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Satisfaction and use of personal emergency response systems

Personal emergency response systems (PERS) or so-called home alarm systems support elderly persons to age-in-place by providing them with immediate access to emergency assistance. PERSs can relieve anxiety, enhance feelings of security, and improve the general quality of life of elderly people living alone [2, 12]. Clinical studies showed that usage of PERS can reduce hospital utilization rates among community-residing subscribers [24] and yield a positive benefit-to-cost ratio [2, 25, 26]. Meanwhile, three generations of telecare technologies have been developed. Automatic falls alarm and intelligent video monitoring systems for fall detection at home [5, 13] are regarded as second generation systems. The conventional PERS, focused on in this study, has no embedded intelligence and belongs to the first generation of home telecare systems. In case of emergency, the PERS user has to press the help button, worn on a neck chain or as a wristband, which then automatically dials a 24-hour monitoring center. Two-way communication allows the staff at the response center to establish the nature of the problem, before deciding whether to notify a designated friend, neighbor, or family member or summon emergency services. In Germany, personal emergency response systems have been in use since 1979 [21]. Currently, there are approximately 350,000 PERS subscribers in Germany [3]. The mean age of the subscribers is 80 years, about one fourth are in need of care [6]. The prevalence of PERS subscribers in Germany who are older than 65 years is about 1.3%. By compari-

son, higher rates of PERS users of more than 65 years are found in the UK (7.8%), Sweden (9.9%), Ireland (10.0%), and Norway (11.8%) [6].

◉ In an emergency, the PERS user presses a button to automatically contact a 24-hour monitoring center

Research on the users' perspective is grounded in theories of user satisfaction [22, 27] and technology acceptance (i.e., the Technology Acceptance Model [8, 28]), which have been developed largely as two separate research streams [30]. Results from international PERS studies indicate that the general level of perceived satisfaction with PERS is high. Over 90% of PERS subscribers are satisfied with their device and 84% rate their PERS as very important [20]. Satisfaction with PERS measured with the Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST 2.0) showed very positive data on overall satisfaction [29]. PERS user satisfaction seems to be a weak predictor of system usage. About half of the older community-residing subscribers wear their help button when alone in the home less than once a week [20, 21]. Reasons given for the non-use of PERS are the lack of perceived need, obtaining the system at the request of a family member, high sensitivity, and the appearance of the emergency button [18, 19].

The actual use of PERS seems to be more common in system users who had obtained the system themselves, had a his-

tory of falls, received positive responses to activations, used an assistive mobility device, and received instruction on the system [14]. Often-stated reasons for using a PERS are related to concerns with falling and to enhanced feelings of security [20]. Regarding assistive-device use in general, an independent predictor of actual home use seems to be a respondent's expectation while hospitalized [16]. Barriers to not using alarms also concern PERS use after falls. It was shown in a recent study that 94% of the person who were living in institutional settings, 78% in the community, and 59% in assisted-living accommodations did not use their call alarm to summon help after they fell alone and were unable to get up without help. In fact, 97% of the persons lying on the floor for over 1 hour did not use their alarm to summon help. Explanations made by the participants were not seeing any advantage in having such a system, not developing the habit of wearing the pendant even if the system was installed, and, in the event of a fall, not activating the alarm—either as a conscious decision or as a failed attempt [15].

Objectives

The present study aimed for four objectives: (1) in a sample of German PERS subscribers, the level of satisfaction by using different satisfaction measures was evaluated, (2) to examine the wearing time of the portable help button when alone at home in everyday life as well as the use of PERS after falls, (3) to elaborate the rela-

Tab. 1 Descriptive statistics of QUEST 2.0

Item	n=52	Valid answers	Mean ^a	SD	Min–Max
Subscale Device					
1. Dimensions	52	100%	4.44	0.87	2–5
2. Weight	52	100%	4.75	0.63	2–5
3. Adjustment	49	94.2%	4.49	1.04	1–5
4. Safety	45	86.5%	4.84	0.43	3–5
5. Durability	40	76.9%	4.54	0.88	2–5
6. Ease of use	47	90.4%	4.74	0.58	3–5
7. Comfort	49	94.2%	4.26	1.09	2–5
8. Effectiveness	49	94.2%	4.30	0.94	1–5
Total subscale device ^b	49	94.2%	4.51	0.49	2.86–5.00
Subscale service					
9. Service delivery	48	92.3%	4.77	0.59	2–5
10. Repairs & servicing	9	17.3%	4.22	1.56	1–5
11. Professional services	46	88.5%	4.61	0.93	1–5
12. Follow-up	17	32.7%	4.29	1.40	1–5
Total subscale service ^c	22	42.3%	4.59	0.61	3.00–5.00
Scale total (1–5)^d	52	100%	4.54	0.44	3.12–5.00

