. For similar reasons, item IPH13 (being able to handle changes) was kept. In total, in *round 2*, 6 out of 30 items were deleted. In addition, the items selected to delete during round 2 were ranked by the expert team to process the order of item reduction in subsequent PCA. First, those items with low FLs <0.5 were deleted from the model (in the following order; IPH9, IPH35, IPH41). Next, those items with also a high FL (>0.32) on another factor were deleted (IPH18, IPH28, IPH24). PCA was executed and checked per deleted item. No changing structures were seen.

In *round 3*, PCA with 24 items resulted in a similar four-factor structure as round 2 with explained variance of 62.4% (see online supplemental file E for FLs). KMO and Bartlett's test were statistically significant (0.96; $p \leq 0.001$). FLs ranged from 0.474 to 0.855. Overall, there was one item with a low FL (<0.5), and one item with FLs >0.32 on more than one factor. It concerned the item about sleeping pattern (IPH4), similar to the results of round 2, and the item about asking for help from official institutes (IPH42). Both items were retained because of their specific and relevant content. In this round, no items were deleted.

In *round 4*, inter-item correlations and Cronbach's alpha (CA) were judged for this four-factor structure with 24 items. For the factor 'Contentment with life', 4 out of 11 items were highly correlated (>0.7 but <0.8) and CA was high (0.94). Two additional items were deleted from this factor. There was some doubt about the content of item IPH26 (feeling safe) and its fit among the factor Contentment with life. It was decided to retain this item because it was the only item about this specific subject and

Table 1 Process of item reduction with the PH42 questionnaire as starting point

	Round 1			Round 2			Round 3			Round 4			Final items PH22 (✓) or round deleted (R)
	IIC	Item deleted (•)	Content**†	FL	Item deleted (•)	Content**†	FL	Item deleted (•)	Content**†	IIC, CA	Item deleted (•)	Content**†	
Acceptance, meaningfulness and satisfaction with life													
IPH25	Feeling well-balanced	>0.8	●	A, D									R1
IPH24	Feeling good	>0.8	○	F	Loads double	●	C, D						R2
IPH23	Being happy	>0.8	●	A, D									R1
IPH22	Enjoyment	>0.8	●	A, D									R1
IPH16	Being high-spirited	0.7–0.8	○	F									✓
IPH11	Being cheerful	0.7–0.8	●	A, D									R1
IPH19	Accepting life	0.7–0.8	○	F						0.7–0.8	○	F	✓
IPH20	Being grateful	0.7–0.8	○	F						0.7–0.8	●	A, C	R4
IPH15	Having a meaningful life	0.7–0.8	●	A, D									R1
IPH12	Accepting yourself												✓
IPH18	Feeling confident about your own future	0.7–0.8	○	F	Loads double	●	B						R2
IPH14	Having control	0.7–0.8	○	F									✓
IPH26	Feeling safe												✓
Physical health and functioning													
IPH7	Exercise	0.7–0.8	●	C									R1
IPH6	Physical condition	0.7–0.8	○	F						0.7–0.8	○	F	✓
IPH2	Feeling fit	>0.8	○	F						0.7–0.8	○	F	✓
IPH1	Feeling healthy	>0.8	●	A, D									R1
IPH41	Being able to work				FL<0.5, Loads double	●	A						R2
IPH3	Having physical complaints or pain				FL<0.5	○	F						✓
IPH4	Sleeping pattern				Loads double	○	F	Loads double	○	F			✓
IPH5	Eating pattern												✓
Self-management													
IPH40	Managing money												✓
IPH37	Knowing your limitations	0.7–0.8	○	F									✓
IPH38	Knowledge of health	0.7–0.8	●	E									R1

