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ORIGINAL PAPER

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Life satisfaction and depression in a 15-year follow-up of healthy adults

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Abstract *Objective* The aim of this study was to investigate the cross-sectional and longitudinal relationship between life satisfaction and depressive symptoms in healthy adults. *Method* This is a 15-year prospective cohort study with a nationwide sample of healthy Finnish adults (N = 9679), aged 18–45, who responded to postal questionnaires in 1975, 1981 and 1990 including a 4-item life satisfaction (LS) scale (range 4–20) and, in 1990, the 21-item Beck Depression Inventory (BDI). *Results* A strong linear association was found between concurrent LS and BDI scales (r = 0.6). With an LS cut-off point of 11/12, moderate/severe depression (BDI ≥ 19) was detected with 87 % sensitivity, 88 % specificity and a 94 % area under the ROC curve. Longitudinally, a strongly increased risk of moderate/severe depression in 1990 was observed among the dissatisfied (LS 12–20) compared with the satisfied (LS 4–6) in 1975 (OR = 6.7; 95 %CI 4.2–10.9) and in 1981 (OR = 10.4; 6.1–17.6). *Conclusion* The 4-item LS scale can identify a group of healthy people from the general population with a high risk of having or developing depressive symptoms. Since low life satisfaction also indicates an elevated risk of other adverse health outcomes, the assessment of subjective well-being should be encouraged both in surveys and in clinical practice.

Key words personal satisfaction – depression – quality of life – twin – cohort studies

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Introduction

Poor mental health is a growing health hazard worldwide. This is especially true with major depression, which was the fifth leading cause of the disease burden in the world in 1999, when both fatal and non-fatal consequences were measured [1]. Despite this, only a proportion of those who suffer from mental problems are reached and diagnosed by health care workers. Thus, improving the ability and validity of screening for depression is important [2]. However, not only suffering from a diagnosed depression but also incomplete recovery from depression and even sub-threshold depressive symptoms have gained deserved attention due to their chronic courses and adverse effects on functional and psychosocial ability [3–7]. Even a loss of subjective well-being might indicate a need for more careful evaluation, since it may be an early sign of an increased risk of long-lasting adverse health effects.

Life dissatisfaction, even when reported by seemingly healthy populations and measured with only four items, is strongly associated with poor health. Its other correlates include poor health behaviour, a poor social situation and personality problems as well as a poor affective status, especially depressive symptoms [8–12]. Longitudinally, life dissatisfaction predicts mortality and suicide [13–15] as well as work disability due to both psychiatric as well as somatic causes [16]. Low life satisfaction might also be an early sign of depression or

predict future depression. The relationship between dissatisfaction and depression has only been studied in the elderly [17] and in psychiatric patients [12] with a short follow-up. This relationship in a general population needs further investigation.

The aim of this study was to examine the relationship between life satisfaction and depressive symptoms in healthy adults with cross-sectional and longitudinal study designs.

Subjects and methods

This prospective cohort study with a follow-up from 1975 to 1990 is based on the Finnish Twin Cohort, a nationwide sample of all Finnish same-sex twin pairs born before 1958 with both members alive in 1975. The aim of the project was to investigate environmental, psychosocial and genetic factors that affect chronic diseases in adults and their risk factors. A baseline health questionnaire was sent in 1975 to twin candidates [18]. The follow-up questionnaires in 1981 and 1990 were sent only to the verified twins. In addition, the 1990 questionnaire was sent only to twins from pairs with both co-twins alive, residing in Finland and born 1930–1957. All the questionnaires included questions on demography, symptoms and diseases, health-related factors and health behaviour as well as a 4-item life satisfaction scale. The subjects were given a complete description of the study before informed consent was obtained. The overall response rates to the questionnaires were 89 % in 1975, 84 % in 1981 and 77 % in 1990. The study procedure has been presented in detail elsewhere [13, 18].

