I-12

A SELF-ADMINISTERED QUALITY-OF-LIFE QUESTIONNAIRE AFTER ACUTE MYOCARDIAL INFARCTION

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Abstract—A slightly modified version of the Quality-of-Life after Myocardial Infarction (QLMI) questionnaire developed by Oldridge and colleagues was applied in a self-administered mode to patients with suspected acute myocardial infarction (AMI) in a randomized controlled trial of secondary prevention. Acceptability of the questionnaire was good, with 93% of responders answering all items. Factor analysis suggested three quality-of-life (QL) dimensions which we called "emotional", "physical" and "social". These differed somewhat from the dimensions proposed by Oldridge and colleagues. However, a sensitivity analysis showed relative invariance of results to weighting schemes. Scores on our three dimensions were responsive to differences between the treatment groups, and demonstrated construct validity based on associations between the measured QL and variables expected to affect QL. We conclude that the QLMI questionnaire has good potential as an instrument for assessing QL in post-AMI patients and that it can be successfully self-administered.

Quality of life   Self-administered questionnaire   Acute myocardial infarction
Factor analysis

INTRODUCTION

The concept of quality-of-life (QL) has received increasing attention as an outcome factor in clinical studies of coronary heart disease (CHD) [1]. A wide range of instruments, both generic and disease-specific, have been used in QL assessment of subjects with CHD [1]. Well-known generic instruments previously used on CHD subjects include the Nottingham Health Profile [2, 3] and the Sickness Impact Profile [4, 5]. Other researchers have opted for disease-specific instruments and have developed instruments ranging from one or several simple

questions [6, 7] to comprehensive questionnaires [8–10].

Most QL questionnaires comprise multiple items. Besides problems of interpretation, analysis of each item separately raises methodological problems because of multiple comparisons. Developers of questionnaires typically aggregate items into a small number of conceptually meaningful QL dimensions [8, 9]. Often QL dimensions are defined intuitively in a manner considered meaningful by the investigators [8, 10] or identified via a data analytic technique such as factor analysis [1].

During 1990 and 1991, we carried out a randomized controlled trial of secondary prevention on subjects with suspected acute myocardial infarction (AMI) [12]. To assess QL, we required a self-administered questionnaire and reviewed several instruments for this purpose.

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We chose to adapt the Quality-of-Life After AMI (QLMI) questionnaire developed by Oldridge *et al.* [9] for use in our study because it was relatively short and simple, was disease-specific and, although not designed to be self-administered, was easily amended for this purpose.

In addition to using the QLMI questionnaire in a self-administered form, we also slightly modified the original questionnaire to better suit our study population. Hence, because of differences between our adapted QLMI and the original, we analysed the data using QL dimensions identified by factor analysis rather than using the QL dimensions specified by Oldridge *et al.* [9]

This paper considers the utility of the QLMI questionnaire in a self-administered mode, and compares analyses of the data based on Oldridge's QL dimensions and our factor analytic ones. In these analyses, particular emphasis was placed on the basic principles of QL assessment as outlined by Cox *et al.* [13] in a seminal paper on methodological issues in QL assessment.

METHODS

Study population

The study setting was a randomized controlled trial in which the hypothesis tested was that 6 months after discharge from hospital following AMI, adoption of secondary prevention activities would be higher, quality of life better and blood cholesterol lower in subjects receiving a mail-out intervention program than those receiving usual care. The details and results of the study are reported elsewhere [12]. A total of 450 subjects agreed to participate in this study, of whom 213 were randomly allocated to the intervention group and 237 to the usual care group. The study outcomes, which included a QL assessment, were determined at 6 months through a questionnaire mailed to each participant. Questionnaires were received from 375 of the 441 (85%) possible subjects (9 subjects died during the 6 months and were not sent follow-up questionnaires). Table 1 summarizes demographic and clinical characteristics of the respondents.

Quality of Life After AMI (QLMI) questionnaire

The QLMI questionnaire of Oldridge *et al.* [9] was designed to be interviewer-administered

and consisted originally of 23 items. An item asking whether the subject "no longer felt like a real man" was considered inappropriate for men and women in this Australian population and was omitted from our questionnaire. The wording of a few items was altered slightly to conform with Australian English expression. In all other respects our questionnaire was identical with that of Oldridge *et al.* [9].