Continued

Table 1 Continued												
	Round 1			Round 2			Round 3			Round 4		
	IIC	Item deleted (•)	Content**†	FL	Item deleted (•)	Content**†	FL	Item deleted (•)	Content**†	IIC, CA	Item deleted (•)	Content**†
IPH39	Managing time											✓
IPH36	Looking after yourself											✓
IPH28	Having enough money				Loads double		A, B					R2
IPH42	Asking for help						FL<0.5	o	F			✓
Social network and societal roles												
IPH32	Having the support of others	>0.8	o	F								✓
IPH31	Doing fun things together	>0.8	●	A								R1
IPH33	Belonging	0.7–0.8	●	A								R1
IPH30	Being taken seriously	0.7–0.8	o	F						0.7–0.8	●	A, D
IPH29	Social contacts	0.7–0.8	o	F						0.7–0.8	o	F
IPH27	Living conditions											✓
IPH35	Being interested in society						FL<0.5	●	D			R2
IPH34	Doing meaningful things											✓
Personal development												
IPH21	Continue learning											✓
IPH17	Wanting to achieve ideals											✓
IPH13	Being able to handle changes						FL<0.5	o	F			✓
Cognition												
IPH8	Being able to remember things	0.7–0.8	●	A								R1
IPH9	Being able to concentrate	0.7–0.8	o	F			FL<0.5	●	B			R2
IPH10	Being able to communicate		●	E								R1
*Results content discussion expressed as A–F to delete or hold an item supported by the measurement properties: ICC; FL; CA. †A–F: A, content is sufficiently reflected in other questions; B, content does not sufficiently match the factor; C, question/wording not inclusive; D, wording not specific enough, too broad; E, unclear wording, may not be properly understood; F, retained for specific content.												
CA, Cronbach's alpha ; FL, factor loading; ICC, inter-item correlation; IPH, item number of the original My PositiveHealth dialogue tool (see online supplemental file 1).												

Table 2 Factor loadings of the PH model of 22 items (round 5) (n=1199)

	Factor*			
	Contentment with life	Physical fitness	Daily life management	Future perspective
IPH32 Having the support of others	0.800	−0.139	0.042	0.057
IPH27 Living conditions	0.785	−0.049	0.098	−0.124
IPH29 Social contacts	0.753	−0.047	0.032	0.096
IPH26 Feeling safe	0.669	0.088	0.083	0.063
IPH16 Being high-spirited	0.648	0.236	−0.028	0.181
IPH19 Accepting life	0.630	0.114	0.037	0.162
IPH14 Having control	0.566	0.124	0.134	0.216
IPH12 Accepting yourself	0.566	0.209	0.113	0.076
IPH34 Doing meaningful things	0.538	0.106	0.074	0.237
IPH2 Feeling fit	0.079	0.689	0.134	0.153
IPH6 Physical condition	0.019	0.686	0.132	0.191
IPH4 Sleeping pattern	0.385	0.667	−0.101	−0.193
IPH3 Having physical complaints or pain	−0.145	0.560	0.052	0.153
IPH5 Eating pattern	0.295	0.545	0.240	−0.184
IPH37 Knowing your limitations	0.033	0.026	0.855	−0.062
IPH36 Looking after yourself	−0.087	0.123	0.793	0.021
IPH40 Managing money	0.101	−0.036	0.781	−0.081
IPH39 Managing time	−0.018	0.067	0.768	0.054
IPH42 Asking for help	0.190	−0.198	0.476	0.169
IPH21 Continue learning	0.060	0.040	0.053	0.760
IPH17 Wanting to achieve ideals	0.153	0.147	−0.061	0.705
IPH13 Being able to handle changes	0.171	−0.018	0.094	0.610

Extraction method: Principal component analysis. Rotation method: Oblimin with Kaiser normalisation. Pattern matrix. Rotation converged in 8 iterations.

In bold are the FL of those items belonging to that factor.

*During the process of item reduction, the names of the factors were Contentment with life, Physical health and functioning, Self-management and Personal development. Afterwards, these were renamed by the research team into Contentment with self, others and life, Physical fitness, Daily life management and Future perspective.

