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Comparison of Well-being of Older Adult Choir Singers and the General Population in Finland: A Case-Control Study

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## Comparison of Well-being of Older Adult Choir Singers and the General Population in Finland: A Case-Control Study

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**Abstract**

Previous research suggests that singing in a choir as an older adult is associated with better quality of life (QOL). However, the degree to which sociodemographic and activity level variables contribute to this relationship is largely unknown. The overall aim of the study was to compare quality of life (QOL) of older adult choir singers with a matched sample of older adults from the general population in Finland, taking into consideration sociodemographic, satisfaction with health, and activity level. Case-control methods were used to match a sample of 109 older adult singers with a sample of 307 older adults from the general population. Tobit regression analysis with sociodemographic covariates was used to explain observed group differences in QOL as measured by two WHOQOL-Bref domains (psychological and physical). Probit regression analysis was used to examine the effect of overall activity level and sociodemographic variables on overall QOL and satisfaction with health. As expected, sociodemographic variables were strong predictors of physical and psychological QOL. After controlling for sociodemographic variables, the older choir singers reported significantly higher ratings on physical QOL, but not psychological QOL, compared to matched controls. Additional adjustment for satisfaction for health attenuated the results. When considering overall activity level, older adult choir singers reported significantly higher overall QOL and satisfaction with health when compared to either active or inactive controls. These results suggest that singing in a choir as an older adult may promote well-being, even after accounting for sociodemographic and overall activity variables.

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6 **Keywords:** choir, older adults, quality of life, music, health promotion, case-control  
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8 methods, arts  
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## 10 11 12 **Introduction**

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15 There has been increasing interest in using community-based arts / cultural  
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17 activities to promote health and well-being across the lifespan. Community-based arts  
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19 include a variety of creative activity, such as dancing, choir singing, theater, painting,  
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21 attending concerts, and visiting museums, visual art and photography exhibits (Brinson,  
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23 1992; Geisekam, 2000). Arts initiatives that occur within community settings (e.g.,  
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25 community centers, clubs, and adult education centers) and are often differentiated from  
26  
27 arts programs in healthcare settings (e.g., hospitals, rehabilitation centers). That is, arts  
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29 initiatives in healthcare settings often focus on applying therapeutic approaches (e.g.,  
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31 music or dance therapy) for the treatment and management of specific medical  
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33 conditions. In contrast, community-based arts programs designed to promote health are  
34  
35 broadly defined, as they not only focus on the intrinsic aesthetic experience of the arts but  
36  
37 also the potential for the arts to help promote health and well-being, expand social  
38  
39 support, and build community. These two goals are not mutually exclusive. However,  
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41 some arts programs are designed for persons with specific medical conditions and are  
42  
43 delivered in the community, which can blur these artificial boundaries. Thus,  
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45 community-based arts and health initiatives often focus broadly on public health, well-  
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47 being, and prevention of disease and disability.  
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There are an increasing number of studies that suggest that participating in creative arts / cultural activities is associated with better health and quality of life for older adults. Over the past several decades, a number of epidemiological studies using large, population-level samples have focused on examining the relationship between participation in the arts and survival, overall health, and well-being (Gordon-Nesbitt, 2015; Theorell & Kreutz, 2012). An early study by Bygren and colleagues (1996) examined the impact of passive and active cultural, sports and religious activities on the risk of mortality in 12,982 randomly selected adults (ages 16-74) in Sweden (Bygren, Konlaan, & Johansson, 1996). After controlling for seven confounders, those who rarely attended cultural events were at increased risk for mortality, compared to others with higher rates of participation. Other studies found a similar relationship with mortality (Bygren et al., 1996; Hyyppä, Mäki, Impivaara, & Aromaa, 2006; Konlaan, Theobald, & Bygren, 2002; Väänänen et al., 2009; Wilkinson, Waters, Bygren, & Tarlov, 2007). Additional epidemiological studies have documented a relationship between participation in the arts and better self-rated health (Cuypers et al., 2012; Nummela, Sulander, Rahkonen, Karisto, & Uutela, 2008; Wilkinson et al., 2007). In addition, Cuypers and colleagues (2012) found that more frequent participation in cultural activities was strongly related to higher life satisfaction, lower anxiety, and lower depression, after adjusting for confounders. In a majority of these studies, socioeconomic status was commonly used as a control variable, but the effect of other sociodemographic variables is less well understood. In addition, these studies suggest a promising role of the creative arts for promoting health on a population level, but it is difficult to know the