Oldridge *et al.* [9] subsequently added three more items to the questionnaire. As this addition occurred part of the way through our study, 139 subjects entering the study early completed a 22-item questionnaire, while 235 entering later completed a 25-item version. An abridged version of these 25 items is shown in the Appendix. The items referred to the 2 weeks prior to questionnaire administration. Responses to the items were on a 7-point ordinal scale, where "1" corresponded with poor QL and "7" with good QL. Items 23, 24 and 25 are the three late additions. The 25-item questionnaire takes less than 10 minutes to complete.

Oldridge *et al.* allocated each item in the QLMI questionnaire to one of five groups, and combined these groups into two dimensions, which they interpreted as "(Physical) Limitations" and "Emotions" [9]. "Limitations" includes the groups "symptoms" and "restrictions", while "Emotions" includes the groups "emotional function", "confidence" and "self-esteem". Items were allocated to groups "intuitively", in contrast to allocation via a data analytic technique such as factor analysis [14].

Diet and exercise questionnaire

As part of his doctoral thesis, Plotnikoff [15] developed a questionnaire to measure attitudes toward and behaviour regarding exercise and diet. This questionnaire was administered to a

Table 1. Characteristics of respondents

Number of participants	375
Mean age (SD)	59.0 (7.4)
Males	267 (71%)
Previous myocardial infarction	91 (24%)
History of ischaemic disease	159 (42%)
Completed high school or higher education	114 (31%)
Currently married	303 (81%)
Currently employed full-time	96 (26%)
Current smoker	99 (29%)
Previous coronary angiography	105 (28%)
Previous coronary bypass graft	46 (12%)

Note: A comparison of the above characteristics between the intervention and the usual care groups showed no statistically significant differences.

subsample of 153 subjects who had completed the 25-item QLMI questionnaire, among whom 147 (96%) responded. Details and characteristics of this questionnaire are reported elsewhere [15].

Attitudes toward regular exercise were assessed on three scales: (1) intentions to follow a regular exercise programme ("Intentions"); (2) confidence regarding carrying out an exercise programme ("Self-efficacy"); and (3) perceived benefits of regular exercise ("Response Efficacy"). A separate scale assessed behavioural changes regarding exercise ("Stage of Change"). A similar set of scales was used to assess attitudes and behaviour toward a low-fat diet. Perceived threat of further heart problems was also assessed through questions relating to fear, vulnerability and perceived severity of condition.

Statistical methods

The analysis was carried out in two stages. First, factor analyses were performed to identify underlying factors, or dimensions. The technique uses the correlation matrix to determine a set of initial factors (principal components analysis) to which a "rotation" is applied to achieve conceptually meaningful factors, each interpretable as a distinct QL dimension [16]. The process defines a set of factor weights, one for each item on each dimension, with the size of the weight reflecting the relative contribution of the item to that dimension.

Various rotations were examined, but as the results were similar, only the varimax rotation is reported here. Only subjects who complete all items in the 25-item questionnaire contributed to this first analysis.

Second, factor scores for each dimension were computed for each subject. For a given dimension, the factor score for a subject is calculated as the weighted average of responses to the items, giving a possible minimum value of "1" and a possible maximum of "7". Factor scores for subjects who failed to answer all items in a dimension were obtained by averaging over only those items answered, and only subjects who answered less than half the items in a dimension were omitted from analysis for that dimension.

The scores in each dimension were then examined for association with study variables expected to affect QL. These were: previous AMI, age, sex, rehospitalization within the 6 months prior to follow-up and whether coronary artery

bypass surgery was performed within the 6 month follow-up period.

All study variables were analysed as dichotomous and the Student's t-test or the Wilcoxon Mann–Whitney test were applied to test for differences in average scores. Correlation coefficients between dimension scores and the diet–exercise scales were also computed. As a further check on the internal consistency of responses, Cronbach's alpha [17] was computed for each QL dimension.

RESULTS

Application of the QLMI questionnaire

Following a screening of the data, we excluded two items from further analysis. The first was item number 15 on sexual intercourse (Appendix). Only 88% of subjects answered this item. Many subjects indicated that the item was inappropriate to their situation, because of age or marital status.

