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**Title:** Effect of a social intervention of choice vs. control on depressive symptoms, melancholy, feeling of loneliness, and perceived togetherness in older Finnish people : a randomized controlled trial

**Year:** 2018

**Version:** Accepted version (Final draft)

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**Please cite the original version:**

Pynnönen, K., Törmäkangas, T., Rantanen, T., Tiikkainen, P., & Kallinen, M. (2018). Effect of a social intervention of choice vs. control on depressive symptoms, melancholy, feeling of loneliness, and perceived togetherness in older Finnish people : a randomized controlled trial. *Aging and Mental Health*, 22(1), 77-84. <https://doi.org/10.1080/13607863.2016.1232367>

**Effect of a Social Intervention of Choice vs. Control on Depressive  
Symptoms, Melancholy, Feeling of Loneliness, and Perceived Togetherness  
in Older Finnish People: A Randomized Controlled Trial**

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Aging & Mental Health (2018) 22 (1), 77-84. doi: 10.1080/13607863.2016.1232367

## **Abstract**

**Objectives:** This study examined effects of a social intervention on depressive symptoms, melancholy, loneliness, and perceived togetherness in community-dwelling Finnish older people.

**Method:** Promotion of mental well-being in older people (GoodMood; ISRCTN78426775) was a single-blinded randomized control trial lasting 1.5 years. Two hundred and twenty-three persons aged 75–79 years reporting symptoms of loneliness or melancholy were randomized into intervention and control groups. The intervention group was allowed to choose among supervised exercise, social activity, or personal counseling. Follow-up measurements were conducted at the end of 6-month intervention, and at 3, 6, and 12 months post intervention.

**Results:** Number of depressive symptoms remained unchanged, while loneliness and melancholy decreased in both the intervention and control groups during the study ( $p < 0.001$ ).

Social integration increased in the intervention group but not in controls ( $p = 0.041$ ).

Attachment and guidance increased in both groups ( $p < 0.001$ ).

**Conclusion:** The intervention did not alleviate depressed mood. Positive changes over time were observed in loneliness, feelings of melancholy, attachment, and guidance but these occurred independently of the intervention. Our secondary analysis suggests that the intervention increased perceived social integration. In sum, the effects of the intervention were moderate only and did not expedite further overcoming depressive mood or loneliness.

**Keywords (3-5):** Depressive symptoms, loneliness, social integration, RCT, older people

## **Introduction**

Declining health and changes in a person's social network with aging may threaten the maintenance of mental well-being in older people. However, older people who have access to social relations in which they experience mutual proximity and security and through which they can get help when they need it, suffer less often from feelings of loneliness and depressive symptoms (Tiikkainen & Heikkinen, 2005). Other observational studies have shown that the incidence of depressive symptoms is lower among people involved in social activity (Glass, Mendes de Leon, Bassuk, & Berkman, 2006; Wahrendorf, Ribet, Zins, & Siegrist, 2008). However, intervention studies suggest that alleviating loneliness and depressive symptoms in older people may not be as straightforward as the observational studies suggest. In a systematic review, Dickens and colleagues (2011) concluded that only 3 out of 12 group interventions were effective in reducing loneliness and 3 out of 8 effective in alleviating depression.

Loneliness may be defined as an unpleasant, anxiety-inducing subjective experience resulting from inadequate social relationships (Peplau & Perlman, 1982). The association between loneliness and social contacts has been addressed in several studies. An important predictor of loneliness is living alone (Routasalo, Savikko, Tilvis, Strandberg, & Pitkälä, 2006). Receiving fewer visits from friends and having a less extensive social network were also related to loneliness (Adams, Sanders, & Auth, 2004). However, the frequency of contacts may not be paramount. Routasalo and colleagues (2006) found that the feeling of loneliness was associated not with the frequency of contacts with children and friends, but with satisfaction with these contacts. Thus, especially qualitative aspects of social contacts count for feelings of loneliness.

Depression is a broader phenomenon than loneliness, as it may result from changes in social relationships or in non-social situations (Peplau & Perlman, 1982). Earlier studies have shown, for example, that chronic diseases, disability, poor self-rated health, poor vision, perceived negative changes in life, lack of a friendly companion, less participation in organized social activities, and irritation with one's family are predictors of depressive symptoms (see Adams et al., 2004; Heikkinen & Kauppinen, 2004; Kaneko, Motohashi, Sasaki, & Yamaji, 2007; McGuire, Strine, Allen, Anderson, & Mokdad, 2009). Grieving over a recent loss of a close person was associated with both depressive symptoms and loneliness (Adams et al., 2004). Depressive symptoms and loneliness are strongly associated, and often co-occur both with each other and other setbacks in life. It is possible that loneliness and depressive symptoms can act in a synergistic way to impair well-being in older people (Cacioppo, Hughes, Waite, Hawkley, & Thisted, 2006).