The life satisfaction scale has been modified from a questionnaire developed for measuring the quality of life for research purposes in Nordic countries [19]. It has been used among general population subjects [13, 19] as well as among psychiatric patients [12, 20, 21]. The four items comprised the following:

Do you feel that your life at present is (response scores in parentheses) …

1. - > very interesting [1], fairly interesting [2], fairly boring [4] or very boring [5]?
2. - > very happy [1], fairly happy [2], fairly unhappy [4] or very unhappy [5]?
3. - > very easy [1], fairly easy [2], fairly hard [4] or very hard [5]?

Do you feel that at the present moment you are …

4. - > very lonely [5], fairly lonely [4] or not at all lonely [1]?

The item responses 'cannot say' were scored as 3. Thus, the total score (LS) ranged from 4 to 20, with higher scores indicating a lower life satisfaction. If three or four items were missing, the sum score was recorded as 'missing'. On the basis of the distribution of sum score (LS), subjects were categorised into the satisfied (LS: 4–6), the intermediate group (LS: 7–11) and the dissatisfied (LS: 12–20) [13]. In this way, the intermediate group consisted of those with an LS score within one standard deviation from the mean. At baseline, responses to all four items were provided by 95.8 % (N = 22416) and at least two items (enabling LS to be calculated) by 99.2 % (N = 23212) of all respondents aged 18–45 years. In the Twin Cohort the correlation coefficients between each item and the LS sum score ranged between 0.63 and 0.80 ($p < 0.001$) and Cronbach's alpha was 0.74 [13]. In psychiatric outpatients, the latter varied between 0.71 and 0.85 [12].

The 21-item Beck Depression Inventory (BDI) was included in the questionnaire only in 1990 [22, 23]. The BDI score ranges from 0 to 63, indicating normal mood (BDI 0–9), mild depression (BDI 10–18) and moderate or severe depression (BDI ≥ 19) [24]. A cut-off point of 14/15 has been suggested as a good indicator for the presence of major depression [25].

The criteria for inclusion of subjects in the present study were the availability of baseline life satisfaction data, being aged 18–45 years on 1 January 1976 and being a twin (N = 19973), since only twins were eligible to receive follow-up questionnaires. Additionally, our study subjects were healthy at baseline (N = 16496, see below for criteria), were sent the questionnaires both in 1981 and 1990 and responded to the life satisfaction scale in both years (N = 9679) and to the BDI in 1990 (n = 8464). The resulting study population consisted of 3984 (47.1 %) male and 4480 (52.9 %) female twins. Their distribution according to the LS score is summarised in Table 1. The mean age (SD) at baseline was 28.6 years (7.4) for men and 27.7 years (7.5) for women.

The criteria for baseline health were based on a health questionnaire (Q) and three nationwide registries, i. e. the Hospital Discharge Registry (H), the Registry of Specially Refunded Medication (M) and the Cancer Registry (C). These registries are based on unique personal identification code assigned for each citizen and linked with the Finnish Twin Cohort. They have very high coverage and validity [26–29]. The Hospital Discharge Registry has 95 % coverage and diagnostic accuracy [26] and nearly all persons with psychotic disorder have the right to free medication [29]. In the health questionnaire self-reported symptoms (such as levels of breathlessness or history of severe chest pain lasting half an hour or more) and reported physician-diagnosed diseases were covered.

Excluded subjects were those: 1) with symptoms/diseases including cardiovascular disease, diabetes, chronic obstructive pulmonary disease (Q) or malignant cancer (C); 2) who had specially refunded medications for 37 selected chronic diseases (including psychosis) before 1977 (M); 3) who had used a hypnotic/tranquilizer for more than 10 days in the preceding year (Q); 4) who were on a work disability pension due to any cause (Q); and 5) who had an inpatient admission due to psychiatric disorder (ICD-8: 290–309), diabetes, cardiovascular (hypertension/venous diseases excluded) or chronic obstructive pulmonary disease between 1972 and April 1976 (H) [13]. Thus, the specific exclusion criteria for psychiatric disorders covered work disability, inpatient treatment and even the slight use of psychotropic medicine.