FL, factor loading; PH, Positive Health.

considered to be an important aspect of Positive Health. For the factor 'Physical health and functioning', two items were highly correlated, but both were kept because of their specific content and good CA of the factor (n=5, CA=0.78). No high inter-item correlations nor CA were present among the other factors Self-management (n=5, CA=0.81) and Personal development (n=3, CA=0.74). In total, in *round 4*, 2 out of 24 items were deleted. For the remaining items (n=22), PCA was applied again.

In *round 5*, PCA with 22 items showed a similar four-factor structure with explained variance of 62.4% (see [table 2](#) for FLs and [table 3A–D](#) for inter-item correlations). KMO and Bartlett's test were statistically significant (0.95; $p \leq 0.001$). The factor Self-management contained the only item with low FL (0.476). Based on the statistical output and its content, no further items were deleted.

In summary, through the five rounds of item reduction evaluation and discussions, 20 out of 42 items were

deleted, resulting in a short self-reported questionnaire to measure Positive Health consisting of four dimensions and 22 items, hereafter called the PH22. The dimensions were renamed by the research team into (1) Physical fitness, (2) Contentment with self, others and life, (3) Daily life management and (4) Future perspective (see online supplemental file F).

It was accepted for the PH22 in favour of keeping specific content that (1) the factor 'Contentment with life' had high CA (0.92), (2) the factor 'Physical fitness' contained two highly correlated items but with an adequate CA of 0.78, and (3) the factor 'Daily life management' contained an item with low FL (also an adequate CA of 0.81).

Cross-validation

The four-factor structure of the PH22 had an acceptable fit in first- and second-order CFA; (1) significant

Table 3 (A) Inter-item correlation matrix of factor *Contentment with life** of the 22 item PH model (n=1199); (B) inter-item correlation matrix of factor *Physical fitness** of the 22 item PH model (n=1199); (C) inter-item correlation matrix of factor *Daily life management** of the 22 item PH model (n=1199); (D) inter-item correlation matrix of factor *Future perspective** of the 22 item PH model (n=1199)

(A)									
	IPH12	IPH14	IPH16	IPH19	IPH26	IPH27	IPH29	IPH32	IPH34
IPH12 Accepting yourself	1.000	0.670	0.635	0.667	0.574	0.479	0.517	0.485	0.527
IPH14 Having control	0.670	1.000	0.669	0.664	0.639	0.545	0.591	0.516	0.583
IPH16 Being high-spirited	0.635	0.669	1.000	0.670	0.597	0.558	0.590	0.548	0.628
IPH19 Accepting life	0.667	0.664	0.670	1.000	0.596	0.492	0.512	0.506	0.524
IPH26 Feeling safe	0.574	0.639	0.597	0.596	1.000	0.605	0.523	0.552	0.521
IPH27 Living conditions	0.479	0.545	0.558	0.492	0.605	1.000	0.509	0.582	0.485
IPH29 Social contacts	0.517	0.591	0.590	0.512	0.523	0.509	1.000	0.695	0.607
IPH32 Having the support of others	0.485	0.516	0.548	0.506	0.552	0.582	0.695	1.000	0.557
IPH34 Doing meaningful things	0.527	0.583	0.628	0.524	0.521	0.485	0.607	0.557	1.000
(B)									
		IPH2	IPH3	IPH4	IPH5	IPH6			
IPH2 Feeling fit		1.000	0.361	0.488	0.516	0.735			
IPH3 Having physical complaints or pain		0.361	1.000	0.262	0.256	0.313			
IPH4 Sleeping pattern		0.488	0.262	1.000	0.529	0.462			
IPH5 Eating pattern		0.516	0.256	0.529	1.000	0.537			
IPH6 Physical condition		0.735	0.313	0.462	0.537	1.000			
(C)									
		IPH36	IPH37	IPH39	IPH40	IPH42			
IPH36 Looking after yourself		1.000	0.656	0.501	0.503	0.305			
IPH37 Knowing your limitations		0.656	1.000	0.628	0.569	0.393			
IPH39 Managing time		0.501	0.628	1.000	0.554	0.417			
IPH40 Managing money		0.503	0.569	0.554	1.000	0.443			
IPH42 Asking for help		0.305	0.393	0.417	0.443	1.000			
(D)									
		IPH13	IPH17	IPH21					
IPH13 Being able to handle changes		1.000	0.449	0.483					
IPH17 Wanting to achieve ideals		0.449	1.000	0.534					
IPH21 Continue learning		0.483	0.534	1.000					

In bold are ICC >0.7.

