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The construction of health state utilities

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The development of the Health-Risk Attitude Scale

The development of the Health-Risk Attitude Scale.

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Abstract

People differ in their attitude towards health risks. This results in differences in preventive health risk behavior and treatment preferences. We developed the health-risk attitude scale (HRAS) in order to assess how persons value their health and manage health risks. The HRAS aims to predict how a person will resolve risky health decisions in the future. Items for the scale were devised mostly on the basis of findings in the literature and through interviews with patients on their treatment preference. The psychometric aspects of the HRAS scale were tested in two studies. To assess construct validity, we used general risk taking scales, a domain specific risk scale, standard gambles, the health locus of control scale and a personality scale. Study 1 describes the construction of the first version of the HRAS and documents the validity and reliability. After factor analysis and reliability analysis the HRAS consists of 13 items. Study 2 describes the validity and reliability of the final version of the HRAS. Relations with other risk scales were positive. In summary, we have developed a short and simple scale assessing risk attitude in a health context. It shows good reliability (both internal and test-retest) and convergent validity.

Introduction

People differ in their attitude towards health risks, and this results in different health risk behavior whether preventive (e.g. diet) or other (e.g. treatment preference) (83-85). There exists a relation between risk attitude and behavior. A person with a positive attitude towards risks will undertake more risk than someone who is risk averse. Differences among individuals in their attitude towards health risks may also be expected to provide valuable information about treatment preferences (33;86;87) and medical decision making (83). There are different ways to assess risk attitude, e.g. a scale or the standard gamble certainty equivalent (CE) method based on expected utility (EU) theory. There are several scales to assess general risk attitude (83;84), but there are no scales to assess health related risk attitude. A CE method involves a time consuming interview to assess a person's health related risk attitude. We developed the health-risk attitude scale (HRAS) in order to assess how persons value their health and manage health risks.

It is difficult to decisively classify individuals as risk-averse or risk-seeking because they behave differently in different situations. Some regard risk attitude as a situation-specific concept (88). Risk attitude can be stable across domains as formulated by Weber et al. (2002). They argued that all persons have a negative attitude towards risk (are risk averse) and that a distinction should be made between risk perception and attitude towards perceived risk. They used perceived risk as a measure of riskiness, and argue that most people are systematically risk averse across domains. (Perceived) risk attitude is inferred by regressing risk taking on risk perception. They argue for the existence of a general risk attitude trait which is obscured by situations and domains that affect risk perception (89). For example, if a person takes risks in the financial domain but not in the social domain, this is due to his/her not perceiving the financial

situation as risky, while perceiving the social situation as risky. EU describes the form of the utility function derived from a series of risk-related questions. According to EU, risk attitude is a trait, and a descriptive label of the utility function. If, however, Weber's argument is valid, then risk attitude is confounded with risk perception.

We developed a health-risk attitude scale instead of a general risk attitude scale. By keeping the scale situation-specific, we circumvent inquiring about a person's risk perception as argued by Weber et al (89). The HRAS only aims to predict how a person will resolve risky health decisions in the future. More knowledge about a person's health risk attitude enables health care providers to better understand their own and patients' treatment preferences. We aimed for a short, and easy to administer scale.

Construct validity of the HRAS was assessed by comparing the scale to other scales. To assess convergent validity we included other risk attitude, risk perception and risk taking scales. We expect the HRAS to show a high correlation with scales that measure risk attitude in the same domain, and a lower correlation with more general risk scales, or risk scales involving other domains as well. We argue that a relation exists between risk perception and risk behavior (89-91). Often risk attitude is inferred from risk behavior. Risky behavior is (at least partly) the result of a positive attitude towards risk together with a low risk perception. Therefore, a negative relation is predicted between risk perception and risk attitude (89).