Previously, in the Finnish Twin Cohort 4-item life satisfaction is associated with a lower age, female sex, cohabiting, an upper social class, non-smoking, low/moderate alcohol consumption and physical activity [13, 14]. To control for confounding, the multivariate model included age (18–24/25–34/35–45), sex, marital status (married or cohabiting/single, divorced or widowed), social class (lower/intermediate/upper group), physical activity (at least 30 min of exercise < 1/1–5/≥ 6 times a month), current smoking status (non-smoker/1–19/ > 19 cigarettes daily) and alcohol consumption (none/1–99/100–399/400–799/≥ 800 g pure alcohol/month) [13]. The upper social class consisted of those with at least 13 years of education and sedentary work, while the lower social class consisted of those with less than 10 years of education and work involving at least standing and walking. The distribution of study subjects according to these baseline characteristics is presented in Table 1.

Data analysis was carried out using STATA (version 7.0). Since a study subject could be an age- and sex-matched twin sibling of another study subject, not all the observations were necessarily statistically independent. Therefore, correct standard errors were computed using robust estimators of variance and by treating each pair of twins as a single unit (cluster procedure). The statistical significance of differences was tested by estimates of means (SVYMEAN and SVYLC procedure) for continuous variables and by the chi-squared test for categorical variables (SVYTAB procedure) corrected for clustered data and converted into F-statistics. The association between concurrent life satisfaction and depressive symptoms in 1990 was examined with Pearsonian correlation, scatter plot (data not shown) and linear regression of continuous variables, again corrected for clustering. Logistic regression for clustered data was used to study how past or concurrent life satisfaction predicted depressive symptoms (BDI) in 1990. The value of the LS score in screening for depressive symptoms was examined by computing sensitivity, specificity, positive and negative predictive values, as well as with the Receiver Operating Characteristics (ROC) curve.

Results

The mean BDI score was 4.6 (SD 5.1) for total study population, 5.1 (SD 5.3) for women and 4.0 (SD 4.7) for men.

Table 1 Baseline characteristics of the study population according to depressive symptoms assessed with the Beck Depression Inventory (BDI*) in 1990

Baseline characteristics	N	All column % (N = 8464)	Depressive symptoms in 1990 (row %)			p-value
			Normal (n = 7298)	Mild (n = 976)	Moderate (n = 190)	
Sex						< 0.001[1)]
Men	3084	47.1	89.1	9.3	1.7	
Women	4480	52.9	83.7	13.6	2.7	
Age group						< 0.001[2)]
18–25	3697	43.7	87.2	10.2	2.6	
16–35	3096	36.6	86.8	11.2	2.1	
36–45	1671	19.7	83.1	15.1	1.7	
Social class						< 0.001[3)]
Upper	532	6.3	89.9	9.0	1.1	
Intermediate	2205	26.1	83.2	13.6	3.2	
Lower	5727	67.7	87.0	11.0	2.0	
Marital status						< 0.001[4)]
Cohabiting	4696	55.5	86.8	11.5	1.7	
Living alone	3766	44.5	85.5	11.5	2.9	
Smoking cigarettes daily						0.004[5)]
Non-smoker	5794	68.5	87.3	10.7	2.0	
1–19	2109	24.9	84.3	13.0	2.7	
> 19	557	6.6	82.9	14.0	3.1	
Pure alcohol g/month						0.004[6)]
None	1118	13.2	85.5	11.9	2.6	
1–99	3527	41.7	86.2	11.6	2.2	
100–399	2367	28.0	88.1	10.3	1.6	
400–799	981	11.6	86.0	11.7	2.2	
≥800	465	5.5	79.4	16.3	4.3	
Physical activity/month						0.001[7)]
< 1	982	12.0	82.4	13.8	3.9	
1–5	4027	49.3	86.8	11.0	2.2	
≥6	3155	38.7	87.1	11.2	1.7	
Life satisfaction						< 0.001[8)]
4–6	1965	23.2	91.2	7.6	1.2	
7–11	5448	64.4	87.0	11.3	1.8	
12–20	1051	12.4	73.0	20.4	6.7	

