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Social participation and mental well-being: does purpose in life mediate the association among older adults?

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Abstract

Objectives: We investigated the association of social participation with mental well-being among older people and whether purpose in life mediates the potential association.

Methods: Cross-sectional (n=1014) and longitudinal (n=660, four-year follow-up) data comprised of three age cohorts (75, 80, 85 years) of community-dwelling people. Life satisfaction was measured with the Satisfaction with Life Scale, depressive symptoms with the Centre for Epidemiologic Studies Depression Scale, and purpose in life with the Scales of Psychological Well-Being purpose in life subscale. Social participation was assessed with questions concerning the frequency of meeting close friends and acquaintances, and volunteering. The data were analyzed using structural equation modeling.

Results: Higher social participation was associated with higher life satisfaction and fewer depressive symptoms both cross-sectionally and after a four-year follow-up. Higher purpose in life mediated the associations of more social participation with higher life satisfaction and fewer depressive symptoms cross-sectionally. In the longitudinal data, the mediation effect was not observed.

Conclusion: Older people with frequent social participation who had a sense of purpose in their lives will likely have higher mental well-being than those with less social participation. Enabling and supporting them to conduct purposeful actions in social contexts may help maintain their mental well-being.

Keywords: social relations, purpose in life, life satisfaction, depressive symptoms, aged people, structural equation modeling

Introduction

Maintaining mental well-being is important, for instance, for sustaining physical health and active life in old age (e.g., Ohrnberger et al., 2017). Mental well-being as a multidimensional phenomenon consists of emotional, psychological, and social well-being as well as the absence or low levels of depressive symptoms (Keyes, 2005). In the present study, we focused on life satisfaction (a dimension of emotional well-being) and depressive symptoms as outcomes. Depressive mood may include depressed affect (e.g., feeling depressed, sad, fearful), somatic symptoms (e.g., poor appetite, trouble concentrating, restless sleep), feeling interpersonal problems (e.g., people perceived as unfriendly), and low levels of positive affect (e.g., not feeling as good as others, not enjoying life) (as assessed in CES-D, Radloff, 1977). Depressive symptoms are usually reactions to adverse life events but when continuing for a long time they can hamper living a normal life (Ploughman et al., 2020). Life satisfaction is a cognitive appraisal of how satisfied one is with one's life as a whole (Diener et al., 1985). Global evaluation of life satisfaction reflects an individual's satisfaction with personally important domains of life and interpretation of overall life. It often predicts future decisions and important life outcomes better than momentary assessments of well-being (Diener et al., 2009). The present study aimed to gain a better understanding of factors related to well-being in later life.

People have a fundamental need for forming and maintaining lasting, positive, and significant interpersonal relationships (Baumeister & Leary, 1995). An association of social relationships or being socially active with higher life satisfaction and fewer depressive symptoms in old age has been proposed by earlier studies. Reker (1997) found that a more extensive friendship network, higher frequency of contact with family and relatives, and availability of help when sick or disabled as well as the high quality of social relationships were related to lower levels of depressive symptoms. The availability of help and feelings of being respected correlate also with higher life satisfaction (Diener et al., 2018). In older adults, becoming more present-oriented and more selective, driven by the motivation to regulate one's emotions, may result in choosing social activities and experiences that provide positive emotions and feelings in the present, as is argued by the socio-emotional selectivity theory (Carstensen, 1992; Carstensen et al., 1999). Parallel findings as in cross-sectional studies have been observed in longitudinal studies even though qualitative aspects of social relationships have been addressed less often. Briefly, social contacts and participating in social activities predict over time higher life satisfaction (Yoon et al., 2020) and fewer depressive symptoms (E. Choi

et al., 2021; Ding et al., 2022; Glass et al., 2006; Min et al., 2016; Pulkkinen et al., 2011). Similarly, doing volunteer work and providing informal help are related to higher levels of life satisfaction (Theurer & Wister, 2010; Yoon et al., 2020) and lower levels of depressive symptoms (K.-S. Choi et al., 2013; Wahrendorf et al., 2008), and may prevent from an increase in depressive symptoms over time (E. Choi et al., 2021; Hong et al., 2009). According to the activity theory, informal social activities have a greater impact on life satisfaction compared to formal social activities (Havighurst & Albrecht, 1953).

The previously presented studies provide strong evidence that qualitative and quantitative aspects of social relationships are linked to well-being. However, what underlies these associations is less clear. We propose that a sense of purpose in life mediates the relationships of social participation with life satisfaction and depressive symptoms. Purpose in life can be seen as one component of psychological well-being (Ryff & Singer, 1998). However, in the present study, we explored it as a potential mediator and at the same time as a potential explanator and predictor of life satisfaction and depressive symptoms (cf. Kashdan et al., 2023). Purpose in life is an essential construct as individuals have a fundamental need and motivation to find and fulfill meaning and purpose in their lives (Frankl, 1988). Purpose can be seen as a central, self-organizing life aim that directs life goals, daily decisions, and behaviors (McKnight & Kashdan, 2009). It may help older adults preserve their health and well-being in many ways (see a review, Irving et al., 2017). Higher purpose in life, for instance, is related to reduced risk of all-cause mortality and serious diseases, maintenance of physical and cognitive functioning, and positive health-related behaviors. Higher purpose in life may contribute to coping with life obstacles and stresses (McKnight & Kashdan, 2009) and is associated positively with life satisfaction (Ang & O, 2012; Ryff, 1989; Steger et al., 2009) and negatively with depressive symptoms (Chow & Ho, 2012; Dezutter et al., 2015; Kim et al., 2014; Pinquart, 2002; Ryff, 1989; Steger et al., 2009; Van der Heyden et al., 2015; Windsor et al., 2015). Irrespective of age, personal relationships are viewed as an important source of purpose (Prager, 1998). Both higher quality and quantity of contact with other persons are related to a higher purpose in life among older people (Nakamura et al., 2022; Pinquart, 2002). Regardless of a large number of existing studies, none of the previous studies, according to our knowledge, have explored the mediation effect of purpose in life in the association of social participation with life satisfaction and depressive symptoms among older adults. The theoretical basis can be drawn from Frankl's thinking. He argued that

purpose is essential for well-being and that by making purposeful actions, for example, to other people, an individual can experience joy, happiness, and pleasure (Frankl 1988).

In sum, we hypothesize that social participation is associated with higher life satisfaction (H1) and lower levels of depressive symptoms (H2), which we aimed to study in cross-sectional and longitudinal designs; the latter takes into account baseline life satisfaction and depressive symptoms levels. Additionally, we hypothesize that social participation propels the sense of purpose in life (H3) which, in turn, is linked to higher life satisfaction (H4) and lower levels of depressive symptoms (H5). The topic is relevant since experiencing a purpose in life may be at risk in old age as the probability of losing sources of purpose in life increases through potential losses in mental and physical vitality and social resources (Pinquart, 2002). Knowledge gained by the current study can be used as reasoning for interventions or practices that aim to maintain the well-being of older adults.

Materials and methods

Study design and participants

The manuscript presents cross-sectional results and longitudinal findings based on data of the Active aging – resilience and external support as modifiers of the disablement outcome (AGNES) cohort study. The study design and data collection have been described in detail earlier (Lindeman et al. 2024; Portegijs et al., 2019; Rantanen et al., 2018). Participants comprised a population-based probability sample of community-dwelling people of three age cohorts (75, 80, and 85 years) living in the city of Jyväskylä, Central Finland. The data of the present study were collected in face-to-face home interviews and by postal questionnaires between September 2017 and December 2018 (baseline, T1, n=1021). Of them, 663 persons took part in the follow-up between October 2021 and October 2022 (T2). Inclusion criteria were willingness to participate and ability to communicate, and additionally in T2, living still in Jyväskylä and their own home. We excluded those participants from the analytical sample who had missing data in all main study variables (social participation, purpose in life, life satisfaction, and depressive symptoms). Thus, analytical samples were comprised of 1014 participants in the cross-sectional data and 660 participants in the longitudinal data.