^a1 not satisfied at all; 2 not very satisfied; 3 more or less satisfied; 4 quite satisfied; 5 very satisfied^b Mean of valid answers with at least six valid scores on the subscale Device^c Mean of valid answers with at least three valid scores on the subscale Service^d Mean of valid answers with at least six valid scores on both subscales together-Scoring according to the QUEST version 2.0 manual.

tion between satisfaction and PERS subscribers' use of PERS in daily life, and (4) as a minor aspect, to investigate the psychometric properties of the German translation of QUEST 2.0 with regard to its applicability for this target group.

Methods

Study population

Study participants were recruited by drawing a cluster sample from a PERS provider in the metropolitan area of Stuttgart. A total of 333 customers who had a signed leasing contract for the PERS in the last 56 months were approached to participate. Inclusion criteria were adult age, community dwellers, use of PERS for at least 4 months, sufficient knowledge of the German language, accessible by telephone, living in the area of Stuttgart, and giving informed consent. Exclusion criteria included severe cognitive impairment and mental disorders (schizophrenia and other psychotic disorders as well as some substance-related disorders). Ethical approval was granted by the ethics committee of the University of Tübingen. All customers approached first received written information from their provider, then 265 were contacted by telephone. The re-

sponse rate was low; only 19.6% (n=52) of the potential participants consented to take part. The reasons not to participate (n=213) were no interest (33.0%), no experience or usage of the alarm system (25.9%), physical or mental disabilities (22.7%), cognitive impairment (information conveyed by a family member) 4.3%, and others (14.1%). No significant differences between responders and non-responders were found in terms of age and gender.

Assessment data collection

Participants' characteristics

Sample characteristics were assessed by sociodemographic data sheet and three additional measures:

(1) Functional ability scales for the elderly [1] with the subscales "tiredness" and "dependency of help." (2) The 6-item screener [4] to identify subjects with cognitive impairment. (3) The 5-item version of the Geriatric Depression Scale (GDS-5) [17]. (4) Attitudes and experiences toward technology, measured with a 7-item scale from the Sentha Project [23].

PERS subscribers' satisfaction

Five measures of PERS subscribers' satisfaction were collected with one question-

naire and four single item measures: (1) The Quebec User Evaluation of Satisfaction with assistive Technology (QUEST 2.0) [9, 11] consists of the two subscales Device (Items 1–8) and Services (Items 9–12). After rating the 12 satisfaction items, the user is asked to select the three most important items. (2) Global measure of satisfaction was assessed via an analogue scale ranging from 0 (not satisfied at all) to 100 (totally satisfied). (3) Affective satisfaction in terms of a judgment about how the system makes the subscriber feel was measured with a facial rating scale, with five facial expressions ranging from 1 (very good feeling) to 5 (very bad feeling). (4) Likelihood of repurchasing was assessed, using a 5-point Likert scale, ranging from 1 (not likely) to 5 (very likely). (5) Buy recommendation was assessed with a dichotomous question (yes/no). Furthermore, the estimation of importance of PERS for the users and for their relatives (from the user's point of view) was assessed using a 5-point Likert scale, ranging from 1 (not at all relevant) to 5 (very relevant). The amount of time subscribers who wear their portable help button when alone at home and the use of PERS after a fall were recorded.

Procedure

After the informed consent from the patients was received, 21 (40.4%) participants were interviewed in face-to-face interviews during a home visit; 31 participants were interviewed by telephone (59.6%). The latter group received written information and the answer categories of each questionnaire in advance. Interviews took from 1–2 hours.