*During the process of item reduction, the names of the factors were Contentment with life, Physical health and functioning, Self-management and Personal development. Afterwards, these were renamed by the research team into Contentment with self, others and life, Physical fitness, Daily life management and Future perspective.
PH, Positive Health.

χ^2 ($p \leq 0.001$), CFI of 0.902, RMSEA of 0.079 with a 90% CI of 0.076 to 0.082 and SMSR of 0.047; and (2) significant χ^2 ($p \leq 0.001$), CFI of 0.901, RMSEA of 0.079 with a 90% CI of 0.075 to 0.0782 and SMSR of 0.047, respectively.

Scores of the developed short Positive Health questionnaire

The scores of the PH22 were interpreted as normally distributed but with slightly more outliers for the lower scores and higher frequency of scores around the mean, which was especially seen for the scores of the factor 'Daily life management'. No floor or ceiling effects were present (see table 4).

DISCUSSION

In this study, a relatively short questionnaire to measure self-reported Positive Health was composed and cross-validated among a general (Dutch) population. The questionnaire contains 22 items stemming from the original MPH dialogue tool with 42 items. Structural validity and internal consistency were satisfactory, supporting the use of this questionnaire for evaluative purposes in scientific or policy research. This questionnaire is called the PH22.

The different methodological approaches of item reduction for the PH17⁹ and PH22 resulted in a different set of items and measurement properties. Contrary to

Table 4 Descriptive statistics of the PH22 scores (n=1258)

	Contentment with life 9 items (score range 0–90)	Physical fitness 5 items (score range 0–50)	Daily life management 5 items (score range 0–50)	Future perspective 3 items (score range 0–30)	Total score PH22 22 items (score range 0–220)
Mean	69.72	34.91	41.36	21.68	167.67
Median	72	36	42	22	171
SD	12.916	8.265	6.275	4.906	27.612
Skewness	–0.909	–0.526	–0.93	–0.718	–0.733
Kurtosis	0.933	0.225	1.118	0.463	0.623
Minimum	17	5	14	3	59
Maximum	90	50	50	30	220
P15	56	26	35	17	139
P85	82	44	48	27	195

the development of the PH17, during the development of the PH22, the approach by de Vet *et al.*¹² was used for item reduction, which includes content discussion and judgement of internal consistency next to highest factor loadings. First, these steps are considered essential to the item reduction process to avoid withdrawing relevant items. Second, retaining items with the highest factor loadings per factor without the other steps can lead to overlap, that is, the answer to one question predicts the answer to the second, thus providing information as if it were merely one item. Overall, the approach by de Vet *et al.*¹² most likely improves a questionnaire's discriminative ability, which means that a tool is better able to generate different scores for populations with different levels of Positive Health. This is considered an essential condition for a measurement instrument, particularly for instruments aiming to evaluate interventions or follow cohorts. The too high internal consistency found for at least parts of the PH17 dimensions might be a consequence of this. Looking at the PH17, internal inconsistency was high for almost all dimensions, especially related to the low number of items per factor (2–3 items; CA; 0.90, 0.89, 0.77, 0.93, 0.89, 0.84). More items result in higher CA by definition. For the PH22, the dimension 'Contentment with life' also had too high internal consistency (CA=0.92), but the factor also consisted of nine items, which might (partly) explain the high CA. The other dimensions of the PH22 showed good internal consistency, with CA ranging from 0.74 to 0.81. Finally, both PH17⁹ and PH22 development started with the 42 items of the MPH dialogue, but the different methodological approaches resulted in other sets of items; only eight items corresponded. When comparing the PH22 to the PH42,¹¹ its internal consistency and user-friendliness improved because of fewer items, at the expense of only a bit less explained variance (62% and 68%, respectively).

