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Measuring Health-Related Quality of Life by Experiences: The Experience Sampling Method

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ABSTRACT

Objective: To explore the potential value of obtaining momentary, instead of retrospective, accounts of the description and valuation of a person's own health-related quality of life (HRQOL). **Methods:** Momentary HRQOL was examined with the experience sampling method (ESM) in 139 participants from four different samples. The ESM consists of a so-called beep questionnaire that was administered 10 times a day by an electronic device. Feasibility was determined by assessing willingness to participate in the study and by analyzing the percentage of dropouts and the number of completed beep questionnaires. Multilevel analysis was used to investigate the relation between momentary HRQOL and momentary feelings and symptoms. The relation between momentary outcomes and the EuroQol visual analogue scale was investigated with a multiple regression model. **Results:** The overall participation rate was low, but there were no dropouts and the number of completed beeps was comparable to that in other studies. Multilevel analysis showed that feelings and symptoms were significant predictors of momentary HRQOL. The strength of these relations differed among three patient groups and a population-based sample. The EuroQol visual analogue scale was not predicted by momentary feelings and symptoms. **Conclusions:** We can conclude that the use of the ESM to measure accounts of the momentary experience of health in different populations is feasible. Retrospective measures may provide a biased account of the impact of health problems in the daily lives of people who are affected. Moreover, the bias may be different in different conditions.

Keywords: *health-related quality of life, experience sampling method, preferences, utility measurement.*

Introduction

The quantification of the subjective experience of health-related quality of life (HRQOL) is crucial to the evaluation of health care technologies. HRQOL has been defined as an individual's perception of his or her physical health, psychological state, level of independence, social relationships, and relationship to the environment [1]. To assign meaningful numbers to HRQOL outcomes, the experience needs to be described in terms of severity and assigned a value. Instruments to obtain patient descriptions and valuations of their own health, such as the EuroQol 5D (EuroQol five-dimensional questionnaire) health description and the EuroQol visual analogue scale (EQ-VAS), rely on retrospective self-report. One problem with retrospective self-report is that it is likely to give a biased account of real-world experiences due to imperfect recollection of past experiences [2,3]. In other words, it only partially captures the impact of health problems in the daily lives of people who are affected. An alternative to retrospective self-report is to study outcomes from moment to moment in the context of daily life. The objective of the present study was to explore the potential value of obtaining momentary, instead of retrospective, accounts of the description and valuation of a person's own HRQOL. In this study, we focus on the physical and psychological dimensions of HRQOL.

Retrospective versus Momentary Self-Report

Robinson and Clore [4] reviewed several studies describing discrepancies between momentary and retrospective self-reports. Retrospective self-reports are less than perfect reflections of

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experience because feelings are not always accurately represented in memory. If not measured directly, affective experience needs to be reconstructed on the basis of episodic or semantic memory. *Episodic memory* is the recollection of past personal experiences that occurred at a particular time and space. With regard to episodic memory, Kahneman [5] and Kahneman et al. [6] found that more memorable details of an emotional event disproportionately affect retrospective estimates of emotion. Also, there is a gradual decline in episodic memory over time [7], which leads to a reliance on semantic memory to fill in the memory gap of hedonic experience.

Semantic memory is a more structured record of facts and knowledge about the external world and relies more on generalized beliefs than on experiences. In this regard, there is a distinction between retrospective self-reports of global concepts and retrospective self-reports of specific feelings and symptoms. Global reports of past health will rely more on semantic memory, whereas reports on specific feelings and symptoms may more easily be recovered by detailed episodic recall [4,8,9]. As a result, the retrospective global valuation of health may be more prone to bias than the retrospective description of detailed aspects of health such as specific feelings or symptoms, a problem that increases with temporal delay [10]. More fundamentally, there is an increasing awareness that experiences are dynamic, situated, and highly context driven (see the contributions in Mesquita et al. [11]), thereby providing a powerful rationale for investigating experiences in the context in which they occur [12]. Moreover, bias in retrospective self-report might be different in different patient populations. For instance, depression has been shown to have an effect on memory performance [13,14]. As a result, a higher discrepancy between retrospective self-report and actual experiences may occur in persons suffering from psychological complaints. Furthermore, people do not adapt well to noise [15,16]. As a result, patients with a complaint such as tinnitus, which is the experience of a sound without an acoustic source, might disproportionately focus on this aspect when evaluating their HRQOL retrospectively.