Statistical analyses

Descriptive statistics were used to report sample characteristics and to examine the distributions of the satisfaction measures. Spearman rank-order correlation coefficients were used to analyze the relationship between satisfaction and sample characteristic as well as subscribers' use of the PERS; the Kruskal-Wallis test has been applied to measure the effects of the different PERS subscribers' importance estimations on PERS use.

Mann-Whitney U tests with Bonferroni correction were applied in order to conduct multiple comparisons. Item analysis in terms of item difficulty, item discrimination, and internal consistency was conducted to examine the psychometric performance of the QUEST 2.0 device subscale. For QUEST 2.0 items with a 5-point scale, the expected item difficulty ought to be about $p=0.60$ [7]. The item-total correlation was expected to be above $r_{it}=0.30$ [10]. We considered a Cronbach's $\alpha>0.7$ to be satisfactory. All analyses were conducted using SPSS version 16 software.

Results

Participants' profile

The average age of the participants was 81.4 years (SD=7.5 years, range 56–100 years), and 71% were female. While 75% lived alone, 25% lived together with their spouse, children, or relatives. The level of education was high: 27% had a high-school degree, 41% a qualified certificate of secondary school, and 32% had a lower degree. Family support was reported to be high by 61% of the participants. None of the participants met the criteria for exclusion (>2 errors) in the 6-item screener. The attitudes and experiences toward technology, measured with the 7-item scale from the Senth Project, were quite high with mean being 20.45 (SD=6.82) out of a possible 35 points.

Participant characteristics vs satisfaction with PERS

Feelings of tiredness were correlated with the general satisfaction with PERS (Spearman's $\rho=0.35$, $p<0.05$) and with higher device satisfaction, measured by the QUEST 2.0 device subscale (Spearman's $\rho=0.29$, $p<0.05$). Attitudes and experiences toward technology of the PERS subscribers were correlated with their buy recommendations (Spearman's $\rho=0.35$, $p<0.05$). Stronger correlations were found between the perceived importance of the PERS and increased tiredness and need for help (Spearman's $\rho=-0.41$ and -0.48 , $p\leq 0.01$ for each) as well as increased depressive symptoms (Spearman's $\rho=0.50$, $p<0.05$) of the PERS subscribers. No sig-

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Abstract

Background. Despite a wide distribution, little is known about the relationship between subscriber satisfaction and the extent of use or non-use of personal emergency response systems (PERS).

Objectives. To examine the degree of satisfaction with PERS, the wearing time and its use in case of a fall.

Study design and setting. Telephone and face-to-face interviews were conducted with 52 elderly community-dwelling PERS users.

Results. PERS subscribers were very satisfied with their device; however, 24% of the participants reported that they never wear the alarm button, and only 14% wear it 24 hours each day. After falls PERS was not activated by 83% ($n=11$) of the subscribers who fell

alone and lay on the floor longer than 5 minutes. None of the five different satisfaction measures and only the subscriber's estimation of relevance of the PERS showed to be a significant predictor of PERS use in daily life.

Conclusions. High rates of non-use of PERS in everyday life and after falls can be found. Subscribers' estimation of relevance but not satisfaction predicts the usage of PERS in everyday life. Further research is needed to better understand the reasons not using a PERS.

Keywords

Accidental falls · Consumer satisfaction · Emergency · Home alarm system · Personal emergency response system

Zur Zufriedenheit und Nutzung von Hausnotrufsystemen

Zusammenfassung

Hintergrund. Trotz einer hohen Verbreitung der Hausnotrufsysteme ist der Zusammenhang zwischen der Zufriedenheit von Hausnotrufrufen und der Nutzung bzw. Nichtnutzung des Systems weitgehend unerforscht.

Ziel. Evaluation der Zufriedenheit von Hausnotrufrufen und der Nutzung des Hausnotrufsystems im Alltag sowie nach einem Sturz.

Studiendesign und Setting. Mit 52 Hausnotrufrufen wurde ein telefonisches oder persönliches Interview geführt.