The ethical committee of the Central Finland Health Care District provided an ethical statement about the AGNES cohort study on August 23, 2017, and to the follow-up AGNES2

cohort study on September 7, 2021. All participants signed informed consent before the start of the study. The AGNES cohort study followed the principles of the Declaration of Helsinki.

Measures

Life satisfaction was assessed with the Satisfaction with Life Scale (SWLS) which measures a person's overall judgment of his or her life (Diener et al., 1985). The scale consists of five items, e.g., 'I am satisfied with my life', each rated on a seven-point Likert scale from strongly disagree (1) to strongly agree (7). For a sum score (range 5–35) with higher scores indicating higher life satisfaction, Cronbach's alphas were good (0.89 in T1 in both cross-sectional and longitudinal data and 0.88 in T2 in longitudinal data).

Depressive symptoms were assessed with the 20-item Centre for Epidemiologic Studies Depression Scale (CES-D) (Radloff, 1977) in T1 and T2. Participants are asked to rate the frequency of each depressive symptom e.g., 'I had trouble keeping my mind on what I was doing' and 'I enjoyed life' during the previous week on a four-point scale ranging from rarely or never (0) to almost all the time (3). Items of positive affect dimension are reverse-coded. For a sum score (range 0–60), with higher scores indicating more depressive symptoms, Cronbach's alphas were good (0.88 in cross-sectional data and 0.89 in longitudinal data in T1 and 0.87 in longitudinal data in T2).

Social participation was measured in T1 with four questions concerning the frequency of meeting one's children and other relatives, close friends, and other acquaintances, and doing volunteer work. Response options were every day (5), every week (4), every month (3), a few times a year (2), little or not at all (1), and have not (0) (see Rantanen et al., 2018). For an average sum score, with higher scores indicating more frequent social participation, Cronbach's alphas were poor (0.39 in cross-sectional data and 0.38 in longitudinal data).

Purpose in life was assessed in T1 with the Scales of Psychological Well-Being purpose in life subscale (Ryff, 2014) which has seven items describing participant's perception of the degree to which e.g., there is purpose and direction in their life. Each item is rated on a Likert scale from strongly disagree (1) to strongly agree (6). Opposite items are reverse-coded. For an average sum score, with higher scores indicating a higher purpose in life, Cronbach's alphas were poor (0.44 in cross-sectional data and 0.42 in longitudinal data).

Since self-rated health, marital status, gender, and perceived economic situation are related to social participation, purpose in life, life satisfaction, and depressive symptoms (e.g., Bukov et

al., 2002; Djernes, 2006; Gaymu & Springer, 2010; Pinquart, 2002), they were used as *covariates* in the current study. The perceived economic situation was re-coded as moderate or poor (0) and good or very good (1), marital status as unmarried, widowed, or divorced (0) and married or cohabitated (1), and self-rated health as poor or very poor (1), moderate (2), and good or very good (3). Perceived economic situation and marital status were taken from T1 and self-rated health both from T1 and T2.

Statistical analysis

We conducted three sets of analyses. First, we validated the measurement models of social participation, purpose in life, life satisfaction, and depressive symptoms by using exploratory factor analysis (EFA). Based on the results, these variables were used as factors in further analyses. Second, we used structural equation modeling (SEM) to test cross-sectional associations between social participation as an independent variable, life satisfaction, and depressive symptoms as outcomes, and purpose in life as a potential mediator. Third, SEM was used to estimate associations between the variables in a longitudinal data setting. In this model, life satisfaction and social participation in T1 were explanators for life satisfaction in T2. Similarly, depressive symptoms and social participation in T1 were explanators for depressive symptoms in T2. Purpose in life in T1 was estimated as a potential mediator between social participation in T1 and life satisfaction/depressive symptoms in T2. Additionally, purpose in life was adjusted for T1 life satisfaction and depressive symptoms (see Lapierre et al., 2001; Nakamura et al. 2022). Social participation, purpose in life, life satisfaction, and depressive symptoms were adjusted for gender, T1 marital status, T1 perceived economic situation, and either baseline or follow-up self-rated health. However, in the final models, only statistically significant associations were included, and adjusting covariates were allowed to correlate with each other suggested by modification indexes. We used Maximum likelihood (ML) as an estimator in EFA and Weighted Least Square Mean and Variance (WLSMV) in SEM models to obtain parameter estimates. MPLUS (version 8.6) was used as a statistical program. The covariance coverage was at its smallest 0.908 in cross-sectional data and 0.939 in longitudinal data. We used a full information maximum likelihood estimator supposing missing values to be missing at random (MAR). The fit of SEM models was evaluated by using the root mean square error of approximation (RMSEA < .06), the comparative fit index (CFI > .95), the Tucker-Lewis index (TLI > .95), and standardized root mean residual (SRMR < .08) (Hu & Bentler, 1999).

Results

The means, standard deviations, and proportions of the study variables are shown in Table 1. The proportion of women was 57%. Of the participants, 45% were 75-, 33% were 80-, and 22% were 85-year-olds. 46% rated their health as good or very good and 49% as moderate at baseline. In the longitudinal data, respective proportions for gender were 58%, for age groups 49%, 35%, and 16%, and for self-rated health 53% and 44%. When taking into account also means and standard deviations of the main study variables, it seemed that cross-sectional and longitudinal data were comparable.

[Table 1]

Results of EFA are shown in Supplementary Tables 1-4. In social participation, factor loading of meeting one's children and relatives was low and thus, it was not included in the factor. In purpose in life, items describing the sense of direction and purpose, the importance of daily activities, not feeling uncertainty about what to reach in life, and enjoyment of planning and working for the future were loaded quite strongly in a factor while loadings of other three items were negative or scattered. Thus, these three items were omitted from the factor. In life satisfaction and depressive symptoms, items loaded well in one factor and thus, they were used as one-dimensional factors.

Cross-sectional bivariate analyses indicated that higher social participation was associated with higher purpose in life, higher life satisfaction, and lower levels of depressive symptoms (Table 2). Additionally, a higher purpose in life was related to higher life satisfaction and lower levels of depressive symptoms. According to the results of the adjusted SEM (Figure 1, factor loadings are shown in Supplementary Table 5), higher social participation was related to a higher purpose in life, which in turn, was associated with higher life satisfaction and lower levels of depressive symptoms score. The indirect effects from social participation to life satisfaction through purpose in life ($\beta=0.17, p<.001$) and from social participation to depressive symptoms through purpose in life ($\beta=-0.22, p<.001$) were statistically significant. Social participation had also a direct effect on life satisfaction, and therefore, purpose in life partially mediated the association between social participation and life satisfaction. Between social participation and depressive symptoms, purpose in life functioned as a full mediator. The path coefficient changed from .30 to .13 between social participation and life satisfaction and from -.20 to .03 between social participation and depressive symptoms when purpose in life was added to the model (see Supplementary Figure 1). Of the adjusting covariates, higher

self-rated health was related to lower levels of depressive symptoms and higher levels in other study variables, higher perceived economic situation to a higher purpose in life and higher life satisfaction, and being married or cohabited to a higher purpose in life. The model fitted data relatively well (RMSEA=.054, CFI=.924, TLI=.917, and SRMR=.067) and explained 39% of the variance in life satisfaction and 43% in depressive symptoms.