To assess discriminant validity, we included a scale that measures health locus of control. Previous studies have linked locus of control with health behavior, but not with health risk attitude. People with an internal locus of control (who believe that

their own actions influence their health) are more likely to adopt health-promoting behaviors. We expected a small and negative correlation between risk attitude and internal locus of control. In other words, people with a high internal locus of control, being more aware of their risks, take fewer health risks (89).

We expect a weak relationship between health risk attitude and personality. However, we found no study linking personality and risk attitude. Studies do report that personality plays a role in risk behavior (92;93) and, hence, it may very well be related to risk attitude as well. Personality factors such as extraversion and openness are suggested to have a positive relation with overall risk propensity, while factors such as conscientiousness, agreeableness, and neuroticism have a negative relation (94). With respect to the proposed relation between personality and risky health behavior (e.g. smoking), contradictory results have been found (92).

Study 1 describes the construction of the first version of the HRAS and documents the validity and reliability of the first version. Study 2 describes the validity and reliability of the final version of the HRAS.

Study 1 Reliability and validity of HRAS (first version)

Methods

Scale development

To develop the items for the HRAS, we performed an extensive pilot study and a literature study. Part of the pilot study was an interview of two patients with severe

autoimmune disease. They underwent an experimental treatment (a high dose chemotherapy followed by autologous stem cell transplantation) which is risky compared to conventional treatment (1 - 3% risk of death) (95). The interviews were about patients' motivations and beliefs with respect to their risk attitude and the relation to the treatment chosen. Furthermore, we explored qualitative data from interviews with 103 Dutch patients with resectable rectal cancer about their treatment preferences (96). These patients commented on their treatment as well as on related risks. We not only included items that were related to medical treatment, but also items related to preventive and risky health behavior. We further assumed that people's health risk attitude is related to their attitude to health in general and, therefore, we also included items that incorporated such attitudes. Based on the interviews and the literature, a pilot version of the health-risk attitude scale was constructed. In total 43 respondents of various ages and backgrounds filled out pilot versions of the health risk scale. Based on inter-item correlations and feedback provided by the pilot respondents, we selected 18 items (see Table 7.2). Each item was followed by a seven-point Likert scale on which the extent of agreement could be indicated (1 = totally disagree to 7 = totally agree).

Respondents

There are three samples. Sample A consisted of 26 women (mean age = 28, s.d. = 15) and 19 men (mean age = 34, s.d. = 14). They filled out the questionnaires as part of another experiment on construction of health state utilities (51). Respondents were recruited through newspaper ads and were paid 25 Euros for participation in the entire experiment. Sample B consisted of students from the Leiden University Medical Center attending a course at medical decision making. Questionnaires were distributed and 50 students returned their questionnaires (response rate = 49%). The respondents were 35 women (mean age = 24, s.d. = 5) and 15 men (mean age = 23, s.d.

= 3). They were paid five Euros for returning the scale. Sample C consisted of 58 medical students from the Leiden University Medical Center following a course. Of the 85 questionnaires that were handed out, 58 were returned (response rate = 68%) by 43 women (mean age = 20, s.d. = 3) and 15 men (mean age = 21, s.d. = 3). Students were paid five Euros for participation. In total 147 respondents participated. Due to time constraints, it was not possible for each respondent to fill out all scales of interest (Table 7.1 shows to which samples which instruments were administered).

Construct validity

We computerized seven standard gamble Certainty Equivalents (CE), CE12.5, CE25, CE37.5, CE50, CE62.5, CE75, CE87.5. A CE is a standard gamble for which probabilities are held constant, in our case at .5. The outcomes of the gamble were in healthy life years. The certain outcome is varied until indifference results. The so-called risk parameter (r) is based on the seven CEs, the indifference outcomes. It measures risk attitude according to EU in this study with respect to healthy life years. If $r < 1$ then according to EU a person is risk averse. If $r = 1$, then a person is risk neutral, if $r > 1$ then a person is risk seeking. For more information on CEs, calculating r and the precise procedure used, we refer to Van Osch et al. (34).