The second was item number 25 on the perceived management of chest pain (Appendix). In retrospect, when given in a self-administered mode, this item can be ambiguous. Several subjects wrote on the questionnaire, commenting that they had not thought of nor were concerned with chest pain in the preceding weeks. However about equal proportions of these subjects responded with "1" or "2" as with "6" or "7". Not surprisingly, this item correlated very poorly with all other items in the questionnaire and invariably showed up as a solitary factor in the factor analyses.

With the exclusion of these two items, 93% of subjects who responded answered all other items in the version of the questionnaire they received. Considered another way, each item (excluding items 15 and 25) was answered by at least 98% of subjects. A comparison of characteristics of subjects who answered all items against those who did not suggested that males, subjects currently married and subjects with a history of ischaemic heart disease were more likely to answer all items.

Distribution of responses

Although the distributions of responses for all items were somewhat skewed towards high QL, the responses covered the entire 7-point range. The median response was "5" or "6" for 74% of items (17/23), and the upper quartile was "7"

Table 2. Factor weights and variances (from principal components analysis and varimax rotation)

	F1	F2	F3
1. Frustrated	0.801	0.149	0.073
2. Worthless	0.750	0.199	0.261
3. Confident	0.628	0.285	0.286
4. Down in dumps	0.849	0.198	0.233
5. Relaxed	0.846	0.223	0.047
6. Worn out	0.672	0.532	−0.014
7. Happy person	0.746	0.111	0.254
8. Restless	0.780	0.309	0.026
9. Breath short	0.139	0.773	0.169
10. Tearful	0.538	0.200	0.316
11. More dependent	0.494	0.292	0.403
12. Social activities	0.506	0.448	0.284
13. Others confidence	0.415	0.089	0.698
14. Chest pain	0.176	0.511	0.452
16. Lack confidence	0.718	0.150	0.369
17. Aching legs	0.426	0.587	−0.162
18. Limited sports	0.140	0.810	0.261
19. Frightened	0.528	0.277	0.416
20. Dizzy	0.358	0.449	0.370
21. Restricted	0.230	0.692	0.443
22. Unsure exercise	0.300	0.609	0.324
23. Overprotective	−0.043	0.206	0.704
24. Burden	0.311	0.245	0.676
% Total variance	31%	18%	14%

for 83% of items. All but one item had at least 11 subjects giving a response of "1".

Correlation matrix

All correlations among items were positive, ranging from 0.08 to 0.76. This is not surprising as, in general, one would expect the dimensions of QL to increase or decrease together. For example, restricted physical ability can be expected to depress QL in the social dimension and, especially in persons accustomed to a high level of physical activity, also in the emotional dimension. This raises the issue of employing a single global QL index, which we examine later.

Weighting schemes

The first three factors identified by factor analysis together explained 63% of the total variation (Table 2). These three factors were considered adequate as the fourth factor explained just 4% of the total variation.

The factors were interpreted by examining the items with high factor weights for that factor. For example, item numbers 1 to 8 and 16 had high weights in the first factor F1 (Table 2). Overall, these items appeared to be extracting information about QL in the emotional dimension (Appendix). Hence we interpreted this fac-

tor as measuring "emotional" QL. Likewise, item numbers 9, 18, 21 and 22, which scored high in the second factor F2, asked about QL in the "physical" dimension. Item numbers 13, 23 and 24 scored high in the third factor and was interpreted as measuring QL in the "social" dimension. Interpretation of these factors as measuring QL in the emotional, physical and social dimensions is consistent with criteria used by Oldridge et al. in developing the QLMI questionnaire, in that it should address these three QL dimensions (Guyatt, personal communication).

We examined weighting schemes which assign weights of either 0 or 1 to each item because of the simplicity of such weights. In weighting scheme A, a weight of 1 was assigned to the dimension in which the factor weight was highest and weight 0 in the other two dimensions (Table 3). In weighting scheme B, a weight of 1 was assigned to all dimensions in which the factor weight was greater than 0.4 and weight 0 to other dimensions (Table 3).

In both these 0–1 weighting schemes, a majority of items appeared in the emotional dimension: 13/24 (54%) for scheme A and 15/24 (63%) for scheme B. For schemes A and B, 7 and 9 items, respectively, appeared in the physical dimension, while 3 and 7 items, respectively, appeared in the social dimension. In scheme B, items could contribute to more than one dimension. But in fact none contributed to more than two dimensions and only 8 items contributed to two dimensions.