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3 impact of specific creative arts activities on health because the majority of studies  
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5 collapse different creative arts activities into one group.  
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8         Choir singing is a popular community-based creative arts activity in many  
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10 countries, and several recent studies suggest a positive relationship between singing in a  
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12 choir and better well-being. For example, several studies have found choir singers from  
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14 different ages and experience levels (e.g., semi-professional and amateur) report that  
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16 singing in a choir contributes to their well-being and quality of life (QOL) (Balsnes,  
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18 2012; Beck, Cesario, Yousefi, & Enamoto, 2000; S. Clift, 2012; S. M. Clift & Hancox,  
19  
20 2001; S. M. Clift, Hancox, Morrison, Hess, & Stewart, 2010; Skingley & Bungay, 2010).  
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22 In a sample of older adult choir singers, we recently reported a positive relationship  
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24 between greater perceived benefits of choir singing and higher ratings of QOL (Johnson  
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26 et al., 2013). That is, older adult singers who reported greater benefits from singing in a  
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28 choir also reported higher quality of life on a World Health Organization QOL measure  
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30 (WHOQOL-Bref). However, this study was cross-sectional and did not include a control  
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32 group, so it is not possible to know the directionality of the effect.  
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39         Only a few studies to date include a control group or compare singers to those  
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41 from the general population. This is important to consider because the choir singers in  
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43 the research studies often come from high sociodemographic status (SES) backgrounds,  
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45 and it is not yet known of the high QOL in choir singers is related to SES level, other  
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47 sociodemographic variables, or choir singing, in particular. We recently compared  
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49 ratings of QOL from a group of older choir singers from Jyväskylä, Finland and a large  
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51 sample from the general population in Finland (N = 1391). When compared to a sample  
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53 from the general population, the older choir singers reported significantly higher ratings  
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3 of overall QOL, in addition to higher ratings of psychological and environment QOL  
4 (XXX). In this study, however, the choir singers also had higher levels of education and  
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6 differed on other sociodemographic variables, so the differences in QOL could  
7  
8 potentially be explained, in part, by the sociodemographic variables. Another possible  
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10 explanation for reports of higher QOL is that older adults who sing in a choir may be  
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12 more active than a typical older person. For example, one study found an increase in  
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14 activities after singing in a choir for one year (Cohen et al., 2006). Thus, it is also  
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16 important to consider overall activity level as another possible explanatory variable.  
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22 Therefore, the purpose of the present study was to investigate QOL of older choir  
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24 singers and older adults from the general population (using case-control methods with a  
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26 large, population-based dataset in Finland) and consider sociodemographic variables and  
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28 overall activity level. Based on the previous literature reviewed above, it was  
29  
30 hypothesized that older choir singers will report higher QOL than matched older persons  
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32 from the general population in Finland, even after controlling for sociodemographic  
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34 variables and overall activity level.  
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## 41 **Design and Methods**

### 42 *Overall Study Design*

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44 Case-control methods were used to compare QOL in older choir singers from XXX and  
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46 matched older adults from the general population in Finland. The data from the choir  
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48 singers were collected prospectively as part of a study about choir singing and health in  
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50 XXXX. The comparison group was obtained from a Finnish population study that  
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3 included the same WHOQOL-Bref questionnaire. Details about each sample and the case  
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5 matching methods are described below.  
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### 10 *Participants*

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12 *Older Adult Choir Singers.* The study sample included 109 older adults (60-93  
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14 years of age) who were singing in an amateur community choir in XXXX (2010). The  
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16 choir singers were recruited prospectively from six choirs that were dedicated to older  
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18 adults and two additional choirs that included older singers. The participants were  
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20 recruited through presentations at choir rehearsals and were self-selected (with a response  
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22 rate of 86%). The participants completed standard surveys about QOL and health. In  
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24 addition to sociodemographic variables (age, sex, marital status, living arrangement, and  
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26 education), we also collected the number of years singing in a choir as an adult.  
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32 *Matched Comparison Group:* To compare the choir sample with older adults  
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34 from the Finnish general public, we utilized data from a large population study in Finland  
35  
36 (HYPA) that included the same QOL questionnaire used with the choir sample and  
37  
38 administered by the Finnish National Institute for Health and Welfare (THL). The  
39  
40 purpose of the HYPA survey is to obtain comprehensive data about the welfare, health,  
41  
42 and service utilization by the adult Finnish population. The data are drawn from a  
43  
44 stratified sample by Statistics Finland. The HYPA survey is completed every third year  
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46 using telephone interviews, postal questionnaires and additional home interviews for  
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48 persons 80 years and older.  
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53 Data from the most recent (2009) HYPA survey (total N=4306) were used for the  
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55 current analysis. We excluded 2,887 who were younger than 60 and 123 who had  
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3 missing data for any of the five sociodemographic matching variables (described below).  
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6 This left 1,296 HYPA participants for potential matching (age range = 60-98 years).  
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10 *Case Matching Methods.* Case-control methods (Newman, Browner, Cummings,  
11 & Hulley, 2013) were used to select matched controls from the HYPA dataset for each  
12 individual choir singer (cases). We selected case-control methods because we had a  
13 limited set of available sociodemographic confounders, which were all used as matching  
14 variables. Five sociodemographic variables were used as matching variables and  
15 included: age (+/- 4 years), sex (male or female), marital status (single,  
16 married/cohabitating or widowed), living arrangement (alone or with others) and  
17 education (primary, secondary, lower tertiary, or upper tertiary). In Finland, compulsory  
18 primary education includes 9 years of education, and secondary education typically  
19 includes 11-13 years of education. Lower tertiary education includes higher vocational  
20 degrees, while upper tertiary education includes undergraduate and graduate university  
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39 To facilitate the matching, reports were generated that only included the  
40 participant identification numbers and the five matching variables. Thus, the matching  
41 process was done blind with respect to the QOL data. We used multiple random  
42 matching from the HYPA dataset. That is, all HYPA participants who matched a choir  
43 singer on all five demographic variables were included in the study, so there are multiple  
44 control matches per one choir singer case.  
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These five sociodemographic variables were used as covariates. In two additional analyses, we included overall satisfaction with health and activity level as additional covariates.