The qualitative aspect of social interaction can be described by the concept of perceived togetherness, which is grounded in Weiss's (1974) idea that people need various kinds of social relationships to fulfill their various social needs. Perceived togetherness describes the way people experience their social interaction and the social support they receive (Tiikkainen, Heikkinen, & Leskinen, 2004). According to Weiss (1973), feelings of loneliness may result from a deficit in one or more relational functions: attachment, social integration, sense of reliable alliance, guidance, nurturance, and reassurance of worth. Emotional loneliness arises from the lack of an intimate relationship or a confidant, whereas social loneliness refers to negative feelings resulting from the absence of meaningful relationships and social integration. Tiikkainen and Heikkinen (2005) found that, among 80-year-old persons, loneliness correlated with the lack of reliable alliance, social integration, and attachment, while depressive symptoms were explained by low scores in guidance, reassurance of worth, reliable alliance, and attachment. Thus, experiencing insufficiently met social needs may

negatively affect mental well-being. Although all six relational functions are important to older people, their relative importance may vary depending on age and life situation.

Previous systematic reviews concluded that interventions that were effective in decreasing loneliness were typically conducted in a group setting, involved some form of educational or training input and social activity, and in which older people were active participants (Cattan, White, Bond, & Learmouth, 2005; Dickens et al., 2011). For older women living alone, discussion on health-related topics reduced their feelings of loneliness (Anderson, 1985). A group intervention focusing on self-management abilities attenuated social loneliness in older women (Kremers, Steverink, Albersnagel, & Slaets, 2006). A group intervention including therapeutic writing and group psychotherapy or physical exercise and discussion or art activities, increased psychological well-being in older participants suffering from loneliness (Routasalo, Tilvis, Kautiainen, & Pitkala, 2009). In addition, reminiscence and life review have been reported to be potentially effective methods for the enhancement of psychological well-being (Bohlmeijer, Roemer, Cuijpers, & Smit, 2007), and for treating depressive symptoms in older adults (Bohlmeijer, Smit, & Cuijpers, 2003). A group-based exercise training program was more effective than individual home exercise in improving mood in older women (Timonen, Rantanen, Timonen, & Sulkava, 2002).

Among the Finnish community-dwelling older population, approximately 5 % report feeling lonely often or almost always (Savikko, Routasalo, Tilvis, Strandberg, & Pitkala, 2005; Tiikkainen & Heikkinen, 2005) and 39 % suffer from loneliness at least occasionally (Routasalo et al., 2006). Heikkinen and Kauppinen (2004) found that over one-third of 75-year-old women and one-quarter of same age men were depressed, and that the proportion of depressed persons increased, particularly among women, from age 80 to 85 years. Minor depression among older people is typically a dynamic and episodic phenomenon (Heikkinen & Kauppinen, 2004). Similarly, loneliness often is a result of situational factors and may be

transitory (Luanaigh & Lawlor, 2008). However, when depressive symptoms and loneliness become prolonged, a person may need support to recover. Regardless of the positive results of intervention studies on enhancing the mental well-being of elderly people, more intervention studies are called for to investigate cost-effective ways to mitigate loneliness and depressive mood in older people.

The objective of this study was to examine the effects of a social intervention on depressive symptoms, melancholy, loneliness, and perceived togetherness in community-dwelling Finnish people aged 75–79 years who reported depressed mood or loneliness at study entry. In addition, the aim was to study whether the parallel effects would be found across the three intervention subgroups, and between the depressed and not-depressed groups. The basic idea behind the intervention was that by giving the participants a possibility to interact and by promoting social integration their loneliness would decrease.

## **Methods**

### *Design*

The GoodMood, project, with the purpose of promoting mental well-being in older people, was a single-blinded Randomized Control Trial (RCT) lasting 1.5 years. The specific aims of the project were to develop screening tools to identify persons with early signs of declining mental well-being, to develop counseling and group interventions promoting perceived togetherness and mental well-being, and to evaluate the impact of early intervention on depressive mood, loneliness, and participation in older people who were at increased risk for impaired mental well-being. GoodMood was carried out in co-operation with the GeroCenter Foundation for Research and Development, University of Jyväskylä, JAMK University of Applied Sciences, and the City of Jyväskylä, Finland. The Ethical Committee of the Central

Finland Health Care District approved the study. All participants gave their written informed consent prior to the study.

The selection of the participants and study design are shown in Figure 1. The target population comprised of all the 75- to 79-year-old residents of Jyväskylä, Central Finland, who were living in the city center area in August 2008 (N = 1167). This age group is suitable for an intervention of this kind: although a large proportion of them will have some health issues, in most cases these are unlikely to be severe enough to restrict participation. Based on earlier studies, it was presumed that some 30%–40 % of population in this age group would report symptoms of loneliness or melancholy (see e.g. Heikkinen & Kauppinen, 2004; Tiikkainen & Heikkinen, 2005), and that two-thirds would be willing to participate in a study of this kind (Leinonen et al., 2007). Therefore, we assumed adequate coverage of the target population. Contact information was gathered from the Finnish population register. Of the original target population of 1167 people, information on perceived loneliness and melancholy was obtained for 985 persons via phone screening. Of these, 24 % reported feeling lonely and 37 % melancholy at least sometimes. Altogether 50 % reported feelings of melancholy or loneliness at least sometimes. All the inclusion criteria: (1) feeling loneliness, melancholy, or depressive mood at least sometimes, (2) a Mini-Mental State Examination (MMSE) score greater than 21 in order to be able to participate in discussions, and (3) willing to participate in the study, were met by 296 persons, of whom 39 withdrew from the study before randomization. After a more detailed structured face-to-face home interview between September and November 2008, the participants met a counselor once. The meeting included discussion of the participant's life situation and available social support. After completion of the screening and data collection process, 257 persons were allocated to the intervention or control groups, using a randomized ratio 1:1, by drawing lots. The trial administrator performed the randomization. Interviewers and data collecting assistants were blinded to the