We presumed the 42 items of the MPH to be a content-valid basis to compose a measurement instrument, reflecting 'health from the perspective of patients and citizens' as assessed by Huber *et al.*⁵ The items of the

MPH tool were formulated based on health indicators that emerged from a large concept elicitation interview study among various stakeholders including patients and citizens,⁵ generating a solid basis for its content. In the meantime, studies showed that scores from the PH17 and PH42 correlated with constructs like quality of life, resilience and recovery^{10 11 26} and with level of education and healthcare use.²⁶ Moreover, the MPH was shown by various users as a relevant and comprehensible dialogue tool.³ We followed an inductive approach towards the development of the PH22. Thereby, four dimensions emerged which we named; 'Physical fitness', 'Contentment with self, others and life', 'Daily life management' and 'Future perspective' aligning with the core elements of the dynamic concept of (positive) health by Huber *et al.*^{2 5}

During the development of the dynamic concept by Huber *et al.*² and during its elaboration into Positive Health,⁵ a deliberate choice was made to strive for an open concept instead of a more demarcated definition. Nevertheless, when creating a measurement instrument, it is important to establish a clear construct.²⁷ It should be noted that no widely agreed construct for Positive Health exists so far.^{27 28} As described above, in this study we chose the construct for the measurement tool to reflect the original concept of health by Huber *et al.*² 'Health as the ability to adapt and to self-manage, in the face of social, physical and emotional challenges'. This concept closely fits a recently proposed description of positive health: 'reserve in capacities'.²⁸ Recently, another Dutch research group published the 32-item Context-sensitive Positive Health Questionnaire (CPHQ).²⁹ This measurement tool aligns the concept of Positive Health with the 'Capability Approach'.³⁰ Accordingly, they formulated the following construct definition for their measurement tool: "The extent to which one is capable to adapt and to thrive given one's physical, mental, social and contextual opportunities". As a result, the CPHQ included more context-related items than the PH22, such as items about feeling disadvantaged because of sexuality or cultural

background or feeling represented by politics. Nevertheless, the PH22 and CPHQ also overlap, both including capabilities and functionings (beings and doings). For the methodological process of item reduction towards the 32-item CPHQ, similar to those for the PH17, the three items with the highest FL (>0.4 without cross-loadings) were leading, possibly hampering its discriminant validity. Lastly, contrary to the CPHQ, the PH22 consists only of original items from the MPH to keep recognisability with the Positive Health approach in practice. As 'Positive Health' is a novice approach, the discussion as to which construct or theoretical framework approximates best should continue. Moreover, van Druten *et al*¹⁷ pointed out that the conceptualisation of health is person- and context-dependent, which necessitates the existence of various constructs. Therefore, different definitions and theoretical frameworks, such as Positive Health, Reserve Capacity Model³¹ or Capability Approach,³⁰ should exist side by side. At the moment, the CPHQ is being further developed and assessed.³² One part of the research consists of comprehensive focus groups with various stakeholders discussing and prioritising items anew with the aim to shorten the questionnaire and resulting in a broadly supported instrument to assess the broad concept of health. It is of interest to explore how these instruments can supplement each other, or in other words, which instrument serves which aim and context best. Future choices of which tool to use should not only depend on the measurement properties and usability of each tool but also on which construct definition is preferred as the outcome to measure.^{8 17}

