



Dedalo Vola project: The effect of choral singing on physiological and psychosocial measures. An Italian pilot study

Erica Viola^{a,*}, Marco Martorana^a, Chiara Airoldi^b, Silvia Caristia^a, Daniele Ceriotti^b,
Marta De Vito^b, Riccardo Tucci^a, Cristina Meini^a, Giorgio Guiot^d, Fabrizio Faggiano^{a,c}

^a Department for Sustainable Development and Ecological Transition, University of Eastern Piedmont, Piazza Sant'Eusebio 5, Vercelli 13100, Italy

^b Department of Translational Medicine, University of Eastern Piedmont, Via Solaroli, 17, 28100 Novara, Italy

^c Epidemiologic Unit of the Local Health Authority of Vercelli (I) - Osservatorio Epidemiologico, ASL Vercelli, Italy

^d Fondazione Cantabile ETS (Turin), Italy

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ABSTRACT

Several studies have been conducted that show the crucial role of active participation in music in health promotion (e.g. Dingle et al., 2021; Sheppard & Broughton, 2020); however, little research has focused on the biopsychosocial effects of choral singing. The present study aims to evaluate the effectiveness, in terms of improving physiological and psychosocial factors, of a choral program for middle-aged and older individuals. We integrated our study with qualitative observations of the atmosphere and flow state experienced by the choristers. The data were collected before and after 12 weeks of training, with 23 participants took part in the study. They experienced significant improvements in weight, oxygen saturation, heart rate, and satisfaction of psychological needs. A beneficial trend, although not statistically significant, were observed for blood pressure, cholesterol, triglycerides, stress, psychological needs, and mental health. The observations progressively revealed a more cohesive and focused group. Our findings support the potential for cross-disciplinary collaboration between healthcare and arts policy to promote and enhance health and well-being throughout the lifespan.

1. Introduction

A current scoping review by Fancourt and Finn (2019) has discussed the value of the arts in promoting health and well-being. Positive effects mostly pertain to (a) physical and neurological outcomes, (b) mental health and the prevention of cognitive decline, frailty, and mortality, (c) social relationships, (d) healthy behaviors, and (e) hedonic and eudaimonic well-being (Fancourt & Finn, 2019). Further studies have highlighted that active participation in music, such as singing or playing an instrument, promotes the maintenance or improvement of health and well-being, suggesting active engagement in performing arts as a significant determinant of health (Sheppard & Broughton, 2020). These findings also emerge from the results of a recent meta-analysis on the effects of active or passive participation in musical activities among elderly, highlighting a crucial positive association between social/group musical participation and well-being (Viola et al., 2023). Indeed, musical participation can contribute to the development of social capital by promoting new relationships (Livesey et al., 2012), counteracting social isolation, a prevalent issue in older age (Dury, 2014). Moreover,

engagement in musical activities shows some positive effects at cognitive and affective levels (Sheppard & Broughton, 2020).

In the context of choral singing, empirical evidence has demonstrated its impact on a physiological level (e.g., Bullack et al., 2018; Sanal & Gorsev, 2014; Schladt et al., 2017). For instance, this activity appears to improve cardiorespiratory functions, immune system functioning, and reduce endocrine stress levels, including cortisol and amylase (Bullack et al., 2018). Listen to music has been found to reduce oxidative stress (Orak et al., 2020), which is implicated in the pathogenesis of several age-related conditions (e.g., obesity, diabetes, cholesterol, cardiovascular diseases, cancer, sarcopenia, frailty, etc.) (Liguori et al., 2018; Marseglia et al., 2014).

The cognitive effects of choral activity need further analysis. For instance, some researchers indicate that regular singing enhances verbal flexibility but not on other cognitive domains (Pentikäinen et al., 2021); others suggest an improvement in phonemic fluency but not in other verbal abilities (Pentikäinen et al., 2023); while others do not show a significant impact on attention, visuospatial skills, and memory (Johnson et al., 2020). Although it may not seem to have an impact on a

* Corresponding author.