[Table 2] [Figure 1]

In the longitudinal data, higher social participation had bivariate associations with higher life satisfaction and lower levels of depressive symptoms four years later (Table 2). Associations remained statistically significant when baseline levels of life satisfaction and depressive symptoms were taken into account (see Supplementary Figure 2). In the adjusted SEM including purpose in life (Figure 2), social participation was related to purpose in life. However, purpose in life was not associated with life satisfaction and depressive symptoms in T2. Social participation in T1 was directly related to life satisfaction in T2 and the path coefficient remained unchanged when comparing models with and without purpose in life. Instead, adding purpose in life in the model attenuated the association between social participation and depressive symptoms. In the model not including baseline depressive symptoms, purpose in life was related to T2 depressive symptoms (Supplementary figure 3). Thus, it seemed that taking into account the baseline levels of depressive symptoms attenuated this association. Higher life satisfaction and fewer depressive symptoms in T1 were related to a higher purpose in life. Self-rated health in T1/T2 was related to depressive symptoms and life satisfaction in T1/T2 and female gender to higher depressive symptoms in both time points. Higher life satisfaction in T1 was additionally explained by being married or cohabited, better economic situation, and female gender and social participation by better health. The fit indexes (RMSEA=.047, CFI=.908, TLI=.903, and SRMR=.076) suggested moderate adequacy between the model and the data. Altogether, the longitudinal model explained 57% of the variance in life satisfaction and 54% in depressive symptoms.

[Figure 2]

Discussion

The current study focused on the question of whether higher social participation is related to higher life satisfaction and lower levels of depressive symptoms in older people of three age

cohorts (75, 80, and 85 years). A novel feature of the study was the investigation of whether purpose in life mediates the associations of social participation with mental well-being. The results confirmed the hypotheses presuming an association of social participation with life satisfaction and depressive symptoms both in cross-sectional and longitudinal data. Furthermore, the hypothesis concerning the mediation effect of purpose in life in the association of social participation with life satisfaction and depressive symptoms was confirmed cross-sectionally. However, in the longitudinal data mediation effect was not observed.

Social participation in our study consisted of the frequency of meeting other people and doing volunteer work while other studies focusing on the quantitative aspect of social relationships have used somewhat different measures. However, the association between participating in social gatherings, volunteering, and life satisfaction has been reported previously (Theurer & Wister, 2010; Yoon et al., 2020). Similarly, the association between participation in activities that enable social interaction, providing help to other people, and doing volunteer work and depressive symptoms have been found earlier (e.g., E. Choi et al., 2021; Ding et al., 2022; Glass et al., 2006). The result regarding the association of social participation with life satisfaction and depressive symptoms was in line with the activity theory's idea that continuing an active social life in older age is important for the maintenance of mental well-being (Havighurst & Albrecht, 1953). However, data were not available to distinguish between informal and formal social activities except that the question concerning volunteering was asked if it was organized by some organization, municipal, congregation, etc. Older people can meet their friends and acquaintances informally but also, for instance, in formally organized hobby groups.

Relationships of social contacts, helping other people, and volunteering with having a sense of purpose in life have been found earlier (Nakamura et al., 2022; Pinguart, 2002). The results concerning the association of purpose in life with life satisfaction (Ang & O, 2012; Ryff, 1989; Steger et al., 2009) and depressive symptoms are in line with earlier studies (Chow & Ho, 2012; Kim et al., 2014; Pinguart, 2002; Ryff, 1989; Steger et al., 2009; Van der Heyden et al., 2015; Windsor et al., 2015). Regardless, the actual novelty of the present study comes from testing purpose in life as a potential mediator between social participation and the two outcomes describing mental well-being among older people. A theoretical basis can be drawn from Frankl's mode of thinking and the socioemotional selectivity theory. According to Frankl's (1988) theory, an individual can find and fulfill purposes when

directing themselves toward another person or the world outside them. Daily life consists of moments that enable an individual to find a sense of purpose by acting, experiencing, or taking a valuable attitude toward a predicament that cannot be changed (Frankl, 1988).

Measuring the quantitative aspect of social relationships (e.g., frequency of meetings) does not allow us to assume that those relationships are qualitatively high and satisfying. Social relationships may include positive characteristics such as trust, love, and acceptance as well as negative characteristics such as rejection, negligence, disillusionment, or betrayal (Kenyon, 1999). However, meeting other people and volunteering offer opportunities to encounter another person as they are in a respectful and loving atmosphere, to do good things for them, or to do meaningful activities together (realizing values by creating or acting) (cf. Frankl, 1988). When this occurs reciprocally, experiences like joy, goodness, or love are possible (realizing values by experiencing). Social relationships may give a person a sense of identity and experiences of being needed and useful (Wong, 1998) and stimulate activities that become a source of purpose in life (Pinquart, 2002). Sirèn et al. (2023) found that social relationships that are perceived as meaningful involve caring reciprocal interactions, support making autonomous decisions, and enable feeling oneself significant as a person. Frankl (1988) further argued that by doing purposeful actions a person can approach positive mental states such as pleasure or happiness. Thus, reaching one's goals (e.g., to do good things) gives a reason to be happy or experience other positive feelings. Instead, existential frustration may lead to boredom and apathy. Socioemotional selectivity theory also sheds light on the phenomenon by stating that older adults become more present-oriented and prioritize social goals related to the regulation of their emotions. Meaningful social interactions, that is social interactions with important others, provide for positive emotions in the present (Carstensen, 1992; Carstensen et al., 1999). Frequent positive emotions, in turn, are associated with a higher purpose in life (Nakamura et al. 2022).

Distinct from the cross-sectional setting, the mediation effects were not observed in longitudinal data. It should be noted that in the cross-sectional setting, mediation refers to the associations between the variables and not to causal relationships. In the longitudinal data, other factors than purpose in life, such as better cognitive functioning (Lv et al., 2024), explain the relationship between social participation and life satisfaction four years later. Purpose in life might have functioned as a mediator between social participation and depressive symptoms four years later as the association was statistically significant when baseline depressive symptoms were not taken into account. However, the results pointed to

the importance of including baseline levels of the variables in the model. Baseline depressive symptoms and life satisfaction were also associated with a sense of purpose in life and correlated with social participation at the same time point. Associations of higher depressive symptoms with lower levels of purpose in life and higher life satisfaction with higher levels of purpose in life have been observed earlier among older adults (Hedberg et al., 2010; Nakamura et al., 2022). It could be thought that a positive mood and experiencing satisfaction with life help people catch opportunities for conducting purposeful actions while people with higher levels of depressive symptoms may have difficulties detecting and seizing opportunities that involve potential for finding and fulfilling the purpose (cf. Fredrickson, 2002). Lapiere et al. (2001) found earlier that having no depressive symptoms increased participants' motivation for goal pursuit. In addition, depressive symptoms leading to interpersonal distrust may hinder people from engaging in normal social activities (Liu et al., 2017).