The PH22 scores, reflecting the outcome measure self-reported Positive Health, can be added to evaluate positive health and patient-centred interventions during treatment and care. Personcentred treatment and care is more and more the standard for (healthcare) practices. In line with the new perspective on health, it is not possible to assess the effect of personcentred care with disease-oriented questionnaires alone. The assessment of personcentred care requires new tools focusing on Positive Health. The PH22 questionnaire provides in this need. It is founded on the Positive Health indicators retrieved from a robust study among diverse stakeholders including patients and citizens.⁵ From here, the widely used MPH dialogue tool was developed. Successfully, the short PH22, derived from the MPH dialogue tool and developed through thorough methods, serves the purpose as a measurement tool for person-centred care and practices. Lastly, it should be emphasised that the PH22 is not meant for dialogue purposes. Specifically, for that aim, the MPH dialogue tool was developed to guide the conversation about someone's Positive Health and reflect on someone's personalised (positive) health-related goals over time in his or her specific context.

Prior to the actual use of the PH22 as a measuring tool in evaluative research, it is essential to explore its test-retest reliability and responsiveness for change. Future research has to explore this so that differences in scores

can be correctly interpreted. Other aspects mentioned by the COSMIN guidelines important to further develop the PH22 are research at its construct or criteria validity by hypothesis testing, in which the PH22 scores are related to other similar constructs, as was also done for the PH17 and PH42.^{9 10 26} Moreover, to assign qualitative meaning to the differences in PH22 scores, it is of major interest to define clinical and commonly understood self-reported outcomes and align these. This will further improve the interpretability of the PH22.

CONCLUSIONS

In this study, a comprehensive methodological approach was applied using both content discussions and statistical output aiming to develop a content valid measurement tool for evaluative purposes in scientific or policy research at positive health or patient-centred interventions assessing self-reported Positive Health. A relatively short questionnaire containing 22 items distributed over four dimensions, the PH22, was developed and cross-validated among a general (Dutch) population. This study supports its structural validity. To apply this questionnaire in evaluative research, its test-retest reliability should be explored first, followed by responsiveness for change. Future research has to assess this.