* BDI: normal mood (0–9); mild depression (10–18); moderate or severe depression (≥ 19)
[1)] F(2, 5964) = 24.53; [2)] F(4, 5962) = 6.68; [3)] F(4, 5962) = 7.00; [4)] F(2, 5963) = 7.11; [5)] F(4, 5960) = 3.89; [6)] F(8, 5955) = 2.86; [7)] F(4, 5815) = 4.45; [8)] F(4, 5962) = 33.8

Being a man, belonging to the upper social class, cohabiting, moderate alcohol consumption, being a non-smoker, physically active and satisfied with life at baseline were associated with having normal mood in 1990. Older age was associated with subsequent mild depressive symptoms more often than younger age, while younger subjects were more often either non-depressive or at least moderately depressive in the future (Table 1).

A strong linear association was detected between concurrent BDI and LS scores in 1990 (Fig. 1) with a correlation of 0.61. The correlation between the BDI in 1990 and LS score in 1975 and 1981, respectively, was 0.22 and 0.30. The LS score in 1990 explained 37.2 % of the variations in the BDI score in 1990. The linear regression coefficient for clustered data with BDI as a dependent variable and the LS score in 1990 as an independent variable was 1.12 (95 %CI 1.07–1.17).

In logistic regression analysis, both past and current dissatisfaction were strong, statistically significant predictors of depressive symptoms. This was true regardless of the BDI cut-off points. The adjusted odds ratios of moderate or severe depression (BDI ≥ 19 vs. BDI < 10) among the dissatisfied (LS 12–20) compared with the satisfied (LS 4–6) are presented in Table 2.

The validity of the 4-item life satisfaction scale in detecting concurrent mild (BDI ≥ 10) or moderate depression (BDI ≥ 19) assessed with the 21-item BDI is detailed in Table 3. With an LS cut-off score of 11/12, moderate depression was detected with a high sensitivity (86.8 %), specificity (87.5 %) and negative predictive value (NPV) (99.7 %) and an area under the ROC curve of 94 %, but the positive predictive value (PPV) was low (13.8 %). When major depression was defined by a BDI cut-off point of 14/15, an LS cut-off point of 11/12 detected the depression with 72.6 % sensitivity, 89 % specificity, an area under the ROC curve of 90 %, 26 % PPV and 98.4 % NPV.

Those who were excluded from the study population due to missing life satisfaction data (1981/1990) or a missing BDI score (1990) were more often men, unmar-

Fig. 1 Relationship between life satisfaction score and Beck Depression Inventory (BDI) score in 1990 among Finnish adults (N = 8464). Vertical bars show 95 % confidence intervals of the mean

Table 2 Risk (OR with 95 % CI) of moderate or severe depressive symptoms* in 1990 related to life satisfaction** in 1975, 1981 and 1990 among Finnish adults

	Risk of BDI ≥ 19 compared with BDI < 10		
	LS 1975 OR (95 % CI)	LS 1981 OR (95 % CI)	LS 1990 OR (95 % CI)
Life satisfaction			
Satisfied	1.0	1.0	1.0
Intermediate[1]	1.53 (0.98–2.39)	1.56 (0.93–2.62)	8.34 (1.13–61.66)
Dissatisfied[1]	6.74 (4.18–10.88)	10.36 (6.11–17.57)	490.1 (68.42–3510)
Adjusted[2]	5.46 (3.32–8.95)	9.33 (5.38–16.18)	452.0 (62.74–3257)