The Domain-Specific Risk Attitude Scale (DOSPERT) consists of two scales, one measuring risk taking (deduced from risk behavior) and another measuring risk perception (89). It measures across six domains, i.e. Gambling (4 items), Investment (4 items), Health/Safety (8 items), Recreational (8 items), Ethical (8 items) and Social (8 items). For the risk behavior scale, respondents indicate the likelihood of engaging in 40 different activities on a five-point rating scale ranging from 1 (Extremely unlikely) to 5 (Extremely likely). The higher the score the more risk seeking one behaves. The risk perception scale inquired to what extent these activities were perceived as risky

on a five-point rating scale ranging from 1 (Not at all risky) to 5 (Extremely risky). The higher the score the more an activity is viewed as risky. We translated the DOSPERT into Dutch using a forward-backward procedure. We replaced two items, and reworded five more items to adapt the scale to the Dutch culture. Moreover, in consultation with one of the authors of the original scale, we added, "should the occasion occur" to the existing instruction ("Please indicate the likelihood of engaging in the following activities") of the risk behavior part of the DOSPERT. The Dutch version is available upon request. Appendix 7A shows results of the construct validity and test-retest reliability of the Dutch version of the DOSPERT.

The short Jackson Personality Index (JPI) measures general risk taking (83). It consists of six items on a five-point rating scale ranging from 1 (Strongly disagree) to 5 (Strongly agree). The higher the score, the higher the general risk taking is.

Lion's risk scale (RS) is also a general risk-taking tendency scale (97). It consists of eight items, each followed by a nine-point rating scale ranging from 1 (Strongly disagree) to 9 (Strongly agree). Again the higher the score, the higher the degree of risk taking is.

The Health Locus of Control Scale (H-LOC) consists of three subscales, i.e. Internal orientation, Doctor orientation, and Chance orientation (98;99). Each subscale consists of 6 items. Each item is followed by a six-point scale ranging from 1 (Strongly disagree) to 6 (Strongly agree).

The five-dimensional personality test (5- DPT) measures personality on five different factors: Insensitivity, Extraversion, Neuroticism, Orderliness, and Absorption (100). The scales consists of 100 items on a "yes/no"- scale.

A subset of sample A (10 women, mean age = 36 and 12 men, mean age = 38) completed the HRAS twice within a two week interval to assess test-retest reliability.

Table 7.1. Samples of study 1, number of respondents and scales that were filled out.

Scale (# of items)	Sub A (N = 22)	A (N = 45)	B (N = 50)	C (N = 58)
HRAS (18)	x		x	x
HRAS retest (18)	x			
DOSPERT (80)		x	x	x
DOSPERT retest (80)		x		
CEs (7)		x		
JPI (6)	x		x	x
RS (7)		x	x	x
H-LOC (18)		x	x	x
5-DPT (100)		x		x

Data analysis

Items 2, 5, 6, 7, 11, 13, 14, 16, and 17 of the HRAS needed to be recoded. The higher the score, the more positive one's attitude is towards health risks. Scores could range from 18 – 126. We performed a factor analysis (principal components analysis followed by a varimax rotation) to explore the scale for constructs (possible subscales) recoding items. We assessed internal reliability of the scale by calculating internal consistency (Cronbach's alpha) and test-retest reliability by Intraclass correlation (ICC). To assess construct validity, we calculated correlations between scales (Pearson's). The missing values of the HRAS were examined. Missing values were imputed if more than 50% of the items of the scale was present.

Results

Two of the 147 respondents together had five missing items in the HRAS. Two respondents were unable to fill out the 5-DPT due to time constraints.