group assignment of the participants throughout the study. After the end of the six-month intervention, a larger follow-up face-to-face interview was carried out between April and June 2009, in the participants' homes. Shorter follow-up interviews were carried out by phone at 3, 6 and 12 months after the intervention ended. One participant died and 33 withdrew from the study during the intervention. Only the data on the persons who participated in both home interviews (intervention group n=105, control group n=118) were analyzed in this study.

[Figure 1 near here]

Drop-outs did not differ from those who remained in the study in sex, self-rated health, or melancholy. A slightly larger proportion of participants lived alone (66 vs. 56 %), felt lonely at least sometimes (68 vs. 52 %), and did not have a supporting person in their network (22 vs. 13 %) than drop-outs. At each stage, reasons most often given for withdrawal were lack of interest (24 %), no expected benefit from participation (27 %), lack of time (28 %), and poor health (27 %). In addition, drop-outs in the intervention group during the intervention did not differ significantly from drop-outs in the control group in depressive symptoms (mean Geriatric Depression Scale (GDS) 5.17 in the intervention group vs. 4.22 in the controls).

### ***Measurements***

The primary outcome of this study was information on *depressive symptoms* measured using a short form of the GDS. The GDS is specially designed to screen for depressed mood in older adults. A larger score indicates greater severity of symptoms and the scale maximum is 15. The cut-off score for depression has most commonly been defined as  $\geq 5$  (see Greenberg, 2007). We used the summary score of the scale in the analyses.

The secondary outcomes were melancholy, feelings of loneliness, and dimensions of perceived togetherness. *Melancholy* was assessed with the question: 'How do you perceive your mood in general?' The response options were almost always good, sometimes

melancholy, and often or almost always melancholy. The response options for the question ‘Do you *feel lonely?*’ were very rarely or never, sometimes, and often or almost always. *Perceived togetherness* was measured using the Social Provisions Scale developed on the basis of Weiss’s theory (Cutrona & Russell, 1987). Its 24 items are equally divided between the six different dimensions or provisions: attachment, social integration, reliable alliance, guidance, opportunity for nurturance, and reassurance of worth. *Attachment* refers to social relationships which satisfy the need for proximity, affection and love, and which can promote feelings of security and well-being. *Social integration* refers to a sense of belonging to a group or community where people can share common concerns and exchange experiences. *Reliable alliance* refers to having a relationship one can turn to in an emergency. *Guidance* refers to having access to advice and assistance. *Opportunity for nurturance* means having the relationships in which a person feels responsible for the well-being of another. *Reassurance of worth* is possible in social relationships where the individual’s skills and competencies are respected. Two of the four questions in each dimension are positively and two negatively worded. On a scale from strongly disagree (scored 1) to strongly agree (scored 4), the respondents were asked to assess to what extent they thought that each statement described their current social relationships. The responses to the negatively worded items were reversed. A composite measure was calculated for each dimension with scores ranging between 4 and 16, where larger values indicated a more positive aspect. Depressive symptoms and perceived togetherness were assessed at baseline and at the end of the six-month intervention, and melancholy and feelings of loneliness were further assessed at the 3-, 6-, and 12- month post-intervention follow-up measurements.

Information on age (in years), sex, full-time education (level of schooling), perceived economic situation (good, moderate, or poor), living alone (yes/no), morbidity, cognitive functioning, and mobility were gathered during the face-to-face interviews. Morbidity was

assessed by asking the participant to state what physician-diagnosed chronic diseases of more than three months' duration he or she currently had. Cognitive functioning was assessed with the MMSE (Folstein, Folstein, & McHugh, 1975). Mobility was assessed by asking about perceived difficulties in walking 2 km, 500 m, ambulating indoors, and climbing stairs. The response options for these were 'not able' (scored 0), 'not able without somebody to help' (scored 1), 'yes, but has difficulties' (scored 2), or 'yes, without difficulties' (scored 3). Summary measures were computed for mobility.

### ***Intervention***

The participants randomized to the intervention group were allowed to select from three alternatives the intervention regime they thought would benefit them the most (Table 1). The exercise program was the most favored (n=45) followed by personal counseling (n=33) and the social activity program (n=27). The three regimes were similar in that each included social interaction, participants were able to influence the content of the meetings, and well-being was promoted. Participants in the exercise and the social activity programs met weekly altogether 19–21 times. The exercise program involved varying types of exercise and was conducted by qualified instructors in municipal gyms. The social activity program was delivered by health care students from JAMK University of Applied Sciences and participants met in the city library. Activities included group discussions, self-expression using art and creative methods, and going on day-trips. Personal counseling was conducted by a rehabilitation counselor and meetings took place in a health care center. Meetings were held approximately every third week and each participant attended 4–5 meetings. The issues discussed in the meetings varied depending on what topics the participant considered important. Counseling was given when needed. The control group received one counseling session which took place prior to randomization. Controls had access to the usual services offered by the municipality and other service providers.