*Quality of Life Measure:*

Quality of life (QOL) is a multidimensional construct that refers to subjective well-being and life satisfaction (Lawton, 1991) and is traditionally measured by asking individuals how they feel about their life in terms of psychological and physical factors, purpose in life, sense of belonging, and environmental resources. In the current study, we used the WHOQOL-Bref questionnaire (WHOQOL-Group, 1998) as a measure of QOL because both the choir singers and HYP A participants completed this instrument. The WHOQOL-Bref has been translated into Finnish according to the WHO international standards.

The WHOQOL-Bref includes 24 questions that focus on four domains of QOL (physical, psychological, social relationships and environment) and two general questions about overall QOL and satisfaction with health. Participants are asked to rate each question using a 5-item Likert-like scale, with higher scores suggesting better QOL. Although the WHOQOL-Bref includes four QOL domains (physical, psychological, social relations and environment), the current study focused only on the WHOQOL-Bref physical and psychological domains because a recent validation study identified limitations with the WHOQOL-Bref social relations and environment domains in the Finnish population (Siljander, Luoma, & Meriläinen-Porras, 2015). That is, Siljander and colleagues found good construct validity, internal consistency and discriminatory power

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3 for the WHOQOL-Bref physical and psychological domains and the two general  
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5 questions; however, they found poor construct validity for the social relations and  
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7 environment domains in the Finnish population. To avoid the pitfalls in these two  
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9 domains, we focus only on the physical and psychological domains for the current study.  
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13 For the current study, we excluded one question about satisfaction with work  
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15 (from the physical domain) because it was not administered in the HYPAsurvey to  
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17 participants over age 80. Following WHOQOL-Bref procedures (Skevington, Lotfy, &  
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19 O'Connell, 2004), the individual item scores were combined to yield domain scores  
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21 representing physical QOL (7 items) and psychological QOL (6 items). The domain  
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23 scores were then transformed to yield scores ranging from 0-100 (WHOQOL-Group,  
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25 1998). Domain scores were not generated when two or more items were missing.  
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### 28 29 30 31 32 *Data Analysis.*

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34 To investigate predictors of QOL, we performed a two-limit Tobit regression  
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36 model analysis (Tobin, 1958). The Tobit analysis can be applied when censored  
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38 distributions (in this case zero truncated and/or limited outcomes/distributions) are  
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40 completely observed ( $y$ ). In the context of the WHOQOL-Bref domain scores, the two-  
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42 limit model refers to a censoring model, with the floor censoring at 0 and the ceiling  
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44 censoring at 100. Because the Tobit model is nonlinear, we use computed average  
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46 marginal effects at mean of covariates ( $X$ 's). The latent dependent variable ( $y^*$ ) is  
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48 normally distributed and parameter estimation is by maximum likelihood (Cameron &  
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50 Trivedi, 2005). It can be mathematically shown that the Tobit parameters of estimation  
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52 converge to standard ordinary least squares (OLS) estimates under certain conditions.  
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3 The dependent variables in the Tobit regression analysis were the Physical and  
4 Psychological domains of WHOQOL-Bref. The first model was unadjusted; the second  
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8 model controlled for sociodemographic variables (age group, sex, living arrangement,  
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10 and education level), and the third model controlled for sociodemographic variables and  
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12 overall satisfaction with health (question 2 from the WHOQOL-Bref). Controlling for  
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14 these variables, the average treatment effect was a variable for the choir singer group  
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16 membership (one or zero otherwise). P values below 0.05 were considered significant.  
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20 The final analysis used two Probit regression models to evaluate the effect of  
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22 activity level on overall quality of life (Q1) and satisfaction with health (Q2). The  
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24 responses to these variables were converted to binary variables (see Table 5a and 5b).  
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26 Overall activity level for the controls was coded based on the response to the question:  
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28 “How often do you engage in hobbies (sports, culture, volunteering, etc.)” from the  
29  
30 HYPA survey. Controls who reported as being active either “every day” or “every week”  
31  
32 were classified as active (N = 124), while those who responded as being active only “a  
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34 few times a month” or “very seldom or never” were classified as inactive (N = 194). By  
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36 default, all choir singers were classified as active.  
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41 For exploratory purposes, we considered the individual items from any QOL  
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43 domain with group differences using the Student’s T-test with an adjustment for multiple  
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45 comparisons. We compared group responses on the WHOQOL-Bref physical and  
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47 psychological domain scores and two general QOL questions using the Student’s T-test  
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49 with adjustment for group specific variances. P values below 0.05 were considered  
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51 significant.  
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## Results

Table 1 summarizes the demographic information for both groups. The study included 109 choir singers (mean age = 71.3 years) and 307 matched older adults from the HYPA dataset (mean age = 68.8 years). There were approximately 3 matched cases for each choral singer. We excluded 7 participants from the choir sample because of a lack of good match with the HYPA dataset. There were no significant group differences in sex between the choir and control samples. However, there were significant group differences for age, education, living arrangement, and marital status (all  $p < 0.05$ ). Participants in the choir were older, had higher education levels (both lower and upper tertiary), were less likely to be living with others or married/co-habiting, and were more likely to be widowed than the controls.