Factor analysis

The eighteen items loaded on six factors (eigenvalues > 1). Factor one explained 28% of the variance, and factors two and three only explained 9% each. Factor four, five and six explained 8%, 7% and 6% respectively. Based on the scree plot (see Figure 7.1), we evaluated a one-, two- and three-factor model. In the two-factor model, most items loaded on factor one (Table 7.2) and no general construct could be observed for the items 4, 8, and 11 that loaded on factor two in the two-factor model. The three-factor model did not point to any clearly interpretable factors. We specified a one-factor model (Table 7.2).

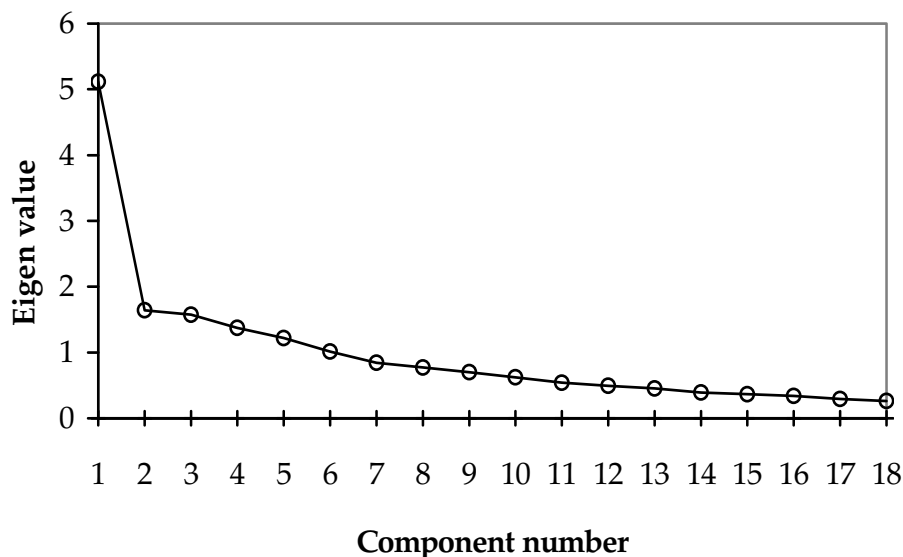


FIGURE 7.1. Scree plot of the factor analysis of the HRAS, first version (18 items).

Table 7.2. Factor analysis of first version HRAS (based on one-factor model). Items with a * are included in the final version. Factor loadings above .30 and below -.30 are depicted.

Item	Factor loading
1. I don't have a problem with taking risks with my health if the benefits are great enough.	.44
2. I think that I take good care of my body.*	.61
3. I don't want to have to consider the consequences for my health with everything that I do every time I do something.*	.49
4. If, due to illness, I could die prematurely, then I would accept a high risk operation which could prevent this from happening.	
5. It is important for me that I organize my life so that I will later enjoy good health.*	.61
6. If it concerns my health, then I see myself as someone who avoids risks.*	.76
7. My health means everything to me.*	.63
8. When I think of an operation, I immediately think of the risk.	
9. When I look back at my past, I think that, in general, I did take risks with my health.*	.59
10. I'm not very fussy about my health.*	.76
11. I would accept risks in undergoing a medical treatment only if I thought there are no reasonable alternatives.	
12. Uncertainty about the consequences of a medical intervention is, in general, part of the game.*	.36
13. Safety first, where my health is concerned.*	.75
14. To enjoy good health now and in the future, I am prepared to forego a lot of things.*	.61
15. People say that I take risks with my health because of my habits.*	.57
16. If the doctor cannot offer me certainty about the possible consequences of a medical intervention, then I would rather not undergo it.*	.36
17. I would never want to have an operation with a high mortality risk no matter what my symptoms are.	.48
18. In general I would estimate that I would not have much of a problem with undergoing a high risk operation.	.45

Reliability

We performed a reliability analysis on items that leaned on the first factor (not including items 4, 8 and 11), based on the analysis items 1 and 17 were removed. Internal consistency of all 13 items now included was .84 (see Appendix 7B for final version of the HRAS). Removal of any other items would not improve internal consistency. Test-retest reliability (based on the 13 items) was computed for the subset of sample A, and the ICC was high at .85. The mean score for all respondents was 62.4, the standard deviation was 13.1, and the median was 62.