[Table 1 near here]

### ***Statistical analysis***

Generalized estimating equations (GEE) models were used to estimate parameters for group- and time-main effects and group-by-time interaction for depressive symptoms, melancholy, loneliness, and the dimensions of perceived togetherness. We report the type III effect *p*-values that are invariant to the choice of reference category. In the analyses, to optimize statistical power relative to the control group, we did not separate the three intervention subgroups but treated them as a single group. We then conducted ancillary GEE analysis for the intervention subgroups and for those above and below the GDS cut-off score ( $\geq 5$ ). These analyses were performed with IBM SPSS Statistics, version 22.0. The proportion of missing data in individual variables varied between 0% and 3.6%. The Multiple Imputation procedure of SAS for Windows (version 9.1) was used to impute missing values using the available information from the model variables and on background characteristics, physical activity and functional ability.

### **Results**

Average participant age was 77.0 years at baseline, 75 % were women, and 65 % lived alone (Table 2). Mean MMSE score was 27.2 and mean number of chronic diseases was 2.9. Participants typically had only early signs of mobility decline as 35 % reported difficulties only in walking longer distances (2 km) and 60 % reported no difficulties in any mobility tasks. In depressive symptoms, melancholy, loneliness, and dimensions of perceived togetherness, the intervention and the control groups were comparable.

[Table 2 near here]

Primary outcome: the six-month intervention did not affect depressive symptoms. The number of symptoms remained at the same level over the six-month intervention (Table 3).

[Table 3 near here]

Secondary outcomes: Table 3 shows that feelings of loneliness and melancholy decreased in both the intervention and control groups. The improvement in melancholy (Figure 2) and loneliness (Figure 3) remained up to the 12-month post-intervention follow-up. Of the dimensions of perceived togetherness, guidance and attachment increased in both groups during the six-month intervention. Time and group-by-time interaction effects were statistically significant for social integration indicating positive change only in the intervention group.

[Figure 2 near here] [Figure 3 near here]

Ancillary analyses conducted for the intervention regimes did not add to the existing results. In each regime, social integration, attachment, and guidance increased, and feelings of loneliness and melancholy decreased during the six-month intervention. One difference between regimes was observed in reassurance of worth. Participants who chose personal counseling reported less often than those in the exercise group that they felt their individual's skills and competencies were respected.

Ancillary analyses among those who were categorized as depressed (GDS score  $\geq 5$ ; n=36 in the intervention and 34 in the control group) or non-depressed (GDS score 1–4; n=69 in the intervention and 84 in the control group) revealed no additional information on the effectiveness of the intervention. Overall, while the time effects indicated that depressive symptoms decreased among those who were depressed and loneliness decreased among those who were non-depressed, the changes were similar in the intervention and the control groups.

As a consequence of the intervention, social integration increased only among those who were non-depressed at baseline.

## **Discussion**

The results of our study showed that the intervention did not alleviate depressed mood.

Feelings of loneliness and melancholy decreased and perceived attachment and guidance increased over time similarly in both the intervention and control groups. The intervention was efficacious in increasing social integration. However, changes in social integration and feelings of loneliness were observed only among those who felt lonely but were not depressed.

Our results add to the diversity of previous findings on the effectiveness of interventions in reducing depressiveness or loneliness in older people. Some randomized controlled trials have reported a decrease in depressive symptoms (Bohlmeijer et al., 2003; Constantino, 1988; Pinguart, Duberstein, & Lyness, 2007; Timonen et al., 2002) or loneliness (Anderson, 1985; Ollonqvist et al., 2008). Other targeted interventions, however, have not been successful in alleviating depressive mood (Arnetz, Theorell, & Arnetz, 1983; White et al., 2002) or loneliness (Routasalo et al., 2009; White et al., 2002). We designed our intervention based on studies that had obtained positive results, but we were not able to detect additional benefits with respect to loneliness, melancholy, and depressive symptoms beyond those achieved naturally over time. Some other studies have similarly reported that, e.g., loneliness was also attenuated in the control group during the study (Kremers et al., 2006; see e.g. Martina & Stevens, 2006).

Improvements in depressive symptoms among those who were depressed at baseline, and in feelings of melancholy and loneliness in the whole study group over time may partly result from the attention participants received during the study. In addition to a home interview,

each participant had a meeting with a counselor at baseline. This may also have brought about an increase in perceived guidance and attachment in both groups. Another explanation may be the Hawthorne effect, according to which people behave differently just because they know that they are being studied (see Becker, Roberts, & Voelmeck, 2003). It is also possible that simply reporting about their feelings of loneliness and melancholy, social relationships, and activities outside the home led the control group members to independently make efforts to change their situation, which was subsequently reflected in reduced loneliness and melancholy.