INSERT TABLE 1 ABOUT HERE

Table 2 summarizes the raw scores by group on the WHOQOL-Bref physical and psychological domains and ratings of overall QOL and satisfaction with health. There were no significant group differences on any of these raw scores (all  $p > 0.05$ ).

INSERT TABLE 2 ABOUT HERE

Tables 3a and 3b summarize the results from the series of Tobit regression model analyses. The first model was adjusted for sociodemographic variables alone and then sociodemographic variables and overall satisfaction with health.

In the unadjusted model (results not shown), as expected, age was a highly significant predictor for both physical and psychological QOL. Each increasing year of age was associated with a reduction in the QOL domain scores by approximately 0.4 – 0.5 points. For example, being less than 70 years of age was associated with a higher

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3 physical QOL domain score by 8.5 points. Age had a similar effect on the psychological  
4 QOL. Higher tertiary education was also a significant predictor of physical QOL. That  
5 is, participants with higher education reported between 4.1 to 6.8 higher scores on the  
6 physical QOL domain. There was a non-significant trend for higher education levels  
7 (lower and upper tertiary) to be associated with higher scores on the psychological QOL  
8 domain. There was also a non-significant trend for higher QOL domain scores for  
9 persons who lived with others, compared with persons who lived alone. However, sex  
10 and living arrangement were not significant predictors of either physical and  
11 psychological QOL. Group (choir or control) was also not a significant predictor of  
12 physical or psychological QOL in the unadjusted model ( $p > 0.05$ ).

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27 The next analysis examined whether sociodemographic variables (i.e., age, sex,  
28 living arrangement, and education) predicted physical and psychological QOL. Because  
29 of multicollinearity between marital status and living arrangement, we opted to use only  
30 living arrangement because some married couples live in separate residences. The  
31 marginal effects results, found in Table 3a, suggest that, after controlling for these  
32 sociodemographic variables, the choir singers reported significantly higher scores on  
33 physical QOL than controls ( $p = 0.04$ ). That is, the choir singers scored an average  
34 treatment effect of 3.8 points higher than the controls on the physical QOL domain scale.  
35 However, group membership was not a significant predictor of psychological QOL ( $p >$   
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0.05).

INSERT TABLES 3A AND 3B ABOUT HERE

Because group membership approached statistically significant levels as  
predictor of overall satisfaction with health ( $p = 0.05$ ), we conducted an additional Tobit

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3 regression model controlling for both overall satisfaction with health (WHOQOL-Bref  
4 question 2) and the sociodemographic variables (i.e., age, sex, living arrangement, and  
5 education). (Table 3b) The results were slightly attenuated, and the choir singing group  
6 indicator variable was only a marginally non-significant predictor of the physical QOL  
7 domain ( $p < 0.10$ ). Group membership was not a significant predictor of psychological  
8 QOL after adjusting for socioeconomic variables and overall health ( $p > 0.05$ ).  
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12 Because group was a significant predictor of physical QOL when adjusting for  
13 sociodemographic variables, we compared individual items from the physical QOL  
14 domain by group for exploratory purposes. (Table 4) These results show that, compared  
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INSERT TABLE 4 ABOUT HERE

with matched adults from the general public, the older choir singers reported significantly  
lower ratings on two of the six physical domain items, including the extent that physical  
pain prevents them from doing what they need to do ( $p < 0.01$ ) and less need for medical  
treatment to function ( $p = 0.04$ ).

INSERT TABLES 5A AND 5B ABOUT HERE

Tables 5A and 5B summarize the results from the Probit regression models that  
take into consideration the sociodemographic variables and overall activity. As expected,  
Table 5A shows that age, marital status and satisfaction with health were significant  
predictors of overall QOL. Group membership was also a significant predictor, and the  
older adult choir singers were 1.58 times more likely to report higher overall  
QOL than either the active or inactive HYPA controls (OR = 1.579; 95% CI = 1.027-  
2.425,  $p < 0.05$ ). The older adult choir singers were also 1.5 times more likely to report  
higher satisfaction with health than either the active or inactive HYPA controls (OR =



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3 1.530; 95% CI = 1.009-2.318,  $p < 0.05$ ). As expected, other significant predictors of  
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6 satisfaction with health included education and overall QOL.  
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## 10 **Discussion**