Nevertheless a concern with scheme B was that the three dimensions were not in fact measuring different QL dimensions because of the contribution of items to more than one dimension. We addressed this by using a weighting scheme which assigned weight 0.5, instead of one, to items which contributed to two dimensions. However as the results were not very different, we preferred the 0–1 weighting scheme for its simplicity.

Weighting schemes A and B contrasted somewhat with Oldridge's weighting scheme (Table 3). Nevertheless items with high factor weights in the emotional dimension tended to be included in Oldridge's "Emotions" dimension, and those with high factor weights in the physical dimension tended to be included in Oldridge's "Limitations" dimension. The items with high factor weights in the social dimension were included in Oldridge's "Emotions" dimension.

Table 3. Weighting schemes

	Emotional			Physical			Social	
	A	B	O*	A	B	O	A	B
1. Frustrated	1	1	1	.	.	.†	.	.
2. Worthless	1	1	1	.	.	.	.	.
3. Confident	1	1	1	.	.	.	.	.
4. Down in dumps	1	1	1	.	.	.	.	.
5. Relaxed	1	1	1	.	.	.	.	.
6. Worn out	1	1	.	.	1	1	.	.
7. Happy person	1	1	1	.	.	.	.	.
8. Restless	1	1	1	.	.	.	.	.
9. Breath short	.	.	.	1	1	1	.	.
10. Tearful	1	1	1	.	.	.	.	.
11. More dependent	1	1	1	.	.	.	.	1
12. Social activities	1	1	.	.	1	1	.	.
13. Others confidence	.	1	1	.	.	.	1	1
14. Chest pain	.	.	.	1	1	1	.	1
15. Sexual	.	.	.	.	.	1	.	.
16. Lack confidence	1	1	1	.	.	.	.	.
17. Aching legs	.	1	.	1	1	1	.	.
18. Limited sports	.	.	.	1	1	1	.	.
19. Frightened	1	1	1	.	.	.	.	1
20. Dizzy	.	.	.	1	1	1	.	.
21. Restricted	.	.	.	1	1	1	.	1
22. Unsure exercise	.	.	1	1	1	.	.	.
23. Overprotective	.	.	1	.	.	.	1	1
24. Burden	.	.	1	.	.	.	1	1
25. Managed pain	.	.	1	.	.	.	.	.

*A = Scheme A; B = Scheme B; O = Oldridge's scheme.
†Zeros are represented by "." for clarity.

Sensitivity analysis

We performed a sensitivity analysis by examining the association between study intervention and the QL dimensions for the different weighting schemes. The p-values in Table 4 suggest invariance of results to weighting scheme. The QL in all dimensions was higher in the intervention group for all schemes. We also examined the sensitivity of a single global QL "index", constructed by setting all weights equal to one. This index also showed higher QL in the intervention group and a trial effect of similar size to the other schemes ($p = 0.070$).

Choice of weighting scheme

Given the relative invariance of results to weighting schemes, we consider simplicity and number of QL dimensions to be important in choosing a weighting scheme. Our preference is

Table 4. Sensitivity analysis

	Emotional	Physical	Social
Scheme A	0.044	0.20	0.34
Scheme B	0.040	0.16	0.33
Factor weights	0.042	0.10	0.19
Oldridge	0.054	0.15	—

The table shows p-values from comparing of factor scores between the intervention and usual care groups for the different weighting schemes.

for scheme B because of its simplicity, because the three QL dimensions indicated by this scheme are consistent with QL dimensions generally considered important in QL assessment, and because this scheme reflects the fact that some items assess attributes in more than one dimension.

Internal consistencies of the dimensions using scheme B are good, as indicated by Cronbach's alphas of 0.94, 0.89 and 0.84 in the emotional, physical and social dimensions respectively.

Validity

Construct validity was assessed by examining the association of the QL dimensions with variables previously reported to be associated with QL. While this study was not designed to detect differences in these variables, one would expect to see results in the right direction.

Table 5 shows the results for weighting scheme B. Subjects who had not previously suffered AMI showed statistically significantly higher QL in all three dimensions. Males, subjects who had coronary by-pass surgery and those who were not re-admitted to hospital within the 6 months follow-up period all showed consistently higher QL in all dimensions, although the associations were not statistically significant in all cases.