In our study, the intervention did not expedite the process of overcoming the depressive mood or loneliness. However, a more individualized therapeutic perspective might have resulted in an improvement in depressiveness (see Pinquart et al., 2007). Loneliness may be difficult to alleviate as it has many different causes and perceived deficiencies in social relationships affect loneliness in many different ways. Theories of loneliness emphasize factors relating to personality or traits, or various states in a person's life. Loneliness may be associated with the loss of a confidant and the resultant grief, lack of meaningful social relationships, dissatisfaction with existing relationships, existential questions, deficits in early attachment relationships, or shyness and fears in social situations. These matters should be taken into account and interventions targeted accordingly.

In this study, social integration increased in the intervention but not in the control group. Social integration refers to experiencing oneself as part of group or having people around one who like the same social activities, think the same way about things, have the same interests and concerns, and like to do things in the same way as oneself. Lack of social integration is associated with social loneliness and might best be resolved by acquiring new contacts. In a pilot study focusing on older people who were clients of home health care, receiving volunteer visitors during a period of six weeks improved older persons' perceived social

integration (MacIntyre et al., 1999). Meeting peers in a group setting or a counselor in a one-to-one setting may offer the older person positive stimulation along with emotional support and attention (see the multidimensional model of affiliation in Hill, 1987; Hill, 2009) which, in turn, may enhance the experience of acceptance and belonging (see Leary & Kelly, 2009). All three intervention regimes in our study included social interaction and were participatory, which may explain the findings.

Participants were allowed to choose from three possible regimes selected on the basis of the results of previous studies. This was done because the opportunity to choose enhances the experience of control over one's life and the motivation to complete the intervention (see Mannell & Kleiber, 1997, 144). In our study, the proportion of drop-outs from the intervention group was 16 %, whereas in studies offering the same intervention regime to all participants the drop-out rate has ranged from 20% to 27 % (Kremers et al., 2006; Ollonqvist et al., 2008; White et al., 2002).

Depressive symptoms were measured with the GDS, which has been found to be a good screening tool for depressive symptoms among older adults (e.g. de Craen, Heeren, & Gussekloo, 2003) and has been observed to detect changes in depressive symptoms. In a study among 85-year-old persons who experienced a major negative life event, the shorter form of the GDS was able to detect a change in their depressive symptoms (Vinkers, Gussekloo, Stek, Westendorp, & Van Der Mast, 2004). The meta-analysis by Pinquart and colleagues (2007) concluded that the GDS detected improvements in depressive symptoms. Consequently, we believe that GDS is valid and reliable and that the present result is not an outcome of deficiencies in the assessment scale.

This study has both strengths and weaknesses. One weakness may be that we assessed loneliness with a single question which does not enable a distinction to be drawn between

emotional and social loneliness, or between the state and trait aspects of the experience (Luanaigh & Lawlor, 2008). However, the question is understandable and generally acceptable, and measures loneliness directly (Bowling, 2005). In addition to loneliness, we measured perceived togetherness, which is a positive perspective on social relationships that correlates negatively with feelings of loneliness.

The strengths of the study were its sampling and screening methods and design. First, the target population included all the residents in a particular age group living in a certain geographical area. Those recruited, based on their feeling of loneliness or melancholy, were otherwise comparable with those who did not meet the study inclusion criteria. Compared to studies based on non-probability or convenience samples, our study gives a more realistic picture of the prevalence of loneliness and melancholy among older people and of the possibilities to alleviate these problems. Second, those who dropped out during the study did not differ in their feelings of melancholy from those who continued their participation in the study. Third, having a control group in the study allowed to conclude that the observed positive changes happened over time independent of the intervention. Had we not had a control group, we would likely have concluded that the intervention alleviated the problems, which would have been a misleading interpretation of the results. Fourth, the participants were allowed to choose the intervention regime they preferred, which probably reduced the drop-out rate. Drop-out during the study was comparable to that reported in other similar studies and it was factored into the study design.

In light of the aspects discussed earlier, we may conclude that the results of our study are generalizable to the older home-dwelling population in other parts of Finland and in other similar cultures. The design and implementation of the study could also be applied in other older population. However, the effect of social intervention of the present kind on loneliness and depressive mood among older populations requires further research.

Conclusion: In sum, the effects of the social intervention of choice were moderate and did not expedite the process of overcoming depressive mood or loneliness. These phenomena were somewhat alleviated, but these improvements occurred independently of the intervention. Notwithstanding, our secondary analysis suggests that some positive changes occurred in perceived social integration as a direct consequence of the intervention, and the improvement was parallel in each of the three intervention regime. Loneliness, melancholy, and the dimensions of perceived togetherness are intertwined, and thus more research is needed to achieve deeper understanding of the links between these psychosocial phenomena.

Acknowledgments: We thank Raija Leinonen, PhD for overseeing the design and implementation of the GoodMood project. The Gerontology Research Center is a joint effort between the University of Jyväskylä and University of Tampere.

Disclosure statement: No potential conflict of interest was reported by the authors.