Experience Sampling Method

In the present study, we used the experience sampling method (ESM) [17] to obtain momentary accounts of feelings, physical symptoms (PS), and HRQOL. The ESM is characterized by the collection of multiple self-reports of an individual's (near) real-time feelings, thoughts, and activities in real-world environments. ESM studies are conducted using paper diaries or (increasingly) electronic devices [18]. These devices beep at random moments, when participants are asked to complete a questionnaire. A potential limitation of the ESM is that it can be time consuming and intrusive, and as a result burdensome to participants [19].

Objectives

In this study, first, we assessed the feasibility of using the ESM to obtain accounts of the momentary valuation of HRQOL in different patient populations. Next, it was expected that if the momentary valuation of HRQOL would vary over time, this would be an indication that the momentary valuation of a global concept such as HRQOL is influenced by the momentary experience of more specific feelings and symptoms. Therefore, we assessed whether the momentary valuation of HRQOL is variable from moment to moment within persons. Furthermore, we examined the relation between momentary accounts of specific feelings and symptoms and the momentary valuation of HRQOL. Finally, we examined the relation between the global *retrospective* valuation of HRQOL (as obtained by the EQ-VAS) and the momentary accounts of feelings and symptoms and valuation of HRQOL.

Methods

Study Population

The study population consisted of 139 participants. To ensure a variety of experienced health states in the study population, participants were recruited from three patient groups—experiencing somatic complaints with a known cause (atherosclerosis or venous insufficiency), somatic complaints without a known cause (tinnitus), and psychological complaints (anxious or depressed)—and a population- based sample. All participants were 18 years or older. Exclusion criteria were not being able to read and write in Dutch or not being able to handle the electronic ESM device because of impaired motor skills (for more details, see Appendix A in Supplemental Materials found at http://dx.doi.org/10.1016/j.jval.2014.10.003).

Measures

ESM using the Maastricht routine [20]

The ESM consists of a beep questionnaire that participants are required to fill out at several unpredictable moments during the day, in addition to questions in the morning, on waking and in the evening when going to sleep. The validity and reliability of the Maastricht routine has been documented elsewhere [20]. In this study, we used the PsyMate, a small user-friendly device programmed to generate beeps (and vibrations) 10 times a day between 07.30 h and 22.30 h randomly in 1½-hour intervals. At every beep, the PsyMate presents the questions and records the responses using a touchscreen keyboard. The beep questionnaire (see Appendix B in Supplemental Materials found at http://dx.doi.org/10.1016/j.jval.2014.10.003) consists of items on feelings, physical symptoms, context (location, interaction, activities), and overall HRQOL. For the items on feelings—six for positive affect (PA) and five for negative affect (NA) and PS (four items)—a seven-point Likert scale was used. The contextual items had predetermined answering categories. To obtain a valuation of momentary HRQOL, a VAS anchored in the same way as the EQ-VAS (0 being the worst imaginable health state and 100 being the best imaginable health state) was included [21]. A detailed description can be found in Appendix A.

A global retrospective valuation of health, or HRQOL, was obtained using the EQ-VAS. The EQ-VAS is part of the EuroQol instrument, and it ranges from 0 (worst imaginable health state) to 100 (best imaginable health state). The EQ-VAS has good reliability [21].

Anxiety and depression was measured with the Hospital Anxiety and Depression Scale (HADS), which contains 14 items and has good reliability and validity [22]. Each item on the questionnaire is scored on a scale of 0 to 3, with 3 indicating higher symptom frequencies. In addition, data on personal characteristics were collected.

Procedures

The study consisted of three phases planned individually for each participant. All participants received €25 for their participation.

Briefing

During the briefing (approximately 3 hours) on the first day, the rationale of the study was explained and an instruction on the use of the PsyMate was given. A try-out sampling moment was simulated in which the participants were coached in answering the questions on the PsyMate. After the try-out baseline, global data were collected (the EQ-VAS, the HADS, and personal characteristics).

Table 1 – Recruitment, characteristics of the participants, and recorded experience sampling data.