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12 The results of the study confirm that sociodemographic variables are strong predictors of  
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14 physical and psychological QOL, overall QOL, and satisfaction with health in older  
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16 adults. In particular, age and education were strong predictors of both physical and  
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18 psychological QOL. Our study sought to examine QOL in older choir singers taking into  
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20 account these significant sociodemographic variables in addition to overall activity level.  
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23 There are two main findings from the study. After controlling for sociodemographic  
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25 variables, older adult choir singers reported higher physical QOL than matched older  
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27 adults from the general population. In our study, the older adult choir singers scored  
28  
29 higher on the WHOQOL-Bref physical QOL domain compared to matched older adults.  
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32 However, these results were attenuated after controlling for both sociodemographic  
33  
34 variables and satisfaction with health. Interestingly, group membership was not a  
35  
36 significant predictor of psychological QOL in any of the models. In addition, after taking  
37  
38 into consideration both sociodemographic variables and overall activity level, older choir  
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40 singers were 1.5 - 1.6 times more likely to report higher satisfaction with health and  
41  
42 higher overall QOL. Even after controlling for these possible confounders, choir singers  
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44 reported higher QOL and higher satisfaction with health. Although the choir singers in  
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46 the study came from relatively high sociodemographic status, the case-control methods  
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48 and controlling for sociodemographic variables helped address the concern that the  
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50 reports of higher QOL in choir singers were driven primarily by their relatively high SES.  
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The majority of studies about choir singing and well-being have focused primarily on psychological and social well-being and less so on physical aspects of QOL (S. M. Clift & Hancox, 2001; S. M. Clift et al., 2010; Gick, 2011). However, it is possible that choir singing could also have an impact on physical well-being and physical health. The choir singers in our study reported higher physical QOL, but not psychological QOL, when compared to matched controls. Skingley and Bungay (2010) reported that the physical benefits of singing was one of the most common themes reported by older adults who participated in community choirs (Skingley & Bungay, 2010). Cohen and colleagues (Cohen et al., 2006) also found that the older adults who sang in a community choir for one year had fewer falls than the usual activity control group, but physical well-being was not assessed in this study.

It is possible that singing in a choir helps improve lower body and core body strength. Cuypers and colleagues (2012) suggested that participating in cultural activities may also encourage greater engagement in other physical activities. We addressed this possible confounder by comparing active controls with the choir singers. However, it is also possible that older adults who are physically healthy are more likely to sing in a choir. Choir singing involves, at the very least, mild physical activity. For example, weekly choir rehearsals require older adults to travel to rehearsal locations, and the rehearsals often involve both sitting and standing and improving posture, which use both lower body and core body muscles. Choir rehearsals often include physical warm-ups, such as stretching and physical relaxation exercises. Given the finding that involvement even mild physical activity is associated higher QOL (Phillips, Wojcicki, & McAuley,