Ergebnisse. Hausnotrufrufen waren mit ihrem System sehr zufrieden. Allerdings berichteten 24% der Studienteilnehmer, den Notrufsender nie zu nutzen, und nur 14% trugen ihn immer bei sich. Von den Hausnotrufern, die allein gestürzt waren und län-

ger als 5 Minuten am Boden lagen, aktivierten 83% ($n=11$) ihren Hausnotruf nicht. Nur die Einschätzung der Wichtigkeit, aber keines der fünf verschiedenen Zufriedenheitsmaße erwies sich als signifikanter Prädiktor für die Nutzung des Hausnotrufs im Alltag.

Schlussfolgerungen. Es zeigte sich, dass das Hausnotrufgerät im Alltag und nach einem Sturz häufig nicht genutzt wird. Nur die Einschätzung der Bedeutsamkeit des Hausnotrufs und nicht die Zufriedenheit mit dem Gerät sagt dessen Nutzung im Alltag voraus. Weitere Untersuchungen sind nötig, um die Gründe der Nichtnutzung besser zu verstehen.

Schlüsselwörter

Stürze · Kundenzufriedenheit · Notfall · Hausnotruf · Persönliches Notrufsystem

Tab. 2 Response distributions for three single item satisfaction measures

Satisfaction measure	n	Mean	SD	Range of scores
General satisfaction	41	90.12	14.35	1 (not satisfied at all) to 100 (very satisfied)
Affective satisfaction	48	3.62	0.84	1 (not satisfied at all) to 5 (very satisfied)
Likelihood of repurchasing	47	4.55	0.75	1 (definitely not) to 5 (very definitely)

Tab. 4 Subscriber's importance estimation and their use of PERS

Wearing time of the help button	Subjective importance estimation of PERS				
	Not important	Less important	Indifferent	More important	Very important
Never	-	3	-	7	2
From time to time	-	-	-	2	5
Daily but <24 h	-	-	1	10	12
Daily: 24 h	-	-	-	1	4

nificant correlations ($p < 0.05$) were found between the five different satisfaction measures and the global mental status (6-item screener) or depressive symptoms (GDS-5) of the participants.

User satisfaction

QUEST 2.0

PERS subscribers were quite satisfied with their device, although they had difficulties evaluating safety, durability, and service aspects of the PERS. The results are shown in **Tab. 1**.

Item 5 (Durability) of the subscale Device could be answered only by 76.9% of the participants. Furthermore, items 10 (Repairs & Servicing) and 12 (Follow-up) were answered only by 32.7% of the PERS users. The Service subscale score with a minimum of three valid answers could be only calculated for 27 of the 52 participants. The psychometric properties of the Device subscale showed low item difficulties ($p = 0.80$ to $p = 0.96$), low to medium item discrimination ($r_{it} = -0.08$ to $r_{it} = 0.49$), and low internal consistency (Cronbach's $\alpha = 0.64$). The three most important rated items by the users were safety (40.4%), effectiveness (27.2%), and ease of use (12.1%).

Single item satisfaction measures

Distributions on the measure of general satisfaction, affective satisfaction, and likelihood of repurchasing were skewed to the left and peaked more than normal, indicating high satisfaction rates of the PERS subscribers (**Tab. 2**). The full

range of scores was found only in the measure of affective satisfaction. The measure "buy recommendation" differed from the others: 60% ($n = 18$) did not recommend the PERS and only 40% ($n = 12$) did.

Use of PERS in everyday life

The use of PERS, defined as wearing the help button when alone at home, was low: 14 (27%) of 52 participants answered that they never wear the alarm button, 7 that they wear it sometimes but not every day, 24 every day but not 24 hours, and only 7 wear the alarm button 24 hours each day. The wearing time of the help button when alone at home was neither significantly correlated (Spearman's ρ ; $p < 0.5$) with the QUEST subscale Device nor with any other single-item satisfaction measure.

Use of the help button after falls

Of the 52 PERS subscribers, 18 reported a fall in the past 3 months; 15 of them were alone at home when the fall occurred. PERS was available. The use of PERS with respect to time on the floor if the person fell alone and was unable to get up is shown in **Tab. 3**.

Two out of 15 fallers could get up within 5 min. Of the remaining 13 fallers with time on the floor longer than 5 min, 11 PERS subscribers did not use their alarm to summon for help. Two of them spent more than 1 hour lying on the floor. Reasons given were the desire for independence and to manage it oneself ($n = 8$), waiting for someone else to come ($n = 1$), and "did not think of the PERS" ($n = 1$). Two participants made no comments.