Validity

Table 7.3 shows correlations between the 13-item HRAS and other (sub)scales. The HRAS showed a positive but non-significant correlation with the risk parameter based on CEs. The risk parameter only showed a positive correlation with Lion's risk scale ($r = .34, p < .05$). As predicted, the HRAS showed mostly positive and moderate to low correlations with the DOSPERT Behavior subscales, except for the correlation with the subscale Health (.50) which was good. The correlation between the HRAS and the DOSPERT perception scale was negative for all scales. The highest correlation was again observed for the subscale Health. The general risk scales (RS and JPI) showed reasonably good correlations with the HRAS.

A negative, and almost significant correlation ($r = -.20, p = .07$) was observed with the subscale Doctor orientation of the H-LOC. For the 5-DPT, there was a negative and high correlation ($r = -.40, p < .000$) between the Orderliness (e.g. to be neatly or to prefer it methodologically arranged) subscale and the HRAS.

Table 7.3. Correlations between HRAS, first version, and other scales.

Scales	HRAS
CE	.23
D-Per Soc	-.07
D-Per Recr	-.27**
D-Per Inv	-.27**
D-Per Gamb	-.01
D-Per Eth	-.19
D-Per Health	-.39**
D-Beh Soc	-.07
D-Beh Recr	.21*
D-Beh Inv	.34**
D-Beh Gamb	.39**
D-Beh Eth	.37**
D-Beh Health	.50**
RS	.51**
JPI	.45**
HLOC I	.04
HLOC D	-.20
HLOC C	.07
5-DPT E	-.02
5-DPT N	-.16
5-DPT A	.01
5-DPT I	.19
5-DPT O	-.40**

**Correlation is significant at the 0.01 level, *correlation is significant at the 0.05 level.

Discussion

The purpose of this study was to evaluate the psychometric properties of the HRAS. Factor analysis did not identify subscales in the HRAS. After factor analysis, reliability analysis showed that five items could be removed to improve reliability. The HRAS showed high reliability, both test-retest reliability and internal consistency.

Construct validity was assessed with various scales. The convergent validity was reasonable to good with all correlations in the expected direction. The highest correlations were observed with the RS and the subscale Health of the DOSPERT. Lower correlations were observed with other subscales of the DOSPERT. This indicated good convergent validity. As expected, correlations with the HRAS were negative for the DOSPERT perception scale and positive for the DOSPERT behavior scale. This agrees with the findings by Weber et al. (89). We had expected a higher correlation between the HRAS and the CEs. The CEs showed a significant correlation with a more general risk tendency scale. The HRAS correlated negatively with the personality dimension Orderliness.

Study 2 Validity and reliability of the final version of the HRAS

Study 2 served to validate the 13-item version of the HRAS, both in students and in a more general sample.

Methods

Respondents

Sample D consisted of medical students of the Leiden University Medical Center attending a course on scientific education. Of the 100 questionnaires, 43 were returned (response rate = 43%). The respondents consisted of 36 women (mean age = 19, s.d. = 1) and 9 men (mean age = 20, s.d. = 2), two respondent won a cinema ticket after participation. Sample E consisted of employees from a training and consultancy firm and from the Dutch organization for council of clients from retirement and nursing homes. Two co-workers handed out 110 questionnaires and 89 respondents responded (response rate = 81%). Respondents consisted of 58 women (mean age = 43 years, s.d. = 15) and 31 men (mean age = 45 years, s.d. = 18). They received no reward for participation. All respondents completed the final version of the HRAS, the DOSPERT, RS, and JPI. Items 1, 3, 4, 6, 8, 9, and 10 of the HRAS need to be recoded. The higher the score, the higher the health-related risk attitude.