Funding: The GoodMood project was funded by the Finnish Ministry of Social Affairs and Health [grant number 059/TEK/TE/2008], [grant number 029/TEK/TE/2009]; Finland's Slot Machine Association. Katja Pynnönen was funded by the Juho Vainio Foundation, Finland; the Finnish Cultural Foundation, Finland; Timo Törmäkangas was funded by the Academy of Finland [grant number 286536].

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**Table 1.** Number of participants and content of subgroup programs of the six-month intervention in the GoodMood project.

<b>Intervention regime</b>	<b>n</b>	<b>Number of meetings</b>	<b>Frequency/length of meetings</b>	<b>Content of regime</b>
Exercise program (three groups)	45	19–21	Once a week/one hour	Varied types of exercise, e.g. circuit training, training with step board or rubber band, planned with the participants. Aims were to exercise together, gain familiarity with various types of exercise, and enhance balance, muscle strength, and movement of joints.
Social activity program (two groups)	27	20–21	Once a week/two hours	Discussion in groups, using art and creative methods, exposure to esthetic experiences, day-trips. The focus was on sharing experiences and thoughts, and acquiring information on health-related topics.
Personal counseling	33	In most cases, 4–5 times per person (range 3–7)	Every third week/one hour	Discussion on topics important to a participant, and counseling using a solution-focused method. Focus on listening, appreciation of the person’s experiences and goals, person’s responsibility for his or her own well-being, and positive attitude and coping skills of the participant.

**Table 2.** Means, standard deviations (sd), and proportions of the baseline characteristics in the whole sample, in the intervention and control groups, and in the intervention regimes.

	<b>All</b> n=223	<b>Intervention</b> <b>group</b> n=105	<b>Control group</b> n=118	<b>Exercise</b> <b>program</b> n=45	<b>Social activity</b> <b>program</b> n=27	<b>Personal</b> <b>counseling</b> n=33
	Mean (sd)	Mean (sd)	Mean (sd)	Mean (sd)	Mean (sd)	Mean (sd)
<b>Age</b>	77.00 (1.43)	77.02 (1.45)	76.91 (1.43)	77.00 (1.43)	76.93 (1.36)	77.12 (1.58)
<b>Education<sup>a</sup></b>	10.36 (4.05)	2.61 (1.61)	2.91 (1.80)	2.73 (1.73)	3.11 (1.74)	2.03 (1.21)^
<b>Economic situation<sup>b</sup></b>	2.30 (0.56)	2.28 (0.63)	2.32 (0.49)	2.24 (0.65)	2.22 (0.58)	2.36 (0.65)
<b>MMSE-score</b>	27.22 (2.07)	27.08 (2.14)	27.35 (2.00)	26.73 (2.30)	27.96 (0.74)	26.82 (2.07)^
<b>Number of chronic diseases</b>	2.85 (1.61)	2.91 (1.64)	2.79 (1.58)	2.64 (1.75)	3.04 (1.43)	3.18 (1.65)
<b>Mobility<sup>c</sup></b>	10.89 (1.84)	10.78 (1.95)	10.99 (1.74)	11.20 (1.80)	10.81 (1.67)	10.18 (2.23)^
<b>Depressive symptoms</b>	3.68 (2.52)	3.91 (2.71)	3.47 (2.33)	3.38 (2.52)	3.78 (2.74)	4.76 (2.82)^
<b>Attachment</b>	12.28 (2.43)	12.06 (2.73)	12.48 (2.10)	12.38 (2.54)	11.85 (2.96)	11.79 (2.84)
<b>Social integration</b>	12.54 (2.16)	12.30 (2.17)	12.75 (2.15)	12.24 (2.27)	12.85 (2.07)	11.94 (2.09)
<b>Alliance</b>	13.07 (2.22)	12.90 (2.36)	13.23 (2.09)	13.11 (1.89)	12.78 (2.85)	12.8 (2.54)

<b>Guidance</b>	12.84 (2.48)	12.56 (2.64)	13.08 (2.31)	12.96 (2.22)	12.52 (3.18)	12.06 (2.86)
<b>Nurturance</b>	11.85 (2.54)	11.60 (2.74)	12.07 (2.34)	12.31 (2.44)	11.48 (2.77)	10.73 (2.92)
<b>Reassurance of worth</b>	11.74 (2.03)	11.61 (2.01)	11.86 (2.04)	12.16 (1.81)	11.81 (1.24)	10.70 (2.46)*
	%	%	%	%	%	%
<b>Women</b>	75.3	72.4	78.0	73.3	74.1	69.7
<b>Lives alone</b>	65.0	64.8	65.3	55.6	70.4	72.7
<b>Melancholy</b>						
-no/very rarely	17.9	17.1	18.6	22.2	14.8	12.1
-sometimes	71.3	69.5	72.9	64.4	74.1	72.7
-often or almost always	10.8	13.3	8.5	13.3	11.1	15.2
<b>Loneliness</b>						
-no/very rarely	31.8	33.3	30.5	37.8	37.0	24.2
-sometimes	54.3	52.4	55.9	51.1	48.1	57.6
-often or continuously	13.9	14.3	13.6	11.1	14.8	18.2