* Beck Depression Inventory (BDI): normal mood (0–9); mild depression (10–18); moderate or severe depression (≥19); ** Life satisfaction scale (LS): satisfied (4–6); intermediate (7–11); dissatisfied (12–20)

[1] Adjusted for age; [2] Adjusted simultaneously for age, sex, marital status, social class, alcohol consumption, current smoking and physical activity (cf. method section)

ried, physically inactive, current smokers, used more alcohol and belonged more often to the intermediate social class than those for whom all the scores were available, but did not differ in age. Furthermore, the subjects with all the scores available (N = 8464) were more satisfied (LS 8.20; 95 % CI 8.14–8.26) than those (N = 8032) who were excluded due to missing data (LS 8.59; 95 % CI 8.52–8.65). Among those for whom a baseline life satisfaction score and the BDI were available in 1990, but who had no life satisfaction score in 1981 and/or in 1990 (N = 350), baseline dissatisfaction predicted at least mild depressive symptoms (BDI ≥ 10) with an age-adjusted OR of 12.50 (95 % CI 3.43–45.50), while the figure was 3.86 (3.12–4.78) for our study population.

Discussion

The results of this study revealed that self-reported life satisfaction was strongly associated with concurrent depressive symptoms. Furthermore, it also strongly predicted subsequent depressive symptoms in the 15-year follow-up of healthy adults. Together with previous studies revealing the strong ability of life dissatisfaction to predict also premature deaths and work disability [13–16], these findings suggest the importance of subjective well-being as a health policy issue.

The strengths of our study include the large nationwide sample, good response rate and long follow-up. The exclusion criteria for health were based on both self-reports and national registries with high coverage and validity [26–29]. Somatic problems and especially any indication of psychiatric problems were excluded. Still, life dissatisfaction at baseline strongly increased the long-term risk of subsequent depressive symptoms.

Our prediction results were conservative. Those whose dissatisfaction might have led to the most adverse result, i. e. death, were excluded from our analysis. The response to follow-up surveys was lower among the dissatisfied and the odds ratios for the studied relationships were higher for those with missing future scores (LS 1981/1990). Moreover, if adjusting for follow-up health behaviour instead of baseline health behaviour variables, the strength of these associations would have increased slightly.

Being a twin does not affect the ability of life satisfaction to predict mortality or suicide [13, 14], and there is at most only a modest contribution of genetics to inter-individual differences in life satisfaction [30]. Furthermore, the potential influence of twinship was taken into account in the statistical analyses of this study.

A limitation might be that we did not have diagnosed depression as a "golden standard". However, we compared the LS scale with the 21-item Beck Depression Inventory, which is a well-known and widely used scale and has been considered as one of the best tools in screening for depressive symptoms [24, 31]. We focused on the whole range of depressive symptoms and used several already established cut-off points of BDI [24, 25]. Previous studies suggest that it is important not only to

Table 3 The validity of the 4-item life satisfaction scale (LS) in detecting concurrent depressive symptoms assessed with the 21-item Beck Depression Inventory (BDI)

A. Mild depression (BDI≥10): ROC = 0.83 (0.82–0.84)					
LS cut-point	Sensitivity	Specificity	Correctly classified	PPV	NPV
	%	%	%	%	%
6	99.3	11.2	23.4	15.2	99.0
7	96.8	23.7	33.8	16.9	97.9
8	85.2	61.5	64.8	26.1	96.3
9	80.9	68.6	70.3	29.2	95.7
10	69.6	81.8	80.1	37.9	94.4
11	60.5	89.0	85.1	46.7	93.4
12	53.0	92.1	86.7	51.6	92.5
13	40.1	96.6	88.8	65.0	91.0
14	34.1	97.8	89.1	71.6	90.3
15	23.9	99.2	88.8	82.1	89.1
16	19.0	99.4	88.4	84.1	88.5
17	8.2	99.9	87.2	89.7	87.2
18	4.0	100	86.8	100	86.7
B. Moderate or severe depression (BDI≥19): ROC = 0.94 (0.92–0.95)					
LS cut-point	Sensitivity	Specificity	Correctly classified	PPV	NPV
	%	%	%	%	%
6	100	10.0	12.0	2.5	100
7	99.5	21.3	23.1	2.8	99.9
8	97.4	56.0	57.2	4.9	99.9
9	96.8	63.2	63.2	5.7	99.9
10	95.3	76.3	76.7	8.5	99.8
11	89.0	83.8	83.9	11.2	99.7
12	86.8	87.5	87.5	13.8	99.7
13	76.8	93.1	92.7	20.3	99.4
14	70.0	94.9	94.3	23.9	99.3
15	56.3	97.2	96.3	31.5	99.0
16	51.1	98.0	96.9	36.7	98.9
17	29.0	99.4	97.8	51.4	98.4
18	15.3	99.8	97.9	63.0	98.1