Older people may need support in finding purpose especially if they have encountered major changes in their life situation. For instance, recently widowed have a lower sense of purpose in life compared to those who are still married (Koren & Lowenstein, 2008). Important points are that purpose in life can be enhanced and supported and that purpose can be achieved via multiple routes (Frankl, 1988). Since social relationships seem to be essential for experiencing a higher purpose in life, offering chances to meet other people and develop new relationships as well as promoting positive interaction may help older adults to maintain a sense of purpose in life. This may need allocating financial resources by policymakers that would enable for instance, Pensioner's associations or other organizations to have premises to organize different types of activities for older adults (Koren & Lowenstein, 2008). In addition to supporting participation in meaningful activities, purpose in life can be enabled by providing older adults opportunities to continue contributing roles and to do volunteer work and sustain their social value and sense of mattering to others (McKnight & Kashdan, 2009; Pinquart, 2002; Ryff & Singer, 1998). Interventions that aim to enhance participants' sense of purpose may help them identify values and important topics or life domains they want to promote, pursue purposeful aims, and better perceive everyday life situations that enable them to find and fulfill purposes (cf. Frankl, 1988; Nakamura et al., 2022). Since higher levels of depressive symptoms were associated with lower purpose in life, using supportive means to decrease the depressive mood of older adults may be beneficial for the maintenance of a sense of purpose in life and well-being.

Limitations and strengths

Assessing social participation as the frequency of meetings and doing volunteer work pays no attention to the quality and satisfaction with one's social relationships and thus, can be seen as a limitation of this study. However, in our study, the variance of purpose in life explained by social participation was relatively high (19-20%) when in the meta-analysis conducted by Pinquart (2002), the quality of relationships explained 13% and the quantitative measures of the relationships explained 6.8% of the variance of purpose in life. Another limitation may be a sampling bias as of 2791 persons invited to the study, 2348 were contacted by phone, and finally, 1021 persons participated in the study (see Rantanen et al., 2020). Of those contacted by phone but refused to participate, 65% answered to a brief interview. The most common reasons not to participate in the study were lack of time, poor physical or cognitive health, and unwillingness to participate. Those participating in the baseline study reported more often good self-rated health and outdoor mobility than those not participating. It is also to be noted that there was some selectivity in the longitudinal data in the present study. Those participants who did not participate in the follow-up were older and had worse self-rated health, lower levels of social participation, purpose in life, and life satisfaction, and higher levels of depressive symptoms than those who participated in it. Thus, the results may be generalizable to the older populations living in their own homes independently and who are relatively healthy.

One strength of this study is exploring the research questions with larger cross-sectional data and longitudinal data with four-year follow-up. Participation rate in the follow-up was high as 73.3% of the target sample and 64.9% of the original sample took part in the home interview (Lindeman et al., 2024). This attrition may undermine the associations found in the present study. Another strength is incorporating life satisfaction as a positive outcome and depressive symptoms as a negative outcome in the same SEM model since it enables receiving a wider understanding of the mental well-being of older adults. Additionally, the study widened existing knowledge by exploring the mediation effect of purpose in life between social participation and the factors describing mental well-being.

Conclusion

In older ages, being socially active may explain current levels of life satisfaction and depressive symptoms and predict these outcomes over time. Higher social participation and

meaningful social interaction may enhance a sense of purpose in life that, in turn, may be related to higher life satisfaction and lower levels of depressive symptoms in the present.

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Declaration of interest

The authors report there are no competing interest to declare.

Availability of data and material

The data used in this study are available upon reasonable request.

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Table 1. Means, standard deviations (SD), and proportions of the study variables of the cross-sectional (n=1014) and the longitudinal data (n=660).

	Cross-sectional data	Longitudinal data	
		Baseline	Follow-up
	Mean (SD)	Mean (SD)	Mean (SD)
Satisfaction with life (5–35)	26.6 (5.37)	27.1 (5.08)	26.6 (5.37)
Depressive symptoms (0–60)	8.6 (7.09)	7.9 (6.96)	10.7 (7.26)
Social participation (0–5)^	2.6 (0.84)	2.7 (0.83)	-
Purpose in life (1-6)^	4.5 (0.86)	4.6 (0.83)	-
	%	%	%
Gender			
men	42.6	42.3	-
women	57.4	57.7	-
Age			
75 years	45.1	49.1	-
80 years	32.8	35.0	-
85 years	22.1	15.9	-
Marital status			
Unmarried, widowed, or divorced	41.2	39.5	-
Married or cohabitated	58.8	60.5	-
Self-rated health			
poor or very poor	4.9	3.6	9.7
moderate	49.4	43.8	48.3
good or very good	45.7	52.6	42.0
Perceived economic situation			
poor or moderate	39.9	37.9	-
good or very good	60.1	62.1	-

Note. ^: sum score is comprised of three items in social participation and four items in purpose in life

Table 2. Standardized bivariate path coefficients (β) and 95 % confidence intervals (CI) between social participation, purpose in life, life satisfaction, and depressive symptom factors in cross-sectional (n=1014) and longitudinal data (n=660).

	Life satisfaction (T1)		Depressive symptoms (T1)		Life satisfaction (T2)		Depressive symptoms (T2)		Purpose in life (T1)	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Cross-sectional data										
Social participation (T1)	.37***	.28;.45	-.28***	-.37;-.20	-	-	-	-	.45***	.35;.54
Purpose in life (T1)	.55***	.48;.61	-.61***	-.67;-.56	-	-	-	-	-	-
Longitudinal data										
Social participation (T1)	-	-	-	-	.36***	.25;.48	-.31***	-.41;-.21	.43***	.32;.55
Purpose in life (T1)	-	-	-	-	.49***	.41;.56	-.52***	-.60;-.44	-	-
Life satisfaction (T1)	-	-	-	-	.70***	.66;.74	-	-	.33***	.23;.43
Depressive symptoms (T1)	-	-	-	-	-	-	.71***	.66;.76	-.30***	-.40;-.20