Characteristics	Total sample	Population-based sample	Psychological complaints	Tinnitus	Somatic complaints sample
Received study information (N)	550	44	59	326	121
Did not respond (N)	123	2	5	108	9
Did not meet inclusion criteria (N)	2	0	2	0	5
Declined participation (N)*	270	2	18	173	63
Final sample (N)	139	40	27	40	32
Age (SD)	50.2 (16.7)	38.6 (14.6)	38.4 (12.7)	58.2 (10.0)	64.8 (10.4)
Sex (% male)	69 (49.6)	29 (72.5)	12 (44.4)	11 (27.5)	17 (53.1)
Living situation (% alone)	42 (30.2)	13 (32.5)	11 (40.7)	4 (10.0)	14 (43.8)
Education (%)					
Low	34 (24.5)	4 (10.0)	2 (7.4)	14 (35.0)	14 (43.8)
Middle	53 (38.1)	9 (22.5)	15 (55.6)	14 (35.0)	15 (46.9)
High	52 (37.4)	27 (67.5)	10 (37.0)	12 (30.0)	3 (9.4)
Mean number of beeps recorded per day	7.2	6.9	6.7	7.3	7.7
Mean number of beeps recorded per patient	43.0	41.7	40.2	43.9	46.1

SD, standard deviation.
* For details see Appendix A in Supplemental Materials found at http://dx.doi.org/10.1016/j.jval.2014.10.003

The ESM period

The ESM period comprised 6 days, starting the day after the briefing. During this week, the participants were asked to continue their normal life while carrying the PsyMate with them.

Debriefing

On the eighth day, the participants returned for a debriefing session. The ESM period was reviewed by means of a questionnaire. Participants had to answer whether the PsyMate had influenced their mood, activities, thoughts, or contacts with other people and whether they had been annoyed by the beeps. Furthermore, participants were asked whether the ESM week had been a typical week, whether any unusual incidents had occurred, whether items were unclear, and whether the questions allowed them to give a good representation of their experiences during the day. The EQ-VAS and the HADS were readministered.

Analyses

Feasibility

To determine the willingness to participate in this study, the number of participants who were approached for participation was compared with the number of participants who actually participated in the study. The percentage of dropouts was recorded and analyzed. Feasibility was further assessed by analyzing the number of completed beep questionnaires.

Construction of scales

A principal-components exploratory factor analysis on PA and NA items and PS was used to examine the underlying factor structure [23]. Results confirmed a three-factor solution. We, therefore, created a PA scale, an NA scale, and a PS scale by calculating the means of the respective items. Details can be found in Appendix A.

Variability of momentary HRQOL within and between persons

To determine whether there was variability in momentary HRQOL within persons, for each respondent an SD was determined for the responses to all beep questionnaires. In addition to a descriptive analysis, a repeated-measures analysis of variance with a Greenhouse-Geisser correction was used to explore whether the variability in valuations during the ESM week differed over the days. A linear regression was used to examine the relation between the mean HRQOL and the mean SD of HRQOL.

Table 2 – Descriptive of momentary outcomes and global retrospective EQ-5D VAS at briefing and debriefing.

Measures	Total Mean (SD)	Population based sample Mean (SD)	Psychological complaints Mean (SD)	Tinnitus Mean (SD)	Somatic complaints Mean (SD)	P-value*
Briefing						
EQ-5D VAS	72.85 (19.4)	88.25 (10.4)	61.26 (16.6)	69.50 (19.4)	67.56 (19.1)	.000
Momentary						
HRQOL	69.85 (16.6)	81.57 (12.3)	59.01 (14.7)	67.38 (16.8)	67.42 (14.5)	.000
Positive affect	4.67 (1.5)	5.19 (1.1)	3.51 (1.5)	4.70 (1.5)	4.89 (1.3)	.000
Negative affect	1.66 (1.1)	1.33 (0.6)	2.52 (1.3)	1.63 (1.1)	1.45 (0.8)	.000
Physical symptoms	2.41 (1.2)	1.67 (0.8)	2.15 (0.9)	3.28 (1.1)	2.45 (1.3)	.000
Debriefing						
EQ-5D VAS	74.37 (19.6)	90.50 (8.8)	56.93 (19.2)	72.75 (17.5)	70.73 (17.4)	.000

ANOVA, analysis of variance; EQ-5D, EuroQol five-dimensional questionnaire; HRQOL, health-related quality of life as measured with the EQ VAS; SD, standard deviation; VAS, Visual Analogue Scale.
* One-way ANOVA on retrospective and aggregated momentary data

Table 3 – Variance in momentary valuation of HRQOL explained by positive affect (model 3), negative affect (model 4), and physical symptoms (model 5) and their interaction with group represented in three dummy variables (model 6).