Results

Three respondents had 6 missing items from the HRAS. The mean score of all respondents was 42.3, the standard deviation was 8.8, and the median was 42. No significant difference in the HRAS was observed between samples.

Reliability

The internal consistency of the HRAS was reasonable at .71. If item 5 was removed it increased to .75. In the final version, only three of the 13 items involve risk related to a medical treatment, one of which is item 5. Therefore, we choose to maintain item 5 as

part of the HRAS. The removal of any other item resulted in a decrease of the reliability.

Construct validity

Table 7.4 shows correlations between the HRAS and the DOSPERT, RS, and JPI. All correlations were in the expected direction. The strongest correlation with the DOSPERT subscales was again with the health/safety scale. The RS and JPI showed positive relations with the HRAS.

Table 7.4. Pearson correlations between HRAS, final version, and other scales.

Scales	HRAS
DR-B Inv	.03
DR-B Gam	.09
DR-B Health	.33**
DR-B Recr	.22*
DR-B Eth	.13
DR-B Soc	-.05
DR-P Inv	-.14
DR-P Gam	-.22*
DR-P Health	-.37**
DR-P Recr	-.32**
DR-P Eth	-.17
DR-P Soc	-.05
RS	.49**
JPI	.25**

**Correlation is significant at the 0.01 level, *correlation is significant at the 0.05 level.

General discussion

The main aim of this chapter was to assess the reliability and validity of a health related risk attitude measure, the Health-Risk Attitude Scale. On the basis of the data showed we argue that it assesses health related risk attitude. The first results from using the HRAS indicate that it is a short and, hence, tractable scale that appears to adequately measure health related risk attitude. The response rate to our study was reasonable.

Internal and test-retest reliability are good. A further indication that the HRAS has a good construct validity is the good convergent validity; the correlation with other risk scales is significant. Moreover, the highest correlation with the DOSPERT by Weber et al. was observed with the health/safety subscale. The Health/safety subscale of the DOSPERT does not incorporate health related risk attitude with respect to medical treatments, and can therefore not substitute for the HRAS. The items of the Health/safety subscale involve mostly preventive health behavior, e.g. the use of sunscreen or the engaging in unprotected sex. The HRAS correlates equally well with the risk taking and risk perception DOSPERT Health/safety subscale. It may be possible that the apparent difference in willingness to take health risks may actually be mediated by differences in the perception of such risks. Future research should focus on the relation between the perceived riskiness of a medical treatment (or health behavior, e.g. smoking) and the willingness to undergo a treatment (or perform health behavior).

The HRAS did not correlate with the CEs. The CEs in our experiment involved future healthy life years (i.e. length of life), and not quality of life. In other words, they measure risk attitude in relation to time preference. Possibly, if the CE involved more

of the qualitative aspect of health, we would have observed a better relation. Moreover, the CEs showed no significant relation to the DOSPERT subscale Health/safety, but it showed the strongest relation to general risk taking tendency. The relationship between risk attitude and time preference needs to be explored further (101).

There exists no relation between health locus of control and health risk attitude. We nevertheless found studies linking health locus of control and health (preventive) behavior. Risk attitude and health locus of control appear to be two different, unrelated constructs that influence health risk behavior to a different extent. There is a negative relation between personality trait Orderliness and health risk attitude. Orderliness is a variant of the Big-five dimension Conscientiousness (100;102). In another study, a negative relation was also observed between Conscientiousness and health risk propensity, but this relation was not significant. Our findings support the natural reasoning that a person who would take care to do things carefully and correctly is more inclined to view health risk taking negatively.

In summary, we have developed a short and simple scale assessing risk attitude in a medical context. It shows good reliability and convergent validity. The next step is to test the scale in studies assessing medical decision making in high risk contexts, such as organ transplants.

Appendix 7A. Reliability and validity of the Dutch DOSPERT based on studies 1 and 2.