Note. ***: $p < .001$

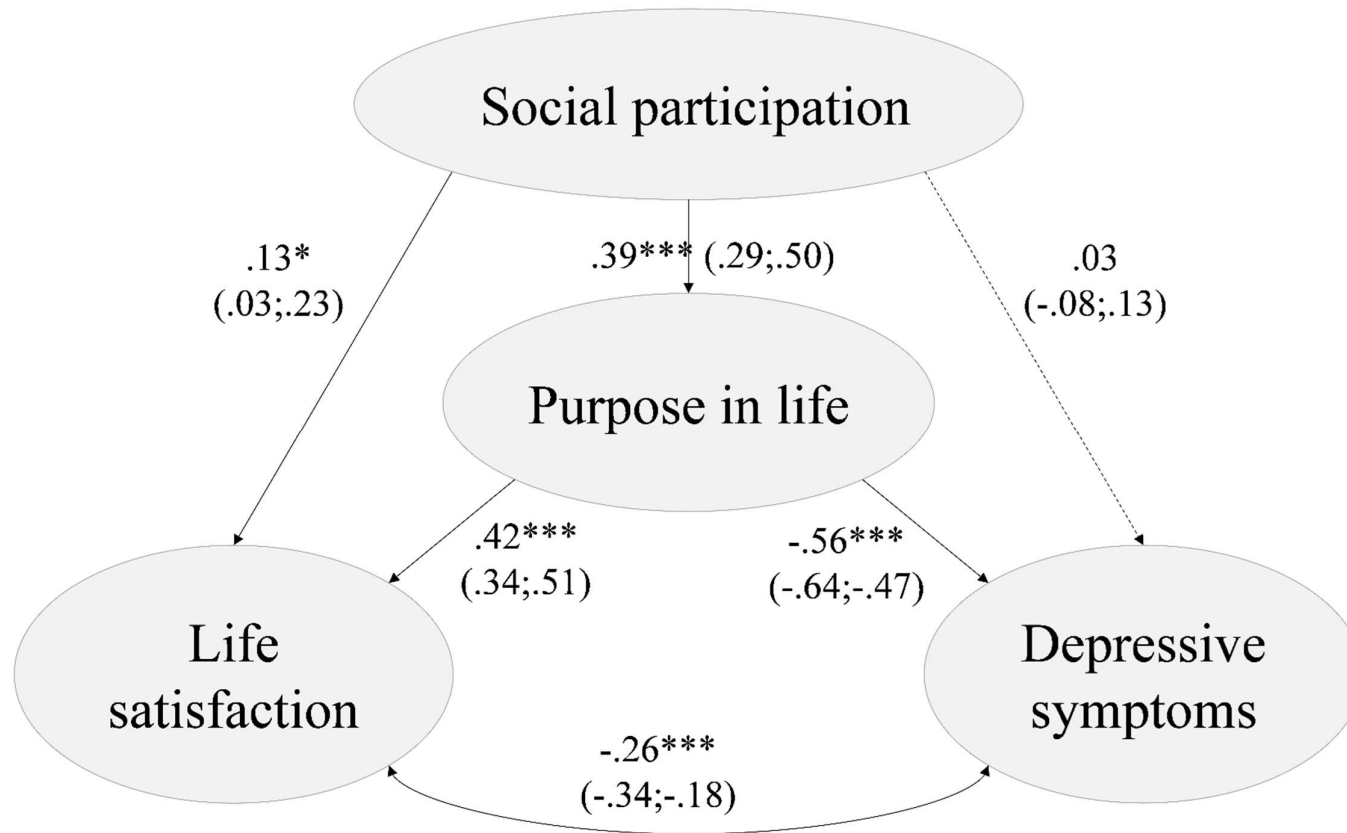


Figure 1. Standardized path coefficients and 95% confidence intervals of the adjusted cross-sectional SEM model (n=1014).

Note. Solid arrows describe statistically significant and dashed arrows are not statistically significant values. *: $p < .05$; ***: $p < .001$

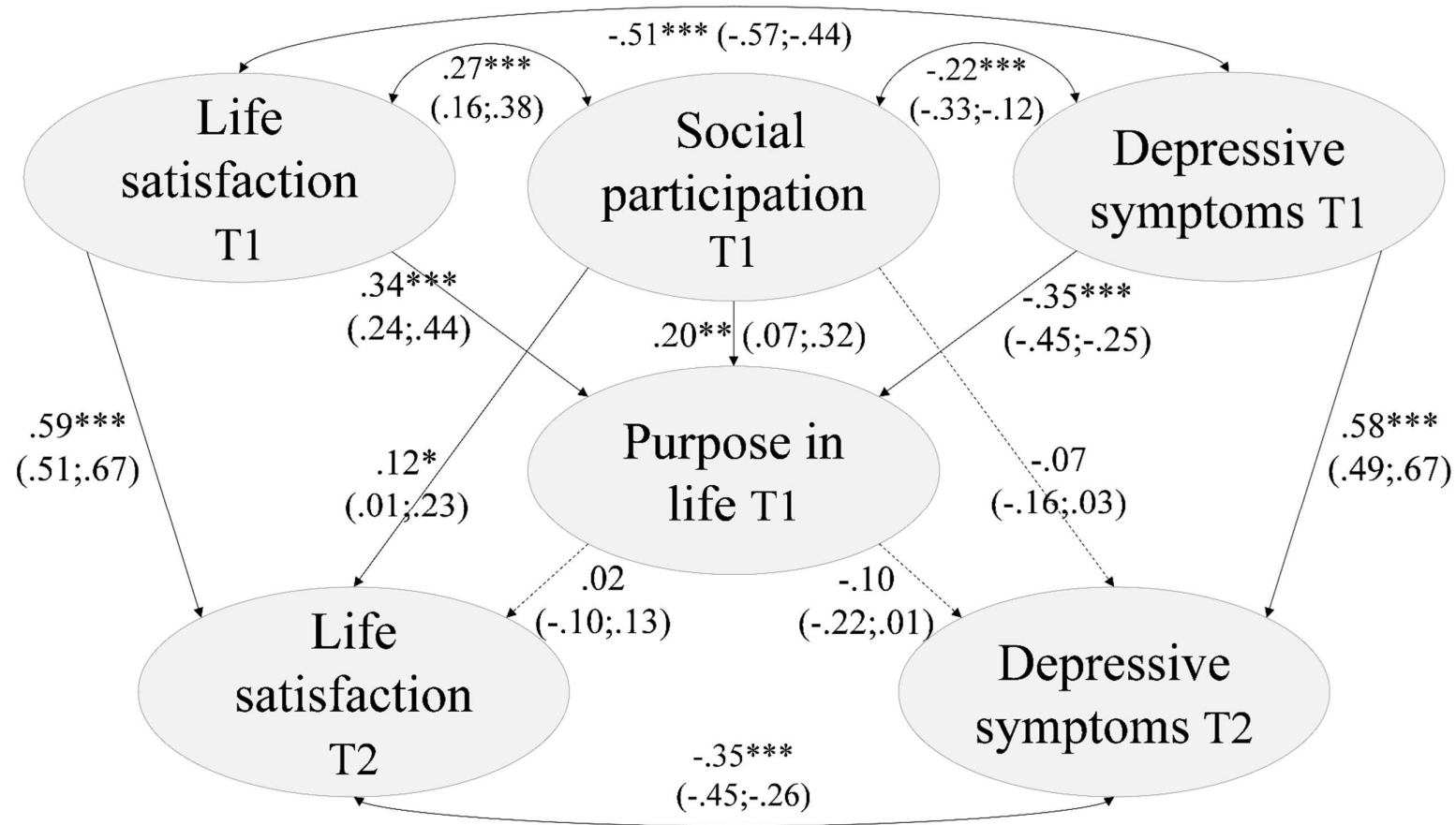


Figure 2. Standardized path coefficients and 95% confidence intervals of the adjusted longitudinal SEM model (n=660).

Note. Solid arrows describe statistically significant and dashed arrows are not statistically significant values. *: $p < .05$; **: $p < .01$; ***: $p < .001$

Supplementary table 1. Factor loadings and model fit statistics from exploratory factor analysis of *the questions concerning social participation* based on cross-sectional data (n=998) and longitudinal data at baseline (n=653).

	Cross-sectional	Longitudinal data
	Factor loadings	Factor loadings
Meeting children and relatives	0.14*	0.18*
Meeting close friends	0.69*	0.72*
Meeting acquaintances	0.48*	0.42*
Volunteering	0.39*	0.35*

Note. *Statistically significant at <.05 level.

Cross-sectional data:

Fit indexes for one-factor solution: Log-likelihood=-5192.730, number of free parameters=24; AIC=10433.460; BIC=10551.198.

Cronbach's alpha: .39; mean (sd.) of inter-item correlation: .14 (.09).

Longitudinal data, baseline:

Fit indexes for one-factor solution: Log-likelihood=-3387.974, number of free parameters=24; AIC=6823.948; BIC=6931.506.

Cronbach's alpha: .38; mean (sd.) of inter-item correlation: .14 (.09).

Supplementary table 2. Factor loadings and model fit statistics from exploratory factor analysis of *the Scales of Psychological Well-Being purpose in life subscale* based on cross-sectional data (n=968) and longitudinal data at baseline (n=644).

	Cross-sectional	Longitudinal data
	Factor loadings	Factor loadings
Item 5rec	0.20*	0.17*
Item 11	0.69*	0.72*
Item 17rec	0.49*	0.49*
Item 23rec	0.59*	0.58*
Item 29	0.60*	0.61*
Item 35	0.27*	0.26*
Item 41rec	-0.13*	-0.17*

Note. *Statistically significant at <.05 level.