N = 5977	Model 1 (intercept only)			Model 2			Model 3		
	β	SE	P	β	SE	P	β	SE	P
Intercept	−0.018	0.081	0.824	0.672	0.155	0.000	0.542	.122	0.000
Psychological (Dummy 1)				−1.353	0.206	0.000	−0.927	.162	0.000
Tinnitus (Dummy 2)				−1.160	0.224	0.000	−0.934	.177	0.000
Somatic (Dummy 3)				−1.148	0.249	0.000	−0.940	.196	0.000
Age				0.364	0.148	0.014	0.113	.076	0.134
Sex				0.154	0.096	0.110	0.244	.117	0.037
Positive affect							0.356	.010	0.000
Variance	Random			Random			Random		
Person level	0.951			0.818			0.643		
Beep level	0.375			0.375			0.340		
Model fit	−3006.19			−2990.59			−2392.94		
Explained variance (%)									
Person level				14			21		
Beep level				0			9		

N = 5977	Model 4			Model 5			Model 6		
	β	SE	P	β	SE	P	β	SE	P
Intercept	0.564	0.136	0.000	0.481	0.127	0.000	0.488	0.109	0.000
Psychological	−1.109	0.181	0.000	−1.197	0.168	0.000	−0.870	0.146	0.000
Tinnitus	−1.043	0.197	0.000	−0.617	0.184	0.001	−0.634	0.159	0.000
Somatic	−1.041	0.218	0.000	−0.847	0.203	0.000	−0.828	0.175	0.000
Age	0.110	0.084	0.192	0.234	0.121	0.121	0.210	0.067	0.244
Sex	0.377	0.130	0.004	0.121	0.078	0.053	0.079	0.104	0.043
Positive affect							0.176	0.020	0.000
Negative affect	−.0223	0.009	0.000				−0.040	0.022	0.071
Physical symptoms				−0.355	0.011	0.000	−0.159	0.025	0.000
Psychological * positive affect							0.161	0.161	0.000
Tinnitus - positive affect							0.136	0.136	0.000
Somatic - positive affect							0.033	0.033	0.280
Psychological - negative affect							−0.057	−0.057	0.036
Tinnitus - negative affect							−0.046	−0.046	0.119
Somatic - negative affect							0.023	0.023	0.458
Psychological - physical symptoms							−0.091	−0.091	0.008
Tinnitus - physical symptoms							−0.134	−0.134	0.000
Somatic - physical symptoms							0.015	0.015	0.676
Variance									
Person level	0.716			0.666			0.573		
Beep level	0.359			0.350			0.322		
Model fit	−1273.48			−2557.27			−2093.17		
Explained variance (%)									
Person level	12			19			30		
Beep level	4			7			14		

Note. Reference group = general population sample.
HRQOL, health-related quality of life as measured with the EQ VAS; SE, standard error.

Relation between momentary HRQOL and the simultaneous experience of feelings and symptoms

Bivariate correlations between momentary HRQOL and PA, NA, and PS for each participant were computed. Correlations were interpreted according to the following benchmarks: 0.1 to 0.3 was interpreted as small, 0.3 to 0.5 as medium, and more than 0.5 as large [24]. To examine whether momentary feelings and symptoms predict momentary HRQOL, a multilevel random regression model was estimated with momentary HRQOL as the dependent variable and momentary PA, NA, and PS as independent variables. These analyses were computed with the XTMIXED modules of STATA (version 11.0). Because different scales were used, all variables were standardized. The analyses were corrected for age, sex, and group. Group was entered in the mixed regression as a categorical variable using dummy coding, with the population-based sample as a reference category (see Table 3 for details). To determine the explained variance of PA, NA, and PS separately, these variables were first added separately to the basic model (which included momentary HRQOL and the covariates). A final model was fitted with momentary HRQOL as dependent variable and momentary PA, NA, and PS and their interaction with the dummy variables as independent variables. We expected a positive relation between PA and momentary HRQOL and a negative relation between NA and PS and momentary HRQOL.