## Hobby activity outside

### home

-not at all	12.1	12.4	11.9	13.3	7.4	15.2
-few times a year	19.7	20.0	19.5	24.4	14.8	18.2
-1-3 times per month	33.2	33.3	33.1	35.6	29.6	33.3
-at least weekly	35.0	34.3	35.6	26.7	48.1	33.3

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Note. <sup>a</sup>=Education: 1=Elementary school, 2=Elementary school + vocational school, 3=Middle school, 4=Middle school + vocational school, 5=Upper secondary school + vocational school, 6=College graduate; <sup>b</sup>=Perceived economic situation: 1=Poor, 2=Moderate, 3=Good; <sup>c</sup>=Sum of the variables of perceived ability to walk outdoors 2km, 0,5km, walk indoors, and climb stairs. 0=Is not able, 1=Needs help, 2=Is able but has difficulties, 3=Is able, no difficulties;

Note. Differences between the exercise, social activity, and personal counseling regimes were tested with Independent-Samples Kruskal-Wallis

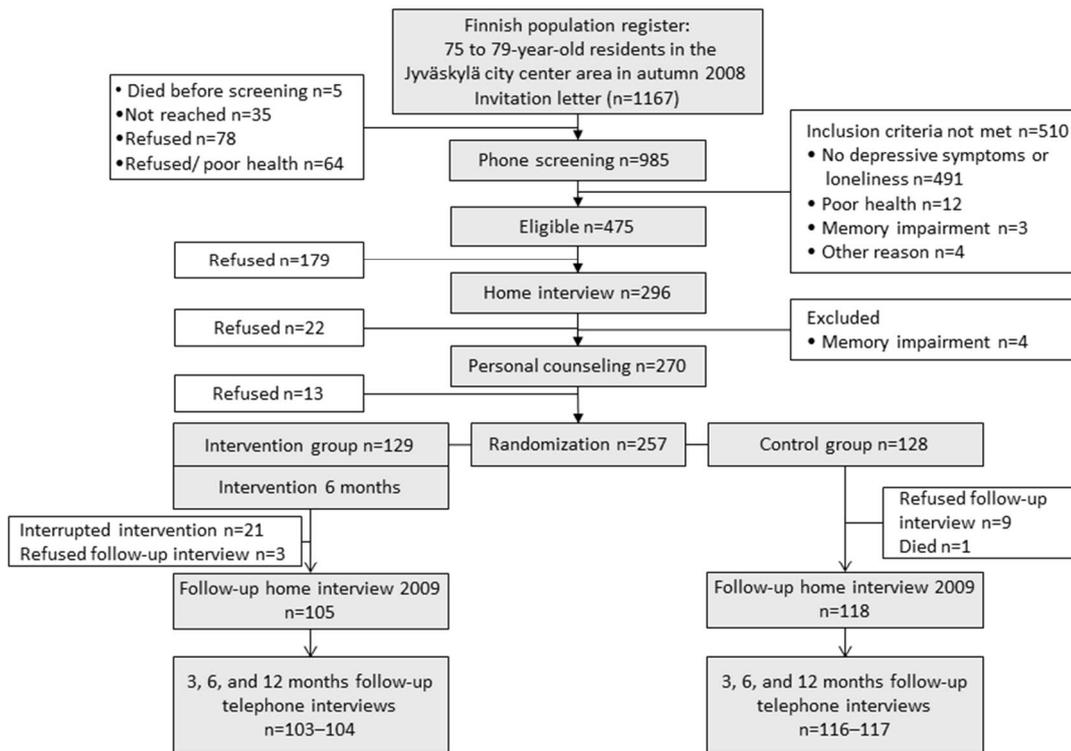
Test: <sup>^</sup>= p-value<0.05; <sup>\*</sup>= p-value<0.01.

**Table 3.** Means, standard deviations, and generalized estimating equations (GEE) model parameters for time-, group-, and group-by-time interaction for depressive symptoms, melancholy, loneliness, and dimensions of perceived togetherness in the intervention (n=105) and control (n=118) groups at baseline and after the 6-month intervention.