Cross-sectional data:

Fit indexes for one-factor solution: Log-likelihood=-10515.964, number of free parameters=42; AIC=21115.929; BIC=21320.689.

Fit indexes for two-factor solution: Log-likelihood=-10469.664, number of free parameters=48; AIC=21035.328, BIC=21269.339.

Cronbach's alpha: .44; mean (sd.) of inter-item correlation: .11 (.14).

Longitudinal data, baseline:

Fit indexes for one-factor solution: Log-likelihood=-6872.768, number of free parameters=42; AIC=13829.535; BIC=14017.179.

Fit indexes for two-factor solution: Log-likelihood=-6849.669, number of free parameters=48; AIC=13795.339, BIC=14009.788.

Cronbach's alpha: .42; mean (sd.) of inter-item correlation: .10 (.14).

Supplementary table 3. Factor loadings and model fit statistics from exploratory factor analysis of *the Satisfaction with Life Scale* based on cross-sectional data (n=984) and longitudinal data at baseline (n=646) and at follow-up (n=647).

	Cross-sectional data	Longitudinal data	
	Factor loadings	Baseline	Follow-up
		Factor loadings	Factor loadings
Item 1	0.88*	0.88*	0.87*
Item 2	0.88*	0.86*	0.86*
Item 3	0.92*	0.90*	0.92*
Item 4	0.81*	0.82*	0.80*
Item 5	0.72*	0.69*	0.68*

Note. *Statistically significant at <.05 level.

Cross-sectional data:

Fit indexes for one-factor solution: Log-likelihood=-5861.331, number of free parameters=35; AIC=11792.667; BIC=11963.874.

Fit indexes for two-factor solution: Log-likelihood=-5832.195, number of free parameters=39; AIC=11742.390, BIC=11933.163.

Cronbach's alpha: .89; mean (sd.) of inter-item correlation: .64 (.09).

Longitudinal data, baseline:

Fit indexes for one-factor solution: Log-likelihood=-3774.447, number of free parameters=35; AIC=7618.894; BIC=7775.372.

Fit indexes for two-factor solution: Log-likelihood=-3748.874, number of free parameters=39; AIC=7575.748, BIC=7750.110.

Cronbach's alpha: .89; mean (sd.) of inter-item correlation: .63 (.09).

Longitudinal data, follow-up:

Fit indexes for one-factor solution: Log-likelihood=-3995.919, number of free parameters=35; AIC=8061.839; BIC=8218.371.

Fit indexes for two-factor solution: Log-likelihood=-3950.976, number of free parameters=39; AIC=7979.952, BIC=8154.373.

Cronbach's alpha: .88; mean (sd.) of inter-item correlation: .61 (.11).

Supplementary table 4. Factor loadings and model fit statistics from exploratory factor analysis of *the Centre for Epidemiologic Studies Depression Scale* based on cross-sectional data (n=991) and longitudinal data at baseline (n=651) and at follow-up (n=651).

	Cross-sectional data	Longitudinal data	
	Factor loadings	Baseline Factor loadings	Follow-up Factor loadings
Item 1	0.49*	0.52*	0.61*
Item 2	0.53*	0.59*	0.51*
Item 3	0.84*	0.86*	0.84*
Item 4 rec	0.47*	0.48*	0.40*
Item 5	0.67*	0.67*	0.67*
Item 6	0.86*	0.88*	0.86*
Item 7	0.72*	0.74*	0.68*
Item 8 rec	0.65*	0.69*	0.56*
Item 9	0.72*	0.74*	0.69*
Item 10	0.65*	0.63*	0.64*
Item 11	0.40*	0.44*	0.42*
Item 12	0.70*	0.76*	0.63*
rec			
Item 13	0.50*	0.53*	0.53*
Item 14	0.74*	0.75*	0.77*
Item 15	0.44*	0.46*	0.36*
Item 16	0.74*	0.76*	0.67*
rec			

Item 17	0.62*	0.70*	0.61*
Item 18	0.74*	0.80*	0.76*
Item 19	0.60*	0.63*	0.58*
Item 20	0.67*	0.69*	0.63*

Note. *Statistically significant at <.05 level.

Cross-sectional data:

Fit indexes for one-factor solution: Log-likelihood=-13542.418, number of free parameters=80; AIC=27244.836; BIC=27636.733.

Fit indexes for four-factor solution: Log-likelihood=-13157.751, number of free parameters=134; AIC=26583.501, BIC=27239.929.

Cronbach's alpha: .88; mean (sd.) of inter-item correlation: .28 (.11).

Longitudinal data, baseline:

Fit indexes for one-factor solution: Log-likelihood=-8399.689, number of free parameters=78; AIC=16955.378; BIC=17304.701.

Fit indexes for four-factor solution: Log-likelihood=-8104.538, number of free parameters=132; AIC=16473.076, BIC=17064.240.

Cronbach's alpha: .89; mean (sd.) of inter-item correlation: .29 (.12).

Longitudinal data, follow-up:

Fit indexes for one-factor solution: Log-likelihood=-9983.625, number of free parameters=80; AIC=20127.250; BIC=20485.531.

Fit indexes for four-factor solution: Log-likelihood=-9631.874, number of free parameters=134; AIC=19531.747, BIC=20131.868.

Cronbach's alpha: .87; mean (sd.) of inter-item correlation: .27 (.12).