Relation between the EQ-VAS and momentary HRQOL, feelings, and symptoms

Aggregated means and SDs of momentary HRQOL, PA, NA, and PS were calculated and compared with the EQ-VAS at briefing and debriefing for the total group and all four subgroups. To examine how much of the variance in the EQ-VAS at debriefing was explained by momentary PA, NA, PS, and momentary HRQOL, a multiple regression model was fitted to the aggregated data using standardized variables. Age, sex, EQ-VAS at briefing, and sample (by including three dummy variables with the population-based sample as reference group) were included as covariates.

Results

Feasibility

Data on the inclusion of participants and demographic characteristics of the total sample and subsamples are presented in Table 1. The study information was sent to 550 participants. The most common reason for not wanting to participate was not interested in the study objective (n = 100), too burdensome (n = 57), not able to combine with work (n = 28), and other physical complaints (n = 28) (for further details, see Appendix A in Supplemental Materials found at http://dx.doi.org/10.1016/j.jval.2014.10.003). The final sample included 139 participants, with 40 participants in the population-based sample, 27 in the psychological complaints sample, 40 in the tinnitus sample, and 32 in the somatic complaints sample. The mean age of the total sample was 50 years, and 50% were men.

All participants who finished the briefing completed the ESM week. Most of the participants (76%) thought of their week as being representative of a normal week. Twenty-two percent of the participants found the PsyMate annoying, while 90% reported that it did not influence their mood, social interactions, or activities and 75% said that it did not influence their thoughts (for details on specific subsamples, see Appendix A in Supplemental Materials found at http://dx.doi.org/10.1016/j.jval.2014.10.003). Most of the participants (92%) also reported that they were able to give a good representation of their experiences during the day. Fourteen percent of the participants found some of the questions unclear.

Variability of Momentary HRQOL within and between Persons

In Table 2, the aggregated means and SDs of momentary HRQOL for the total group and the subgroups are presented. The SDs of momentary HRQOL per participant are displayed in Figure 1. The mean of the within-person SDs was 5.64, with a range from 0.94 to 18.22. The mean SD at day 1 was 5.2 and decreased to 3.9 at day 6. A repeated-measures analysis of variance determined that there was a statistically significant difference between the mean SDs over the 6 days ($F = 3.545$; $df = 4.417$; $P = 0.005$). Post hoc tests using the Bonferroni correction revealed that there was a statistically significant difference only between day 1 and day 6. In participants with a higher mean momentary HRQOL, there was less variance in responses than in participants with a lower momentary HRQOL. This relation was confirmed by a linear regression that showed a significant negative relation of the mean and SD of the momentary HRQOL per participant ($\beta = -0.388$; $P = 0.000$; $R^2 = 0.150$).

Relation between Momentary HRQOL and the Simultaneous Experience of Feelings and Symptoms

The aggregated means of PA, NA, and PS are presented in Table 2. Six participants showed no variance in PA, NA, or PS, and so data for these participants are not included in the following analyses. The mean correlation between momentary HRQOL and PA, NA, and PS was 0.35 (range −0.28 to 0.91), −0.22 (range −0.86 to 0.30), and −0.26 (range −0.90 to 0.30), respectively. The within-person correlations between the HRQOL and feelings (PA and NA) and PS for the total sample are displayed in Figure 2. For most of the participants, the correlations with HRQOL were positive for PA (86%) and negative for both NA (75%) and PS (81%).