Table 5. Association with study variables, Scheme B

	Emotional			Physical			Social		
	n	Mean	SD	*n*	Mean	SD	*n*	Mean	SD
Previous AMI									
N	281	5.33	1.16	280	5.42	1.20	280	5.89	1.06
Y	91	5.03	1.29	91	4.95	1.29	90	5.50	1.26
		$(p = 0.040)$			$(p = 0.002)$			$(p = 0.008)$	
Sex									
M	267	5.42	1.17	267	5.38	1.28	266	5.86	1.11
F	108	4.87	1.17	107	5.11	1.20	107	5.65	1.14
		$(p = 0.000)$			$(p = 0.06)$			$(p = 0.11)$	
Rehospitalization									
N	266	5.31	1.18	265	5.37	1.24	264	5.88	1.05
Y	105	5.13	1.23	105	5.12	1.31	105	5.57	1.28
		$(p = 0.19)$			$(p = 0.10)$			$(p = 0.03)$	
Surgery									
Y	64	5.53	1.16	64	5.68	1.18	64	5.96	1.08
N	310	5.20	1.20	309	5.22	1.26	308	5.76	1.13
		$(p = 0.05)$			$(p = 0.01)$			$(p = 0.20)$	

Note: The group sizes (*n*) differ slightly because patients who answer less than half the items in a dimension were omitted from the analysis.

It is not surprising that QL is lower in subjects with previous AMI and in those rehospitalized. These observations are consistent with findings of other investigators [3]. Coronary artery surgery has previously been shown to significantly improve QL by the relief of chest pain and a diminished requirement for drug therapy [7]. Males have consistently been found to have higher QL than females, both in the general community [2] and 5 years post-AMI [3]. An interesting interaction between age and previous AMI was observed. In subjects with no previous AMI, there was little difference in QL, in any of the three dimensions, across age groups. However, among subjects who had previously suffered AMI, QL appears to improve with age. Confounders such as time since previous AMI might explain this effect, but there was insufficient information to address the issue in this study.

Construct validity of the QLMI questionnaire was further assessed from correlations between each QL dimension and scales in the diet-exercise questionnaire (Table 6). Moderate positive and statistically significant correlations existed between all three QL dimensions and the exercise-related scales, indicating that subjects with a positive attitude toward exercise tended to have better QL. In contrast, correlations with the low-fat diet scales were negligible. Items measuring perceived threat of further heart problems showed statistically significant negative correlations with all three QL dimensions.

DISCUSSION

We applied a slightly modified version of the QLMI questionnaire of Oldridge et al. [9] in a self-administered mode to a sample of post-AMI subjects in a randomized controlled trial of secondary prevention activities. Overall, the implementation of this QL instrument was successful, with 93% of responders answering all items in the questionnaire. The questionnaire was responsive to differences between the intervention and usual care groups in the trial, and demonstrated construct validity based on associations between the measured QL and variables expected to affect QL. Another important characteristic of a good QL instrument is its reproducibility over time in subjects whose health and social circumstances remain stable.

Table 6. Pearson correlations

	Emotional	Physical	Social
Exercise			
Intentions	0.27**	0.38**	0.21**
Self efficacy	0.42**	0.42**	0.33**
Resp. efficacy	0.30**	0.36**	0.30**
Stage of change	0.32**	0.33**	0.32**
Low-fat diet			
Intentions	0.01	0.02	−0.04
Self efficacy	0.07	0.05	−0.00
Resp. efficacy	0.05	0.03	−0.01
Stage of change	0.20*	0.20*	0.21*
Threat of further heart problems			
Fear	−0.48**	−0.46**	−0.59**
Severity	−0.44**	−0.58**	−0.57**
Vulnerability	−0.34**	−0.46**	−0.40**

$**p < 0.01$; $*p < 0.05$.

Our study was not designed to assess this property, however Hiller *et al.* [14] reported a high degree of reproducibility of the original QLMI questionnaire.