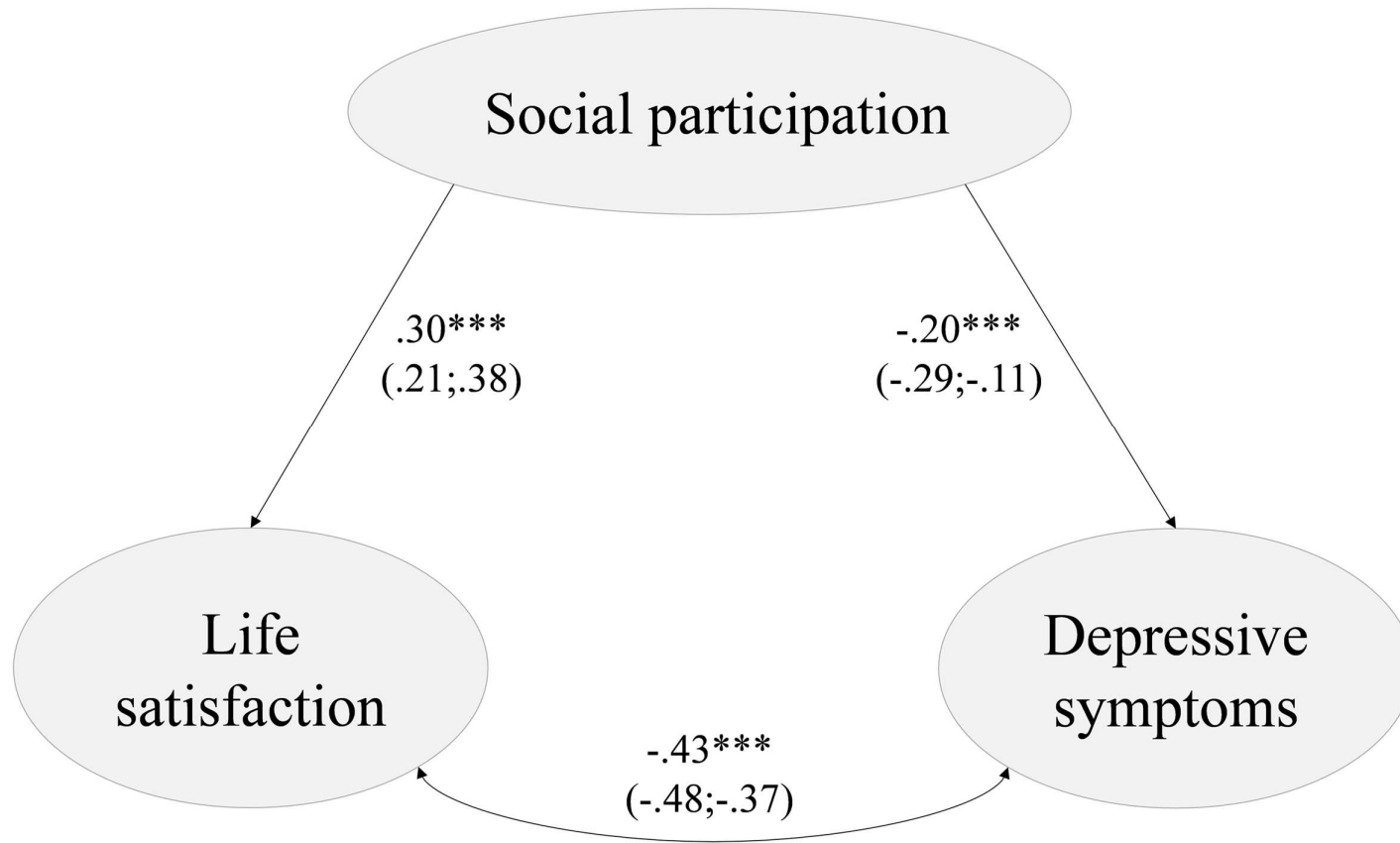
Supplementary table 5. Standardized factor loadings for confirmatory factor analysis, 95 % confidence intervals (CI), and coefficient of determination (R^2) for social participation, purpose in life, life satisfaction, and depressive symptom factors in cross-sectional (n=1014) and longitudinal SEM models (n=660).

	Cross-sectional data			Longitudinal data		
	Factor loadings	95% CI	R^2	Factor loadings	95% CI	R^2
Social participation (T1)						
Meeting close friends	.67***	.56;.78	.45***	.60***	.47;.73	.36***
Meeting acquaintances	.45***	.36;.54	.20***	.45***	.33;.58	.21***
Volunteering	.49***	.37;.61	.24***	.49***	.34;.65	.24***
Purpose in life (T1)						
Item 11	.66***	.60;.72	.43***	.64***	.56;.71	.41***
Item 17 rec	.59***	.52;.66	.35***	.60***	.52;.68	.36***
Item 23 rec	.55***	.48;.62	.30***	.56***	.48;.64	.31***
Item 29	.53***	.46;.59	.28***	.57***	.49;.65	.32***
Life satisfaction (T1)						
Item 1	.88***	.86;.90	.78***	.88***	.85;.91	.78***
Item 2	.88***	.86;.90	.78***	.87***	.84;.89	.75***
Item 3	.93***	.91;.94	.86***	.90***	.88;.93	.81***
Item 4	.79***	.77;.82	.63***	.83***	.80;.86	.68***
Item 5	.74***	.71;.77	.54***	.70***	.66;.75	.49***
Life satisfaction (T2)						
Item 1				.88***	.85;.90	.77***
Item 2				.84***	.81;.87	.71***
Item 3				.91***	.88;.93	.82***
Item 4				.82***	.79;.85	.67***

Item 5				.73***	.69;.77	.53***
Depressive symptoms (T1)						
Item 1	.51***	.45;.57	.26***	.50***	.43;.58	.25***
Item 2	.48***	.39;.57	.23***	.56***	.46;.66	.31***
Item 3	.85***	.81;.88	.72***	.84***	.79;.88	.70***
Item 4 rec	.47***	.40;.54	.22***	.44***	.36;.53	.20***
Item 5	.66***	.60;.71	.43***	.67***	.61;.73	.45***
Item 6	.85***	.82;.89	.73***	.86***	.82;.91	.74***
Item 7	.69***	.64;.74	.48***	.71***	.66;.77	.51***
Item 8 rec	.70***	.66;.75	.50***	.71***	.67;.76	.51***
Item 9	.72***	.67;.78	.52***	.76***	.69;.83	.58***
Item 10	.60***	.53;.67	.36***	.61***	.53;.70	.38***
Item 11	.40***	.34;.47	.16***	.50***	.42;.57	.25***
Item 12 rec	.78***	.74;.81	.61***	.81***	.77;.85	.65***
Item 13	.50***	.44;.57	.25***	.51***	.43;.59	.26***
Item 14	.71***	.66;.77	.51***	.77***	.72;.85	.60***
Item 15	.45***	.37;.54	.20***	.41***	.30;.51	.17***
Item 16 rec	.82***	.79;.86	.68***	.83***	.79;.87	.68***
Item 17	.56***	.48;.64	.31***	.63***	.53;.72	.39***
Item 18	.73***	.69;.78	.54***	.75***	.69;.81	.56***
Item 19	.60***	.53;.67	.36***	.63***	.54;.71	.39***
Item 20	.65***	.60;.70	.42***	.71***	.65;.76	.50***
Depressive symptoms (T2)						
Item 1				.53***	.46;.60	.28***
Item 2				.50***	.41;.60	.25***
Item 3				.80***	.76;.85	.65***
Item 4 rec				.38***	.30;.46	.14***
Item 5				.61***	.55;.67	.37***
Item 6				.85***	.81;.89	.72***
Item 7				.67***	.61;.74	.45***
Item 8 rec				.64***	.58;.70	.41***
Item 9				.74***	.67;.80	.54***
Item 10				.56***	.49;.64	.32***