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3 2012), it is not surprising that the physical aspects of choir singing may influence  
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5 physical well-being of older adults.  
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8           When looking more closely at the WHOQOL-Bref physical QOL items, the post-  
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10 hoc exploratory analysis suggested that, compared with matched controls, the older choir  
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12 singers reported that physical pain interfered less with their life, and they had less need  
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14 for medical treatment to function. No studies to date have examined the effect of choir  
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16 singing specifically on these aspects of physical well-being. However, several studies  
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18 suggest that listening to music may be useful for reducing the perception of pain for  
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20 persons in a number of different clinical settings (e.g., cancer, burn, pre-post surgery,  
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22 chronic pain). For example, Gale and colleagues (Gale, Enright, Reagon, Lewis, & van  
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24 Deursen, 2012) found that three months choir singing improved cancer survivors' quality  
25  
26 of life, as measured by the RAND SF-36 questionnaire. The measured domains included  
27  
28 bodily pain, vitality, social function, and mental health. In another study, Grape and  
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30 colleagues reported that choir singing helped reduce pain in persons with irritable bowel  
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32 syndrome (Grape, Wikstrom, Ekman, Hasson, & Theorell, 2010). It is possible that  
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34 music functions as a distraction or helps shift attention away from painful sensations  
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36 towards competing stimuli (Bushnell, Villemure, & Duncan, 2004). However, it is not  
37  
38 yet known how singing in a choir might help relatively healthy older adults cope with  
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40 pain in everyday life. The older choir singers in the current study also reported needing  
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42 less medical treatment to function than older adults from the general population. Cohen  
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44 and colleagues (Cohen et al., 2006) found that older adults who sang in a community  
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46 choir for one year used fewer over-the-counter medications and fewer doctor visits than  
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48 the usual activity control group. Future studies should focus on the possible cost-  
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3 effectiveness of choir singing for promoting physical function given the possible impact  
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5 of singing on physical conditions associated with aging.  
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8 In addition, we found that the older adult choir singers were more likely to report  
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10 higher satisfaction with health and higher overall QOL, even when taking into account  
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12 overall activity level and socioeconomic factors. Thus, presumably active older choir  
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14 singers report even higher well-being than active controls, suggesting that a higher  
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16 general activity level does not completely explain the higher ratings of overall QOL and  
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18 satisfaction with health in the older choir singers.  
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22 Our study is also one of the first to compare a group of older choir singers with a  
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24 matched sample from the general population and also consider sociodemographic and  
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26 activity level variables. This is an important step because it is not known how choir  
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28 singers compare with their counterparts in the same country. Several studies suggest that  
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30 choir singers often come from high SES backgrounds (Louhivuori et al., 2012). It is,  
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32 therefore possible that the higher reports of well-being in choir singers might reflect the  
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34 higher SES and not the experience of singing in a choir, *per se*. Although Finland is  
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36 considered to have a high standard of living, according to Human Development Index  
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38 (HDI), which is a composite of several dimensions, including income, health, education,  
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40 etc. that compares how well people are living in countries across the world (United  
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42 Nations Development Programme, 2013), it appears that singing in a choir in a country  
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44 with an already high standard of living may provide additional benefit for well-being.  
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46 However, the direction of this effect is still not causally known because of the cross-  
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48 sectional design of this study. It is possible that selection bias remains, such that older  
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50 adults who have better health choose to sing and remain in a choir. However, the results  
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3 in our study remained significant after adjusting for overall satisfaction with health and  
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5 taking overall activity level into consideration. We did not acquire direct measurements  
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7 of physical health in our study, and longitudinal or randomized studies are still needed to  
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9 better determine if choir singing has a direct impact on physical well-being in older  
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11 adults.  
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15 It is possible that different aspects of choir singing impact well-being in different  
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17 ways. For example, we previously found that the older choir singers (from the same  
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19 sample in Jyväskylä, Finland) who reported higher benefits from choir singing also had  
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21 higher psychological, social relationship, and environment QOL, as measured by the  
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23 WHOQOL-Bref (Johnson et al., 2013). The methods in the current study differed from  
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25 this previous study and revealed a different pattern of results. The previous study  
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27 examined the relationship between QOL and reported benefits of choir singing, while the  
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29 current study compared older choir singers to matched adults from the general population  
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31 and adjusted for socioeconomic variables.  
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37 Several studies have considered possible reasons for why choir singing may  
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39 promote well-being. Clift and colleagues (2010) identified six possible pathways in  
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41 which choir singing can impact well-being, including structured breathing, social  
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43 bonding, participation in a meaningful activity, positive emotions, and learning new  
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45 things. Ruud and colleagues (Ruud, 2012) suggest that vitality and pleasure, agency  
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47 (mastery), belonging, and meaning contribute to the effect of choir singing on well-being.  
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49 Hyypä and colleagues studied reasons why Swedish-speaking Finns live longer  
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51 compared to Finnish-speaking Finns. According to Hyypä and colleagues (Hyypä &  
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53 Mäki, 2001), Swedish-speaking Finns participate more frequently in community-based  
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3 activities than Finnish-speaking Finns. Social capital is suggested to be one possible  
4 explanation for better health and well-being of choir singers (Hyypä & Mäki, 2003).  
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6 Social capital is not a well-defined concept, but it consists of elements that are present in  
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8 choir singing activity, such as social networks, volunteering, and trust (Putnam, 2000;  
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10 Kreutz & Brunger, 2012). Choir members represent variety of professions, such as  
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12 bankers, teachers, social workers, etc., which offers an opportunity for choir singers to  
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14 obtain information about those aspects of life, which may also relate to well-being.  
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20 A number of private, public and government commissions from different  
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22 countries have published policy statements regarding the use of community-based arts  
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24 programs to promote health and well-being. Finland also has a long-standing interest in  
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26 the arts and well-being. In 2011, the Finnish Art and Culture for Well-being programme  
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28 (Taiku) was launched by the Finnish Ministry of Education and Culture to promote equal  
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30 access to the arts and cultural activities for all citizens. The aim of the programme is to  
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32 promote health and well-being through culture and to strengthen social inclusion on the  
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34 individual, communal, and societal level. The three priority areas are: 1) culture in  
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36 promoting social inclusion, capacity building, networking and participation in daily life,  
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38 2) art and culture as part of social welfare and health promotion, 3) culture in support of  
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40 well-being and health at work. This program relies on inter-agency cooperation and is  
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42 administered by several government, arts, and health organizations.  
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48 There are several limitations to the study. The study included a relatively small  
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50 sample from one medium sized city in Finland, so the findings cannot generalize to choir  
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52 singers in Finland, in general, or other countries. It is also possible that there were older  
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54 adults in the control sample who had choir singing as an activity, but this would have  
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3 attenuated our predictions by group. Despite the case-control matching, there were  
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5 significant group differences in four of the matching variables; participants in the choir  
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7 were older, had higher education levels, were less likely to be living with others or  
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9 married/co-habiting, and were more likely to be widowed than the controls. These  
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11 variables were further controlled for in the statistical models, and the fact that there were  
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13 approximately 3 matched cases for each choral singer helped improve the validity of the  
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15 analysis. It is also important to point out that the HYP A data were collected one to two  
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17 years prior to the collection of data with the choir singers. In addition, it is possible that  
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19 it takes several years of choir singing to have a direct influence on QOL, and the choir  
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21 singing sample included those who had been singing just a few years and those who had  
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23 been singing more than half of their life. According to previous studies (S. M. Clift et al.,  
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25 2010; Kreutz, Bongard, Rohrmann, Hodapp, & Grebe, 2004), choir singers often report  
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27 about the importance of relaxation and strong emotional experiences and of social aspects  
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29 of singing. Future studies should consider improved methods for measuring well-being,  
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31 including more rigorously designed clinical trials, a larger sample size, and examine  
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33 possible dose-dependent effects of choir singing on well-being as well. In addition, the  
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35 biological and psychological mechanisms that drive the positive benefit of choir singing  
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37 need to be better understood.  
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46 In summary, the results from this study suggest that older adult choir singers have  
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48 higher QOL than older adults from the general population in Finland, even when taking  
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50 into consideration sociodemographic and activity level factors. This higher well-being  
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52 may translate into lower healthcare expenses and better health for older adults, and future  
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54 studies should consider the possible health care cost savings, particularly because choir  
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Running Head: Well-being in Older Singers