Test-retest reliability of the DOSPERT behavior scale varied per subscale. ICC for the subscale Social (.47) was low, correlations were moderate for the subscales Health (.52), Gambling (.55), Investment (.62), and Ethics (.68). Correlation was high for the subscale Recreational (.89). For the DOSPERT perception scale, the ICCs were overall somewhat lower. They were low for the subscales Health (.33) and Gambling (.43), and moderate for Investment (.56), Recreational (.60), Ethics (.66) and Social (.69). The DOSPERT subscales Health/safety and Recreational showed either the highest or the most frequently a correlation with other scales, see Table 7A.

Table 7A. The DOSPERT (D in table) consists of two scales, i.e. behavior (B) and perception (P), each is made up of six subscales: Investment (Inv), Gambling (Gam), Health/Safety (Health), Recreational (Recr), Ethics (Eth), and Social (Soc). Correlations between Dutch DOSPERT and other scales are depicted. The short sensation seeking scale (SSS) measures risk taking behavior involving thrill and sensation (103). The Revised Life Orientation Test (LOT) measures dispositional optimism (104). For other scale abbreviations, number of respondents, see Methods section of Study 1.

Scales	D-B	D-B	D-B	D-B	D-B	D-B	D-P	D-P	D-P	D-P	D-P	D-P
	Inv	Gam	Hea	Recr	Eth	Soc	Inv	Gam	Hea	Recr	Eth	Soc
RS	.17**	.19**	.43**	.45**	.22**	.16**	-.27**	-.15*	-.35**	-.35**	-.25**	-.13*
JPI	.18**	.21**	.29**	.35**	.23**	.15*	-.28**	-.12	-.28**	-.28**	-.23**	-.17**
SSS	.21**	.11	.23**	.50**	.20*	.02	-.14	.04	-.12	-.41**	-.12	-.06
LOT	.08	-.10	.12	.25*	-.09	.07	.06	.05	-.13	-.25*	-.11	-.09
HLOC I	.10	.14	-.02	.14	.17	.16	.02	.00	.01	.00	.16	.08
HLOC	.19	.01	-.10	-.22*	-.21*	.06	-.03	-.07	.10	.18	.17	.08
D												
HLOC C	.08	-.06	.09	-.23*	.00	-.17	.07	.10	.01	.11	-.08	.04

**Correlation is significant at the 0.01 level, *correlation is significant at the 0.05 level.

Appendix 7B. Final version

H-RAS (Van Osch & Stiggelbout)

On the following pages you will find several statements. Read through each statement. Please circle the number which best reflects your opinion. There are no right or wrong answers. We are interested in your opinion.

For example:

I am a morning person

Totally disagree 1 2 3 4 5 6 7 Totally agree

By putting a circle around number 4, you would indicate that you neither agree nor disagree with this statement.

If you totally disagree with the statement, then put a circle around number 1.

If you disagree to a great extent with the statement, then put a circle around 2.

If you slightly disagree with the statement, then put a circle around 3.

If you slightly agree with the statement, then put a circle around 5.

If you agree to a great extent with the statement, then put a circle around 6.

If you totally agree with the statement, then put a circle around 7.

1. I think I take good care of my body.
2. I don't want to have to consider the consequences for my health in everything that I do.
3. It is important to me that I organize my life so that I will later enjoy good health.
4. If it concerns my health, then I see myself as someone who avoids risks.
5. Uncertainty about the consequences of a medical intervention is, in general, part of the game.
6. My health means everything to me.
7. When I look back at my past, I think that, in general, I did take risks with my health.
8. If the doctor cannot offer me certainty about the possible consequences of a medical intervention, then I would rather not undergo it.
9. Safety first, where my health is concerned.
10. To enjoy good health now and in the future, I am prepared to forego a lot.
11. People say that I take risks with my health because of my habits.
12. I'm not very fussy about my health.
13. In general I would estimate that I would not have much of a problem with undergoing a high risk operation.