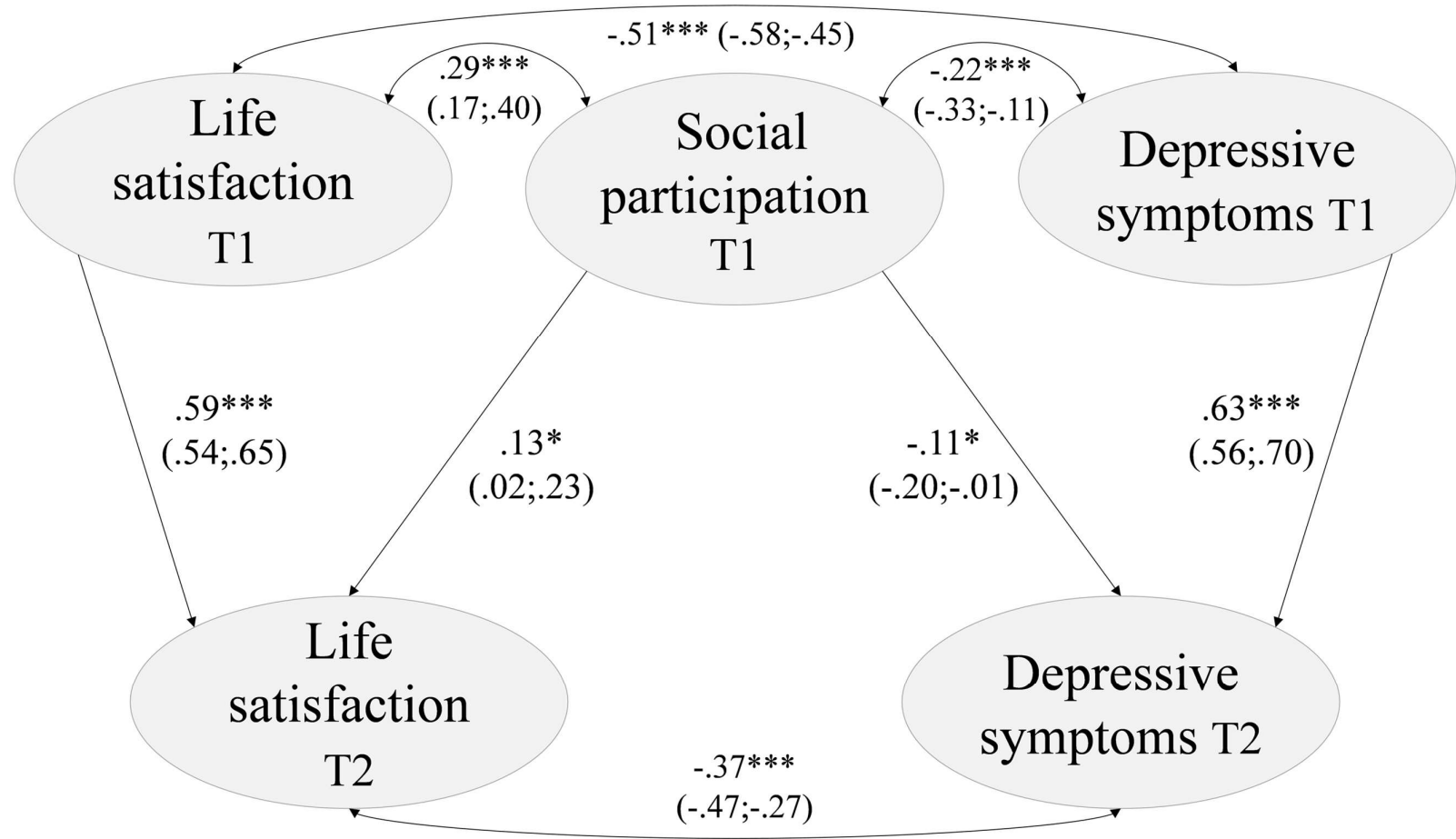
Item 11	.38***	.30;.46	.14***
Item 12 rec	.77***	.73;.81	.59***
Item 13	.45***	.37;.54	.21***
Item 14	.76***	.70;.81	.57***
Item 15	.35***	.25;.44	.12***
Item 16 rec	.78***	.73;.82	.61***
Item 17	.50***	.40;.60	.25***
Item 18	.71***	.65;.77	.50***
Item 19	.57***	.49;.66	.33***
Item 20	.63***	.57;.69	.40***

Note. rec: reverse-coded. ***:p<.001



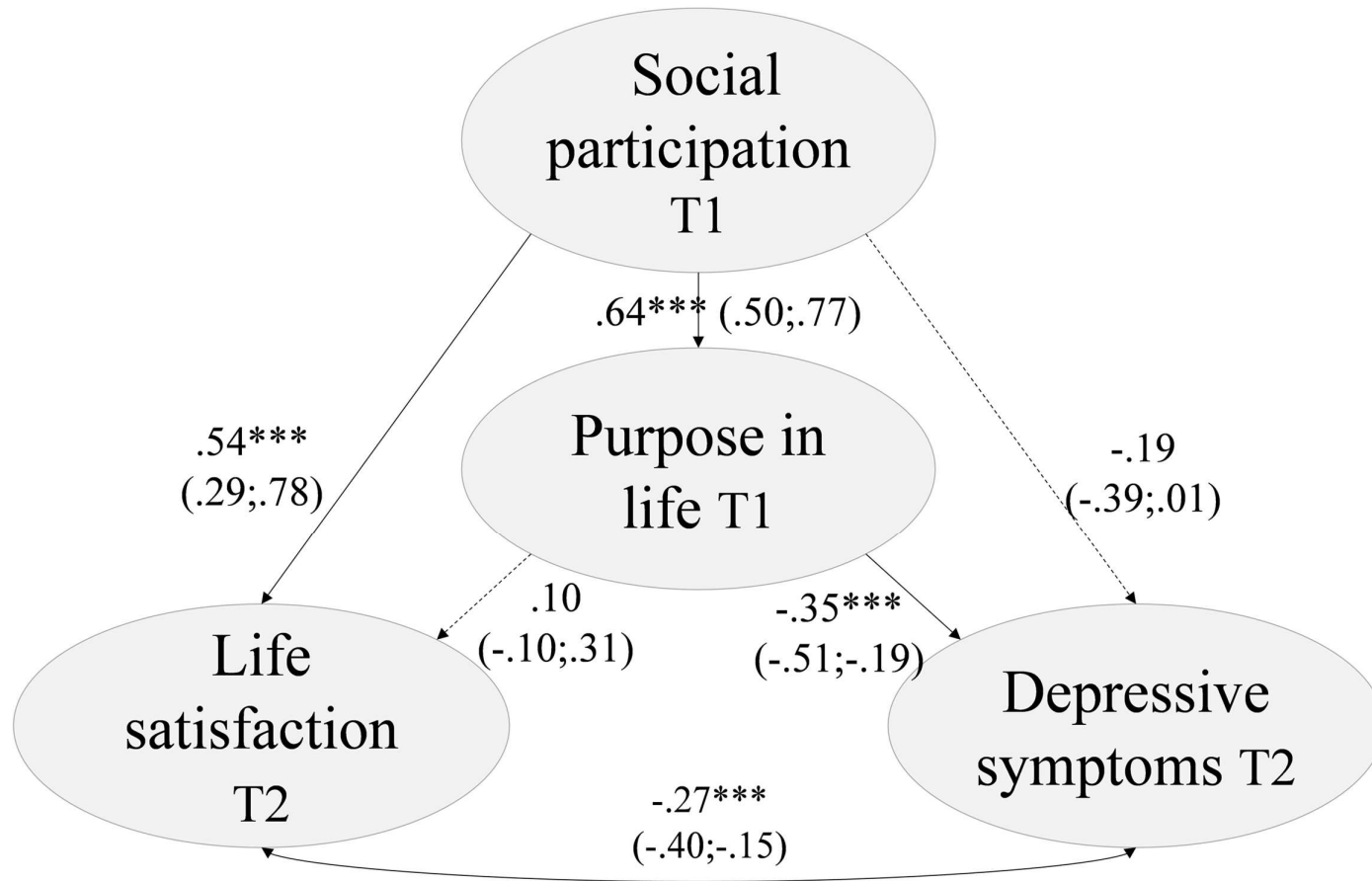
Supplementary figure 1. Standardized path coefficients and 95% confidence intervals of the adjusted cross-sectional SEM model including social participation, life satisfaction, and depressive symptoms (n=1014).

Note. Solid arrows describe statistically significant and dashed arrows are not statistically significant values. ***: p<.001



Supplementary figure 2. Standardized path coefficients and 95% confidence intervals of the adjusted longitudinal SEM model including social participation at baseline and life satisfaction and depressive symptoms at baseline and the four-year follow-up (n=660).

Note. Solid arrows describe statistically significant and dashed arrows are not statistically significant values. *: $p < .05$; ***: $p < .001$



Supplementary figure 3. Standardized path coefficients and 95% confidence intervals of the adjusted longitudinal SEM model including social participation and purpose in life at baseline and life satisfaction and depressive symptoms at 4-year follow-up (n=660).

Note. Solid arrows describe statistically significant and dashed arrows are not statistically significant values. ***: $p < .001$