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3 programs are relatively low cost to sustain. The majority of prior studies have focused on  
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5 correlational associations between choir singing and well-being. Without conducting  
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7 randomized studies or longitudinal studies, it is not possible to determine the causal  
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9 pathways for the relationship between choir singing, well-being, and health.  
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**Declaration of Conflicting Interests:** No conflict of interest  
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Running Head: Well-being in Older Singers

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**Table 1. Demographics of Choir and Control (HYPA) samples**

	Choir sample N=109	HYPA sample N=307	T- or Z-test of column proportions; H1: difference not 0 P value
Age , mean and SD (range)	71.3 (7.2) (60 – 93)	68.8 (6.6) (60 - 92)	0.001***
Gender, % male	64%	73%	0.10
Education, % in each category			
Primary	23%	57%	<0.001***
Secondary	18%	12%	0.10
Lower Tertiary	22%	13%	0.03*
Upper Tertiary	37%	18%	<0.001***
Living Status, % in each category			
Alone	18%	9%	
With Others	82%	91%	0.007**
Marital Status, % in each category			
Single	7%	4%	0.20
Married / cohabitating	81%	91%	0.007**
Widowed	12%	5%	0.02*
Years of singing, mean and SD (range)	33.6 (17.6) (1-70)	NA	NA

SD = standard deviation, NA = not applicable

Note: statistical significance levels are: \*  $p < 0.05$ , \*\*  $p < 0.01$ , and \*\*\*  $p < 0.001$

Table 2. WHOQOL-Bref domain and overall scores with Student's T-test with adjustment for group specific variances (mean, median in brackets, standard deviation below in parentheses).

WHOQOL-Bref Questions and Domains	Choir sample	HYP A sample	P value
Q1. How would you rate your quality of life?	3.99 [4] (0.52)	3.95 [4] (0.70)	0.73
Q2. How satisfied are you with your health?	3.99 [4] (0.69)	3.82 [4] (1.01)	0.52
Physical QOL domain	77.8 [78.6] (13.2)	75.2 [78.6] (17.5)	0.44
Psychological QOL domain	72.9 [75] (11.3)	73.7 [75] (13.7)	0.55

TABLE 3a: Tobit regression analysis results for **Physical QOL** controlling for sociodemographic variables (age, sex, living arrangement, education) (Model 1) and sociodemographic variables and satisfaction with health (Model 2). Marginal effect coefficient.

	<b>Model 1</b>	<b>Model 2</b>
<b>Covariates</b>	coefficient - marginal effect	coefficient - marginal effect
Age		
60-64 years	<b>12.187 ***</b>	<b>7.826 **</b>
65-69 years	<b>12.258 ***</b>	<b>8.470 **</b>
70-74 years	<b>6.745 *</b>	3.738
75-79 years	4.164	2.077
80-93 years (ref)	1.000	1.000
Sex		
Male (ref)	1.000	1.000
Female	<b>-4.188 *</b>	-3.686
Living Arrangement		
Alone (ref)	1.000	1.000
With others	-0.732	-0.764
Education		
Primary (ref)	1.000	1.000
Secondary	3.292	1.813
Lower tertiary	-0.496	-0.402
Upper tertiary	3.465	<b>5.216 *</b>
Satisfaction with Health +		
Very dissatisfied (ref)	NA	1.000
Dissatisfied		4.044
Neither satisfied nor dissatisfied		-4.152 4.044
Satisfied		9.703 4.044
Very satisfied		21.824 4.044
Average treatment effect = choir – dummy	<b>3.832 *</b>	2.905
_constant	<b>67.774 **</b>	<b>60.764 ***</b>

Note: statistical significance levels are: \*\*\* p<0.001, \*\* p<0.01, \* p<0.05,  
 + = WHOQOL-Bref Question: “How satisfied are you with your health?”  
 Ref = Reference, NA = Not applicable

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Table 3b. Tobit regression analysis results for **Psychological QOL** controlling for sociodemographic variables (age, sex, living arrangement, education) (Model 1) and sociodemographic variables and overall satisfaction with health (Model 2). Marginal effect coefficient.

	<b>Model 1</b>	<b>Model 2</b>
<b>Covariates</b>	Coefficient - marginal effect	coefficient - marginal effect
Age		
60-64 years	<b>13.916 ***</b>	<b>11.114 ***</b>
65-69 years	<b>10.957 ***</b>	<b>8.511 **</b>
70-74 years	<b>9.907 ***</b>	<b>8.392 ***</b>
75-79 years	<b>6.027 *</b>	5.276
80-93 years (ref)	1.000	1.000
Sex		
Male (ref)	1.000	1.000
Female	-2.858	-2.209
Living Arrangement		
Alone (ref)	1.000	1.000
With others	2.301	2.868
Education		
Primary (ref)	1.000	1.000
Secondary	2.078	1.500
Lower tertiary	-1.715	-1.242
Upper tertiary	1.667	3.060
Satisfaction with Health +		
Very dissatisfied (ref)	NA	1.000
Dissatisfied		-9.664
Neither satisfied nor dissatisfied		-7.093
Satisfied		-1.935
Very satisfied		8.772
Average treatment effect = choir – dummy	0.774	0.549
_constant	<b>62.686***</b>	<b>63.965***</b>

Note: statistical significance levels are: \*\*\* p<0.001, \*\* p<0.01, \* p<0.05  
 += WHOQOL-Bref Question: “How satisfied are you with your health?”  
 Ref = reference, NA = Not applicable



Table 4. Group differences to individual WHOQOL items for Overall satisfaction with health and Physical QOL domain items. Student's T-test (mean and SD, p value).