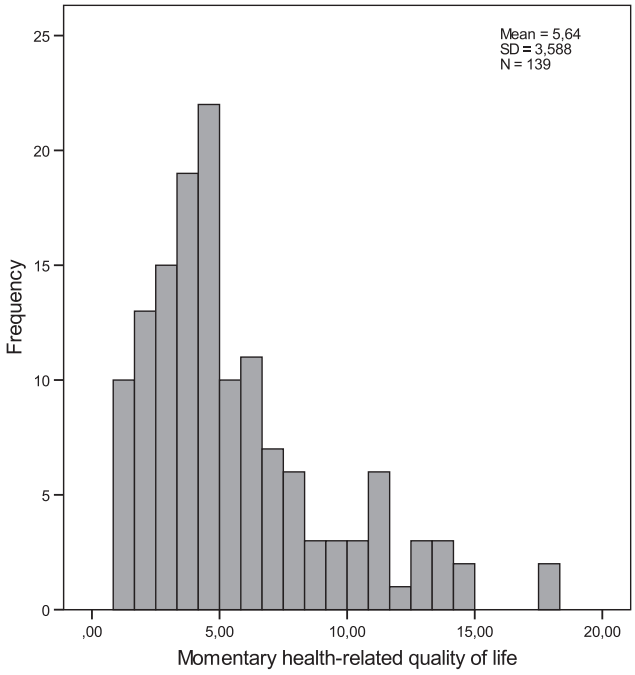

Fig. 1 – Frequency of within-person SDs of momentary health-related quality of life.

In Table 3, the results of the multilevel analysis are presented. Model 6 (the final model) showed that all variable estimates were in the expected direction. Both PA and PS were highly significant predictors ($P < .001$) when controlling for age, sex, and sample (i.e., condition). These main effects, however, were moderated by condition. Specifically, significant interaction terms for PA and psychological complaints and tinnitus samples suggest that PA is a stronger (positive) predictor of momentary HRQOL in these two conditions than in the population-based sample, an effect not found for the somatic complaints sample. With respect to PS, the interactions suggest a stronger (negative) predictor of momentary HRQOL in these two conditions than in the population-based sample. Moreover, although there was only a marginally significant main effect of NA ($P = 0.07$), the significant interaction between NA and psychological complaints suggested that this was the only condition in which NA was more negatively related to HRQOL compared with the population-based sample.

Relation between the EQ-VAS and Momentary HRQOL, Feelings, and Symptoms

There was no significant difference between mean momentary HRQOL (69.85) and mean EQ-VAS (72.85) at briefing ($t = -3.111$; $P = 0.002$) and at debriefing (74.37; $t = -4.606$; $P = 0.000$) (Table 2). When EQ-VAS at debriefing was predicted by momentary experiences (and corrected for group differences, age, sex, and EQ-VAS at briefing) without taking into account the interaction effects between momentary experiences and sample, it was found that EQ-VAS at briefing ($\alpha < .05$) and momentary HRQOL ($\alpha < .05$) were significant predictors of EQ-VAS at debriefing (Table 4). If the interaction terms were added to the model, the fit of the model did not improve ($R^2 = 0.82$).