Tab. 3 Use of PERS with respect to time on the floor if the person fell alone and was unable to get up

Laying on the floor after a fall	Using the call alarm system	
	Yes	No
<5 min	1	1
5–60 min	2	9
1–2 hours	-	1
>2 hours	-	1

Subscribers' importance estimation and their use of PERS

The Kruskal-Wallis test was applied to measure the effect of the different importance estimations of PERS subscribers on the time they wear their help button when alone at home. A significant difference in the time subscribers wear their help button was found, depending on their estimation of importance of the PERS ($H = 8.9$, $df = 3$, $p = 0.02$; **Tab. 4**).

Compared with subscribers who regarded their PERS as less important, those who considered it as important wore their help button significantly longer ($U = 3.00$, $p = 0.007$). This effect is still significant, referred to the adjusted critical value ($p < 0.016$) after Bonferroni correction.

Discussion

The present study confirms previous findings that community-dwelling PERS subscribers are very satisfied with their system and the service [20, 29]. We found that the three aspects of satisfaction with PERS considered as the most important are safety, effectiveness, and ease of use. Although PERS subscribers were very satisfied, we found substantial differences in satisfaction applying different measurement approaches. The single item measures "affective satisfaction" and "buy recommendation" discriminate better between more and less satisfied PERS subscribers than "overall satisfaction" and "likelihood of repurchasing." The study revealed that PERS subscribers had difficulties evaluating safety, durability, and service aspects of their system. Thus, only the psychometric properties of the QUEST 2.0 Device subscale could be calculated, which showed low item difficulties ($p = 0.80$ to $p = 0.96$), low to medium item discrimination ($r_{it} = -0.08$ to $r_{it} = 0.49$)

and low internal consistency (Cronbach's $\alpha=0.64$). QUEST 2.0 proved not to be particularly suited for measuring PERS subscriber satisfaction. This result contrasts with studies using QUEST 2.0 for measuring satisfaction predominantly with mobility assistive devices [9, 10, 11]. Our thematic analysis of subscriber comments identified their need for a smaller help button, a greater range of the transmitter as well as higher durability, better adjustment, and more comfort. A second major finding of this study was that elderly PERS subscribers tend to positively evaluate their PERS, even in the absence of using the system and the help of the PERS provider. We found different patterns of PERS usage, including high rates of non-use in everyday life and even after falls.

— **Of PERS subscribers who fell and lay on the floor longer than 5 minutes, 84% ($n=11$) did not use their alarm to summon for help.**

The most-often stated reason why participants would not use their PERS after falls, is the longing to manage the situation oneself. Both results coincide with a previous study [15] that describes additional stated concerns like wanting to avoid admission to hospital. A further essential finding of our study is that none of the different satisfaction measures and only the subscriber's estimation of relevance of their PERS showed to be a significant predictor of PERS use in daily life.

Limitations

It is important to note some limitations of the study that may affect the accuracy of the results and the generalizability of the findings. First, the comparability of satisfaction data obtained by telephone ($n=31$) and face-to-face interviews ($n=21$) can be doubted. A potential for bias must be acknowledged in terms of the low response rate (19%) as well as the small sample size ($n=52$). The restricted number of cases may limit the generalizability of the results. Another positive bias may be introduced by surveying only people who are currently using PERS rather than including people who had discontinued service, which may indicate a lack of satisfaction with the PERS or the service.

A recall bias in retrospective self-reported data of falls is another limitation and a potential threat to the internal validity of the study. Additional limitations arises that we did not test any further predictors of subscribers' PERS use besides satisfaction and users' estimation of relevance of the PERS. It is possible, even likely, that there are other factors predicting PERS use or disuse.

Conclusions

Further qualitative research is needed for a better understanding of predictors not to use PERS in daily life and after falls. In particular in the face of future assistive and telehealthcare technologies to support independent living, a better understanding of possible obtrusive factors is indispensable. Age-specific designs for instruction and consistent supervision may be needed for a successful implementation of technologies in this field.

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Conflict of interest. The corresponding author states that there are no conflicts of interest.

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