ROC = area under the ROC (Receiver Operating Characteristics) curve
PPV = positive predictive value
NPV = negative predictive value

detect a diagnosed disorder but also sub-threshold depression, since even the latter may have adverse health consequences [3, 32]. Still, in psychiatric patients, the LS scale has been shown to be closely related both to depressive symptoms measured with BDI (self-reported) or Hamilton depression scale (objective rater), or depression diagnoses [12]. Moreover, the LS scale has already proven to be a significant long-term predictor of several fatal and non-fatal adverse health consequences including suicides and psychiatric disability pensions, as well as now also depressive symptoms among healthy adults [13–16].

The high specificity (88 %), sensitivity (87 %) and negative predictive value (~100 %) of the 4-item LS scale indicates its ability to detect depressive symptoms, but there is still need for further evaluation of those who report life dissatisfaction in order to establish to what extent the instrument can be used for assessment of individuals. A review of depression case-finding instruments reveals average values of 80 % for sensitivity and 72 % for specificity [33]. Some data on the validity of detecting a depressive mood have also been presented, but the most valid scales seem to be those with far more items than the LS scale [2]. Recently, however, two verbally asked questions (i. e. depressive mood and interest in doing something) were also shown to detect most cases of depression in general practice [34]. On the other hand, from the four items of the life satisfaction scale, the happiness-item was found to be the most powerful predictor of suicide [35]. Brevity or whether the questions are asked in writing or verbally does not hinder in screening depression, but false positives should be sought out with further clarification.

However, while BDI concentrates on the presence or absence of unfavourable symptoms, the LS scale also taps the positive pole of subjective well-being. Questions on subjective well-being are well accepted. LS sum score was available for 99 % of all respondents [13, 14]. The 21-item BDI had a lower overall completion rate than the LS scale. This might be due to the lower number of items of the LS scale. Thus, we do have an easily applicable indicator of low subjective well-being, which might also facilitate the early detection of depression. Furthermore, it also provides possibilities to measure and intervene in long-term adverse health processes in the general population.

In psychiatric patients with depressive disorder, recovery from depression coincided with an improvement in life satisfaction [12]. This improvement, which was mainly attained during the first 6 months of psychiatric care, persisted up to the end of the 1-year follow-up study. Life satisfaction explained somewhat more of the variation in the BDI score in patients with depression (46.6 %) [12] than in our healthy general population subjects (37.2 %). For the same BDI score, our study population reported greater life dissatisfaction (Fig. 1) than depressive patients undergoing psychiatric treatment [12]. This could indicate that receiving psychiatric treatment will first improve life satisfaction and only afterwards will recovery from depression follow. However, longer follow-up studies are needed to determine the kind of intervention and support needed to maintain the improvement in the long term.

Conclusions

This concise life satisfaction scale can help to detect a group of people from the general population with low subjective well-being and a high risk of having or developing depressive symptoms. Since life dissatisfaction also indicates an elevated risk of other adverse health outcomes, the assessment of subjective well-being should be encouraged both in surveys and in clinical practice.

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