WHOQOL-Bref Question	Choir sample – mean [median] (SD)	Control sample – mean [median] (SD)	T-test p value
Q3. To what extent to you feel that physical pain prevents you from doing what you need to do? (reverse scale)	4.49 [5] (0.83)	4.19 [5] (1.08)	0.01**
Q4. How much do you need any medical treatment to function in your daily life? (reverse scale)	3.88 [4] (0.81)	3.67 [4] (1.13)	0.04*
Q10. Do you have enough energy for everyday life?	4.30 [4] (0.71)	4.18 [4] (0.52)	0.21
Q15. How well are you able to get around?	3.94 [4] (0.73)	3.81 [4] (0.56)	0.23
Q16. How satisfied are you with your sleep?	3.75 [4] (0.92)	3.87 [4] (1.09)	0.25
Q17. How satisfied are you with your ability to perform your daily living activities?	4.31 [4] (0.63)	4.29 [4] (0.79)	0.77

Note: statistical significance levels are: \*  $p < 0.05$  and \*\*  $p < 0.005$

Q = Question, SD = standard deviation

Table 5a. Probit analysis for overall QOL controlling for sociodemographic variables (age, sex, marital status, education), satisfaction with health, and overall activity level. Odds ratios with 95% confidence intervals in brackets.

		Overall QOL ^
X Variable		Odds Ratio [95% CI]
Age	60-64 years	<b>1.953 [1.088-3.506] *</b>
	65-69 years	1.685 [0.933-3.045]
	70-74 years	1.238 [0.691-2.219 ]
	75-79 years	1.354 [0.728-2.520]
	80-93 years (ref)	1.000
Sex	Male (ref)	1.000
	Female	1.470 [0.950 - 2.272]
Marital Status	Single (ref)	1.000
	Married / Cohabiting	0.687 [(0.317 - 1.486]
	Widowed	<b>0.341 [0.142 - 0.819]*</b>
Education	Primary (ref)	1.000
	Secondary	0.712 [0.436 - 1.163]
	Lower Tertiary	0.294 [0.755 - 2.219]
	Upper Tertiary	0.520 [0.940 - 2.458]
Satisfaction with Health #	Very dissatisfied (ref)	1.000
	Dissatisfied	1.142 [0.443 - 2.941]
	Neither dissatisfied nor satisfied	0.827 [0.313 - 2.190]
	Satisfied	2.810 [1.152 - 6.851]*
	Very satisfied	<b>8.076 [2.842 - 22.950]**</b>
Overall Activity Level	Non-active control (ref)	1.000
	Active control	1.138 [0.781 - 1.657]
	Active choir	<b>1.578 [1.027 - 2.425]*</b>
Observations		410

Note: statistical significance levels are: \*\*  $p < 0.01$  and \*  $p < 0.05$

^ WHOQOL-Bref Question 1 (How would you rate your quality of life?) Very dissatisfied/dissatisfied vs. neither dissatisfied nor satisfied/satisfied/very satisfied

# WHOQOL-Bref Question 2 (How satisfied are you with your health?)

Table 5b. Probit analysis for satisfaction with health controlling for sociodemographic variables (age, sex, marital status, education), overall QOL, and overall activity level. Odds ratios with 95% confidence intervals in brackets.

		Satisfaction with Health <sup>#</sup>
X Variable		Odds Ratio [95% CI]
Age	60-64 years	1.019 [0.558 - 1.861]
	65-69 years	0.983 [0.542 - 1.784]
	70-74 years	1.366 [0.747 - 2.497]
	75-79 years	1.853 [0.455 - 1.601]
	80-93 years (ref)	1.000
Sex	Male (ref)	1.000
	Female	1.019 [0.689 - 1.508]
Marital Status	Single (ref)	1.000
	Married / Cohabiting	1.525 [0.835 - 2.787]
	Widowed	1.439 [0.652 - 3.177]
Education	Primary (ref)	1.000
	Secondary	1.359 [0.786 - 2.351]
	Lower Tertiary	1.007 [0.620 - 1.638]
	Upper Tertiary	<b>0.595 [0.392 - 0.905]*</b>
Overall QOL (Question 2) <sup>^</sup>	Very poor or poor (ref)	1.000
	Neither poor nor good	2.650 [0.882 - 7.962]
	Good	<b>7.866 [2.707 - 22.862]**</b>
	Very Good	<b>14.187 [4.401 - 45.735]**</b>
Overall Activity Level	Non-active control (ref)	1.000
	Active control	1.026 [0.723 - 1.456]
	Active choir	<b>1.530 [1.009 - 2.318]*</b>
Observations		410

Note: statistical significance levels are: \*\* p<0.01 and \* p<0.05

# WHOQOL-Bref Question 2 (How satisfied are you with your health?) Satisfied/very satisfied vs. neither satisfied not dissatisfied/dissatisfied/very dissatisfied

<sup>^</sup> WHOQOL-Bref Question 1 (How would you rate your quality of life?)