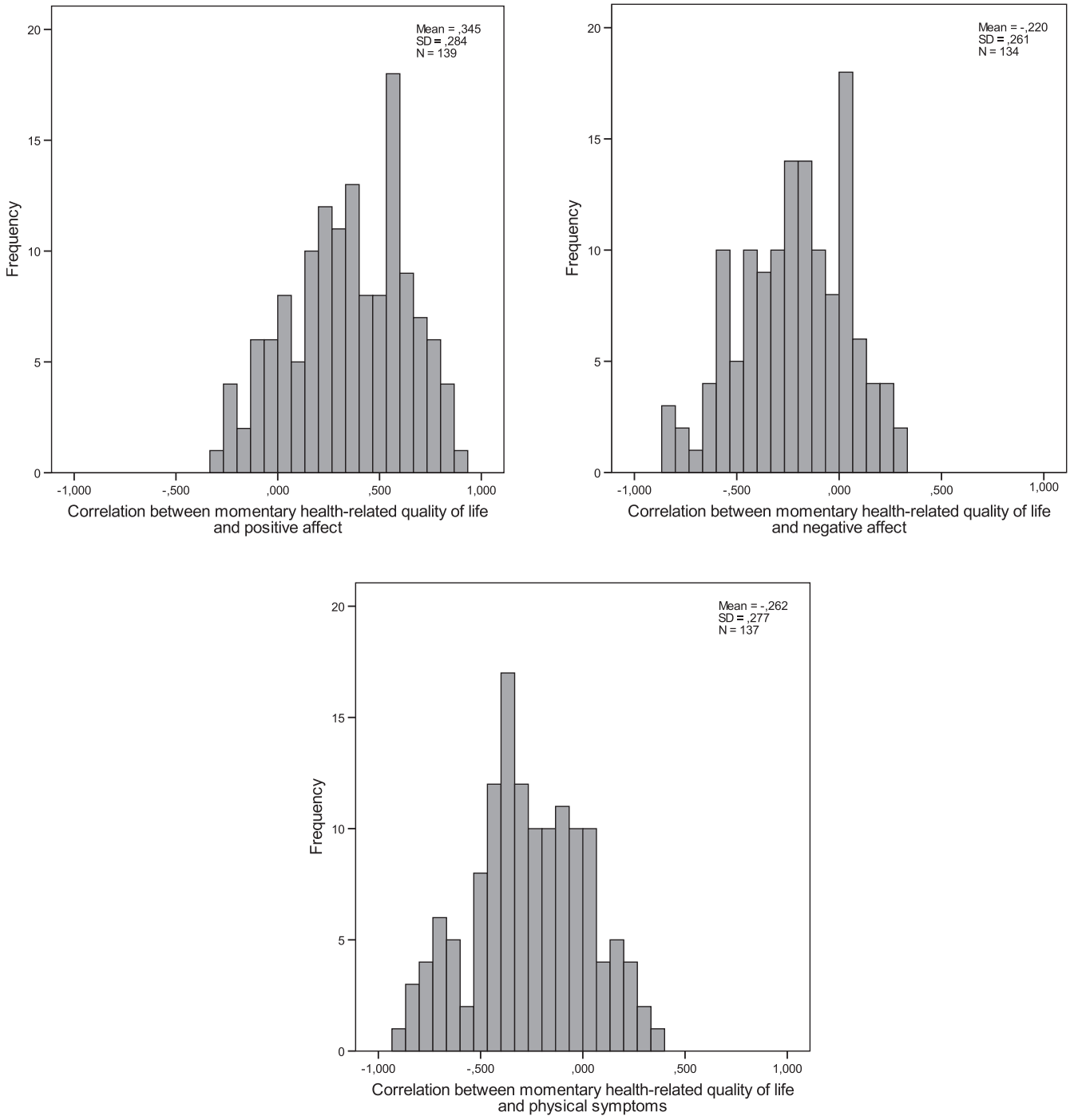

Fig. 2 – Frequencies of within-person correlations between momentary health-related quality of life and positive affect, negative affect, and physical symptoms.

Discussion

This article reports on what is, to our knowledge, the first study that uses the ESM to obtain accounts of momentary HRQOL and compare these with retrospective HRQOL measures. The results will be discussed in the next paragraphs.

With regard to the feasibility of using the ESM to obtain accounts of momentary experience of HRQOL, two things need to be considered: the overall participation rate and the response rate in the persons who agreed to participate. The overall participation rate was low in the patient groups, especially in the tinnitus population and the atherosclerosis/venous insufficiency group. The most common reason for not wanting to participate was that people were not interested in the study objective, which was measuring quality of life in daily life instead of retrospectively, and thus not a particular problem for the methodology. The study was observational and therefore not part of any treatment that could be of interest to the patients. More research has to be done to learn more about the feasibility of

Table 4 – Variance in EQ-VAS at debriefing explained by positive affect, negative affect, and physical symptoms.

N = 139	β	*P*-value	VIF
Psychological (Dummy 1)	−0.257	.000	2.031
Tinnitus (Dummy 2)	−0.066	.323	3.197
Somatic (Dummy 3)	−0.103	.103	2.833
Age	−0.009	.864	2.015
Sex: Male	0.073	.090	1.327
EQ-VAS briefing	0.506	.000	3.235
Positive affect	0.005	.940	3.646
Negative affect	−0.067	.300	3.037
Physical symptoms	−0.106	.092	2.839
Momentary HRQOL	0.196	.025	5.427
Explained variance			
R^2	0.827		
Adjusted R^2	0.813		

Note. Dummy 1: The reference group indicates a population-based sample.
HRQOL, health-related quality of life; EQ-VAS, Euro-Qol visual analogue scale; VIF, Variance Inflation Factor.

using the ESM to obtain accounts of the momentary HRQOL as part of a randomized controlled trial. Another common reason for not participating was "too burdensome," which is related to the method. The low participation rate in the tinnitus population was probably a result of the fact that they had just completed a 12-month randomized controlled trial in which they had to answer a substantial number of questionnaires. For the atherosclerosis/venous insufficiency group, the higher mean age of the group could be an explanation for the low participation rate. Although it was clearly stated in the information letter that the PsyMate is a user-friendly device, a lack of experience with these electronic devices [25] could deter older participants. Furthermore, part of this group just underwent an intensive (clinical) rehabilitation program because of a leg amputation.