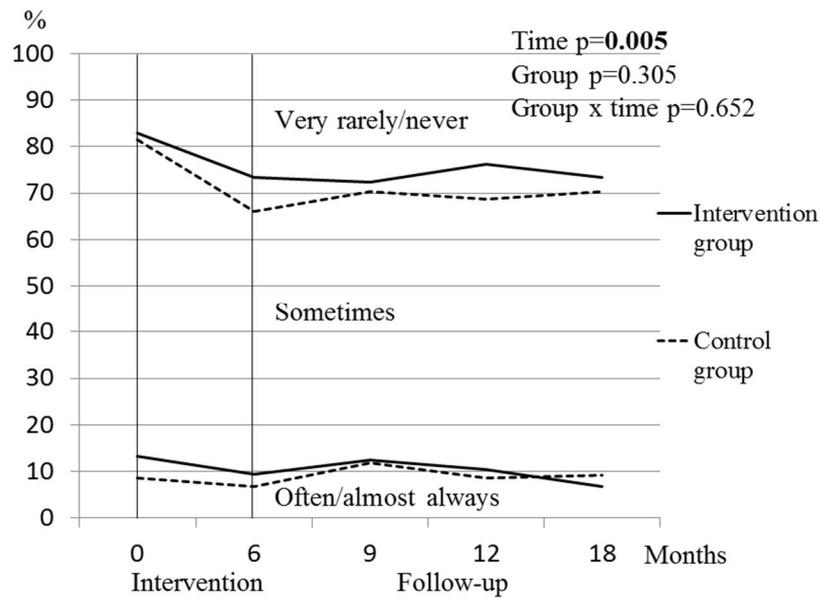
	Mean (standard deviation)				<i>p</i> -value for type III GEE model effects <sup>^</sup>		
	Baseline		After 6-month intervention		Time	Group	Group x time
	Intervention group	Control group	Intervention group	Control group			
<b>Depressive symptoms</b>	3.91 (2.71)	3.47 (2.33)	3.73 (2.86)	3.32 (2.61)	0.204	0.191	0.885
<b>Social integration</b>	12.30 (2.17)	12.75 (2.15)	12.92 (2.00)	12.77 (2.18)	<b>0.027</b>	0.553	<b>0.041</b>
<b>Alliance</b>	12.90 (2.36)	13.23 (2.09)	13.04 (2.35)	13.54 (1.77)	0.103	0.098	0.542
<b>Guidance</b>	12.56 (2.64)	13.08 (2.31)	13.22 (2.35)	13.54 (1.90)	<b>0.001</b>	0.106	0.550
<b>Attachment</b>	12.06 (2.73)	12.48 (2.10)	12.70 (2.44)	12.93 (2.10)	<b>0.001</b>	0.233	0.534
<b>Nurturance</b>	11.60 (2.74)	12.07 (2.34)	11.71 (3.00)	12.11 (2.28)	0.678	0.143	0.849

<b>Reassurance of worth</b>	11.61 (2.01)	11.86 (2.04)	11.65 (1.91)	12.17 (1.80)	0.174	0.088	0.286
	%	%	%	%			
<b>Melancholy</b>	<hr/>				<b>0.001</b>	0.190	0.785
-no/very rarely	17.1	18.6	26.7	33.9			
-sometimes	69.5	72.9	63.8	59.3			
-often or almost always	13.3	8.5	9.5	6.8			
<b>Loneliness</b>					<b>&lt; 0.001</b>	0.487	0.578
-no/very rarely	33.3	30.5	53.3	48.3			
-sometimes	52.4	55.9	36.2	39.0			
-often or continuously	14.3	13.6	10.5	12.7			

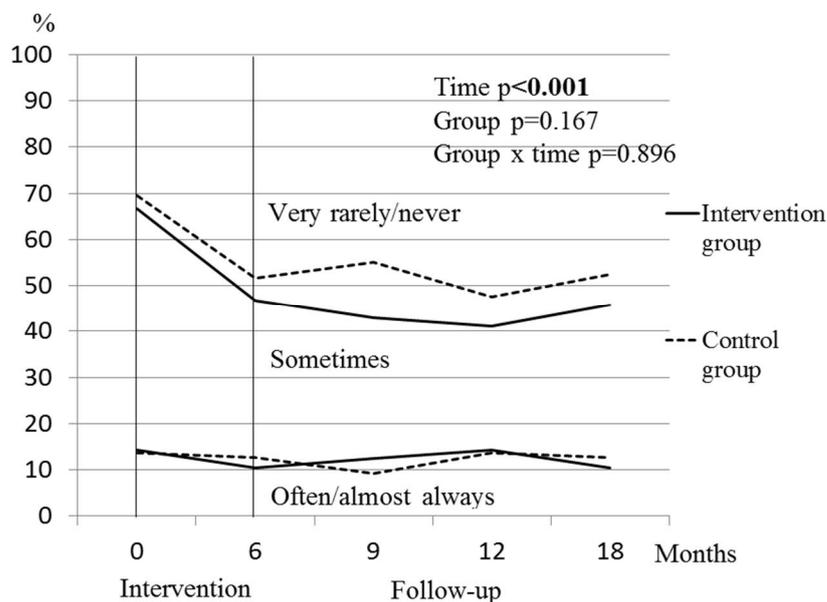
Note. ^ = Differences were tested with Generalized Linear Models, bold typeface indicates effect significant at the 0.05 significance level.



**Figure 1.** Flow of the study.



**Figure 2.** Proportions of participants (in the intervention n=105 and control n=118 groups) reporting feelings of *melancholy* at baseline, after the 6-month intervention, and at 3, 6, and 12 months post-intervention follow-ups, and generalized estimating equations (GEE) model parameters for time-, group-, and group-by-time interaction for the whole follow-up period.



**Figure 3.** Proportions of participants (in the intervention n=105 and control n=118 groups) reporting feelings of *loneliness* at baseline, after the 6-month intervention, and at 3, 6, and 12 months post-intervention follow-ups, and generalized estimating equations (GEE) model parameters for time-, group-, and group-by-time interaction for the whole follow-up period.