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REFERENCES

- 1 Constitution of the world health organization. Available: <https://www.who.int/about/governance/constitution> [Accessed 13 Jun 2022].
- 2 Huber M, Knottnerus JA, Green L, *et al*. How should we define health? *BMJ* 2011;343:bmj.d4163.
- 3 van Vliet M, de Kleijn M, van den Brekel-Dijkstra K. Rapid Review on the Concept of Positive Health and Its Implementation in Practice. *Health Care (Don Mills)* 2024;12.
- 4 MijnPositieveGezondheid.nl. Available: <https://mijnpositievegezondheid.nl/> [Accessed 22 Sep 2023].
- 5 Huber M, van Vliet M, Giezenberg M, *et al*. Towards a “patient-centred” operationalisation of the new dynamic concept of health: a mixed methods study. *BMJ Open* 2016;6:e010091.
- 6 Landelijke nota gezondheidsbeleid 2020–2024—gezondheid breed op de Agenda. 2020.
- 7 Lemmens L, de Bruin S, Beijer M, *et al*. Het gebruik van brede gezondheidsconcepten, inspirerend en uitdagend voor de praktijk. 2019. Available: <https://www.rivm.nl/documenten/gebruik-van-brede-gezondheidsconcepten-inspirerend-en-uitdagend-voor-praktijk-0>
- 8 Nahar-van Venrooij LMW, Timmers J. Het meten van een brede benadering van gezondheid vraagt een brede aanpak in wetenschappelijk onderzoek. *TSG Tijdschr Gezondheidswet* 2022;100:170–3.
- 9 Van Vliet M, Doornenbal BM, Boerema S, *et al*. Development and psychometric evaluation of a Positive Health measurement scale: a factor analysis study based on a Dutch population. *BMJ Open* 2021;11:e040816.
- 10 Doornenbal BM, Vos RC, Van Vliet M, *et al*. Measuring positive health: Concurrent and factorial validity based on a representative Dutch sample. *Health Soc Care Community* 2022;30:e2109–17.
- 11 van Druten VP, Metz MJ, Mathijssen JJP, *et al*. Measuring Positive Health using the My Positive Health (MPH) and Individual Recovery Outcomes Counter (I.ROC) Dialogue Tools: A Panel Study on Measurement Properties in a Representative General Dutch Population. *Applied Research Quality Life* 2024;19:2825–46.
- 12 de Vet HCW, Terwee CB, Mokkink LB. Measurement in medicine - a practical guide. Cambridge University Press, 2011. Available: <https://research.vu.nl/en/publications/measurement-in-medicine-a-practical-guide>
- 13 Scherpenzeel AC, Das M. “True” longitudinal and probability-based internet panels: evidence from the Netherlands. In: Das M, Ester P, Kaczmarek L, eds. *Social and behavioral research and the internet: advances in applied methods and research strategies*. Boca Raton: Taylor & Francis, 2010: 77–104. Available: <https://www.lissdata.nl/>
- 14 How it works - liss panel. Available: <https://www.lissdata.nl/how-it-works> [Accessed 02 Feb 2024].
- 15 Gagnier JJ, Lai J, Mokkink LB, *et al*. COSMIN reporting guideline for studies on measurement properties of patient-reported outcome measures. *Qual Life Res* 2021;30:2197–218.
- 16 STROBE - strengthening the reporting of observational studies in epidemiology. Available: <https://www.strobe-statement.org/> [Accessed 18 Jul 2024].
- 17 van Druten VP, Bartels EA, van de Mheen D, *et al*. Concepts of health in different contexts: a scoping review. *BMC Health Serv Res* 2022;22.
- 18 Velicer WF, Jackson DN. Component Analysis versus Common Factor Analysis: Some issues in Selecting an Appropriate Procedure. *Multivariate Behav Res* 1990;25:1–28.
- 19 Floyd FJ, Widaman KF. Factor analysis in the development and refinement of clinical assessment instruments. *Psychol Assess* 1995;7:286–99.
- 20 Alavi M, Visentin DC, Thapa DK, *et al*. Exploratory factor analysis and principal component analysis in clinical studies: Which one should you use? *J Adv Nurs* 2020;76:1886–9.
- 21 Tabachnick B, Fidell LLS. Using multivariate statistics. Bacon P, ed. 2007.
- 22 Rosseel Y. Lavaan: An R package for structural equation modeling. *J Stat Softw* 2012;48.
- 23 Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Struct Equ Modeling* 1999;6:1–55.
- 24 McHorney CA, Tarlov AR. Individual-patient monitoring in clinical practice: are available health status surveys adequate? *Qual Life Res* 1995;4:293–307.
- 25 Mokkink LB, de Vet HCW, Prinsen CAC, *et al*. COSMIN Risk of Bias checklist for systematic reviews of Patient-Reported Outcome Measures. *Qual Life Res* 2018;27:1171–9.
- 26 van Druten VP, Nahar – van Venrooij LMW, Tiemens BG, *et al*. Construct validity of the measurement tools PH42 and I.ROC12 to measure positive health in a general population. Under revision. 2025.
- 27 Prinsen CAC, Terwee CB. Measuring positive health: for now, a bridge too far. *Public Health (Fairfax)* 2019;170:70–7.
- 28 Bodryzlova Y, Moullec G. Definitions of positive health: a systematic scoping review. *Glob Health Promot* 2023;30:6–14.
- 29 Doornenbal BM, van Zutphen T, Beumeler LFE, *et al*. Development and validation of a Context-sensitive Positive Health Questionnaire (CPHQ): A factor analysis and multivariate regression study. *J Patient Rep Outcomes* 2024;8:44.
- 30 Chiappero-Martinetti E, Venkatapuram S. The Capability Approach: A Framework for Population Studies. *APS* 2014;28:708.
- 31 Gallo LC. The Reserve Capacity Model as a Framework for Understanding Psychosocial Factors in Health Disparities. *Applied Psych Health & Well* 2009;1:62–72.
- 32 Gezond meten. Available: <https://gezondmeten.nl/huidig-project/> [Accessed 16 Jul 2024].