With regard to the response rate after inclusion, all participants who finished the briefing also finished the ESM week and the debriefing (with the exception of only a single participant). The participants on average answered 72% of the beeps, which is comparable to the rate in other studies [26–28]. The fact that beeps are missing is not problematic for the statistical analysis because the major advantage of the ESM is that it collects several data points for each respondent. Therefore, the respondent can miss about two third of the beeps without being excluded from the analyses. Furthermore, most of the participants reported that the week was representative of a typical week and that the PsyMate did not influence their health or mood. In this respect, feasibility is more than satisfactory. We can conclude that the low participation rate in this study might be the result of a motivational problem related to not knowing what to expect from the ESM.

Furthermore, present findings showed that there is some variability from moment to moment in momentary HRQOL. This indicates that people take different things into consideration, or are at least influenced by different factors, when making a momentary assessment of their HRQOL during the day. A significant within-person relation between mean momentary experienced HRQOL and the variability from moment to moment was found: the lower the mean momentary HRQOL, the more variability during the ESM week. These findings are in line with other research that found more variability in patients with worse mood levels (higher on NA and lower on PA) [29]. This is the result of a ceiling effect, in this case on momentary HRQOL. To explore whether this was problematic, we computed the SD for participants with a ceiling effect on momentary HRQOL (>90), and the correlations between mean and SD. The results show that the SD was 1.1, and the correlations were equal in the four groups (tested with a Fisher z transformation; $\chi^2 = 6.93$). These findings suggest that the ceiling effect has only a limited effect on the data. There is at least one possible drawback when examining the variability in this study. Momentary assessment of experienced HRQOL was one of the last questions in the beep questionnaire. The reason for this is that feelings can be influenced by preceding questions and therefore have to be measured first after the beep. As a result, the variability found in momentary experienced HRQOL could be the result of a focusing effect. Further research is needed to investigate these kinds of order effects.

The results of this study demonstrated that PA ($\alpha < .05$), PS ($\alpha < .05$), and NA ($\alpha < .10$) are significant predictors of momentary HRQOL, confirming the relation between momentary HRQOL and feelings and symptoms. In addition, it was found that these relations are stronger among those with psychological complaints (PA, PS, and NA) and tinnitus (PA and PS) than among persons from the population-based sample, suggesting some variability across illness type. Further work is needed to investigate the causes of these differences.

Finally, the relations between a retrospective global measure of HRQOL (EQ-VAS) and momentary HRQOL, feelings, and symptoms were examined. The multiple regression model that was fitted to the data revealed that if the interaction terms were added to the model, none of the momentary feelings and symptoms was significant predictors of EQ-VAS. This supports earlier findings that global reports of past health will rely more on beliefs (semantic memory) than on specific feelings and symptoms [4,8,9]. Momentary HRQOL was a significant predictor of EQ-VAS, which was expected because the framing of the questions was similar in both methods.

In this article, we focused only on momentary HRQOL and feelings and symptoms. ESM data, however, also hold information on contextual items that could look more in detail at the different dimensions of health in the retrospective questionnaires. For instance, is the mobility dimension as measured by the EuroQol five-dimensional questionnaire reflected by the different locations a person is at during the day as measured by the ESM. In addition, dimensions of HRQOL not included in the present study, such as level of independence, social relationships, and interaction with the environment, can be included in the beep questionnaire. These questions are beyond the scope of this article but need to be considered in future articles.

Conclusions

The use of the ESM to measure accounts of the momentary HRQOL in different populations is feasible. The results showed that within persons, the valuation of global HRQOL and specific feelings and symptoms varies from moment to moment. Also, the relation between momentary specific feelings and symptoms and momentary HRQOL differed among populations. A global retrospective valuation of HRQOL, however, was not predicted by momentary feelings and symptoms. This highlights that retrospective measures may provide a biased account of the impact of health problems in the daily lives of people who are affected. Moreover, the bias may be different in different conditions. Therefore, the ESM may provide a valuable addition to the measurement of HRQOL.

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Supplemental materials

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