In studies which make use of previously developed QL questionnaires, investigators usually adopt the QL dimensions, weights and item allocation specified by the developers of the questionnaire. However, differences between the study population to which a previously developed questionnaire is applied and the population on which the questionnaire was developed could render some items inappropriate or ambiguous. Identification of such items is important and could be aided by factor analysis. Three items of the original QLMI questionnaire were found to be inappropriate in our study. One item was excluded prior to administration because of American colloquialism in its wording. Many of our subjects considered the item on sexual intercourse inappropriate to their situation. This could be because the average age in our study population was higher than that in Oldridge *et al.* [9]. Self-administration of the questionnaire was another difference between Oldridge's study and ours. In retrospect, the item on perceived ability to manage chest pain was ambiguous when asked in the self-administered mode. The latter two items correlated poorly with other items and were identified as such in a factor analysis. These three items, excluded from our analysis, should be further reviewed for inclusion in future questionnaires.

Overall, the QL dimensions identified by factor analysis in our study corresponded well with Oldridge's QL dimensions. This serves as additional reassurance that the questionnaire is valid for our study population.

Items in the questionnaire used a 7-point response scale, which has the advantage of ease of interpretation when compared, for instance, with visual analogue scales. As an example, an interpretation of the improvement in emotional QL from 5.1 in the usual care group to 5.4 in the intervention group is: usual care subjects on average have good QL "most of the time" compared with intervention subjects who on average have good QL somewhere between "most of the time" and "almost all of the time". Whether such a difference is of clinical significance is another issue.

In agreement with Cox *et al.* [13], we stress the necessity for sensitivity analyses. When a previously developed questionnaire is used in a new study, a factor analysis would generally suggest

dimensions, weights or item allocation which differ (slightly) from those proposed by the developers. The issue of which set of weights or dimensions to use is a philosophical one, so long as the results are relatively invariant to weighting schemes. In our study, results using several weighting schemes, including Oldridge's, were similar.

We rejected a single global QL index in our study because QL is generally considered to be a multidimensional construct. Although we agree with this concept, we believe that, in the context of post-AMI QL assessment, the simplicity of such an index merits further consideration because the different dimensions of QL in post-AMI subjects appear to correlate positively with each other.

Finally, we conclude that the QMLI questionnaire has good potential as an instrument for assessing QL in post-AMI subjects. As far as we know, no other self-administered QL questionnaire designed for post-AMI subjects is available.

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APPENDIX

Adapted QLMI Questionnaire

For brevity in the following, the parts of each item relating to time period have been omitted. For example, item 1 in full reads "In general, how much of the time *during the last two weeks* have you felt frustrated, impatient or angry?".

**Item
No.**

1. How much of the time have you felt frustrated, impatient or angry?
2. How often have you felt worthless or inadequate?
3. How much of the time did you feel very confident and sure that you could deal with your heart problem?
4. How much of the time did you feel discouraged or down in the dumps?
5. How much of the time did you feel relaxed and free of tension?
6. How often have you felt worn out or low in energy?
7. How happy, satisfied or pleased have you been with your personal life?
8. How often have you felt restless or as if you were having difficulty trying to calm down?
9. How much shortness of breath have you experienced while doing your day to day physical activities?
10. How often have you felt tearful or like crying?
11. How often have you felt as though you were more dependent than you were before your heart trouble?
12. How often have you felt unable to do your usual social activities or social activities with your family?
13. How often have you felt as if others no longer have the same confidence in you as they did before you had the heart problem?
14. How often have you experienced chest pain while doing your day to day activities?
15. How often have you felt your heart problem limited or interfered with sexual intercourse?
16. How often have you felt unsure of yourself or lacking in self-confidence?
17. How often have you been bothered by aching or tired legs?
18. How much have you been limited in doing sports or exercise as a result of your heart problem?
19. How often have you felt apprehensive or frightened?
20. How often have you felt dizzy or lightheaded?
21. How much have you been restricted or limited as a result of your heart problem?
22. How often have you felt unsure as to how much exercise or physical activity you should be doing?
23. How often have you felt as if your family is being overprotective toward you?
24. How often have you felt as if you were a burden on others?
25. How much of the time have you felt that you could manage chest pain if and when you had any?

Responses to items were in the form "None of the time" (1), "A little of the time" (2), "Some of the time" (3), "A good bit of the time" (4), "Most of the time" (5), "Almost all of the time" (6) and "All of the time" (7).