E-mail address: erica.viola@uniupo.it (E. Viola).

cognitive level, demonstrates interesting benefits on a socio-emotional level (e.g. Viola et al., 2023). Systematic participation in community music and singing activities produces improvements in mental health and mood among the elderly, reducing anxiety and depression (e.g., Bullack et al., 2018; Coulton et al., 2015; Daykin et al., 2018; Johnson et al., 2020). Singing in a choir enhances participants' psychological well-being more than singing solo (Stewart & Lonsdale, 2016). Overall, these studies demonstrate that choral singing interventions, due to their systematic and social nature, promote active lifestyles and reduce the risk of cognitive decline (Stern & Munn, 2010; Verghese et al., 2003). Moreover, in healthy older choir participants, verbal flexibility, social engagement, and general health tend to increase (Pentikäinen et al., 2021). In a recent narrative review that analyzed 19 studies, it was found that choral singing appears to have positive effects on physical and psychological health, especially on anxiety and depression, however, a cause-effect relationship cannot be established (Campbell et al., 2022).

Regarding the methodologies employed in studies on choral activities, a literature review conducted by Clift et al. (2010) found that few studies utilized standardized measures to assess outcomes and included a control group. In general, methodological issues often arise, such as difficulties in randomizing groups or achieving an adequate sample size. Furthermore, researchers have primarily focused on the effects of listening to music, with only a few studies investigating choral singing (Viola et al., 2023). Additionally, although the relationship between choral singing and well-being at a psychosocial level has been highlighted in several studies (e.g. Lamont et al., 2017; Vaag et al., 2013), a limited number of studies have examined the complex of biopsychosocial effects, in samples of people with chronic illness or suffering (Hopper et al., 2016; Lee & Dvorak, 2023).

Given the complexity of conducting measurements in a particular setting such as a choral singing group, it was decided to use a mixed-methods approach in the present study by integrating qualitative observation of the sample aiming to explore both the flow experience and group atmosphere, as they are related to subjective well-being (Densley & Andrews, 2021; Heo et al., 2010). Insofar as music represents the purest form of art that promotes the state of flow, this complete involvement in what one is doing can indeed emerge within choral activities (Altorjay, 2014; Csikszentmihalyi & Gilbert, 1995; Li & Rui, 2023). Wrigley and Emmerson (2013) considered the state of flow in music education across different dimensions, which encompass the necessity of balancing task challenge with personal skills to sustain interest and engagement, the integration of action and awareness during the flow state, and the focus on the task. Direct feedback facilitates participants' adaptation to real-time demands, while a sense of control and clear goal comprehension contribute to the experience of flow. During the flow state, self-awareness diminishes, and temporal perception may become distorted, creating an autotelic experience wherein the activity itself becomes inherently rewarding, irrespective of external reinforcement. Wrigley and Emerson propose that the state of flow enhances musical experiences and performance, therefore in chorus lessons the challenging learning environment can induce flow during leisure time.

1.1. The present study

Our study is part of the “Dedalo vola” project, part of a multicomponent community-based intervention program called “Dedalo”. “Dedalo” is active in northern Italy, specifically in Vercelli's municipality, with the aim of promoting healthy and active aging among adults (Bortoluzzi et al., 2022). Particularly, “Dedalo Vola” involves the implementation of diverse cultural activities to promote health and well-being. The main goal of this project is to foster a connected network between the health and cultural sectors of the region, directly contributing to cultural well-being and promoting an integrated model of well-being.

Through a biopsychosocial approach, the present study aims to

investigate the effects of a choral singing course on physical and psychosocial parameters related to oxidative stress, well-being, and healthy behaviors in a sample of middle-aged and older adults. Specifically, the study aims to examine: i) changes in physiological parameters (BMI and waist-to-height ratio, oxygen saturation, blood pressure, heart rate, glycated hemoglobin, cholesterol, triglycerides) at post-test; ii) changes in subjective perceived stress levels and an increase in psychological well-being; and iii) the observation of participants' engagement in the activity (flow) and the group atmosphere. We hypothesize an improvement in physiological parameters in line with the results of studies that have shown a positive impact on variables related to age-related problems (e.g. Orak et al., 2020); additionally, we hypothesize an enhancement in psychological well-being, aligning with previous studies indicating a positive relationship between choral singing and mental health (e.g. Daykin et al., 2018); finally, we hypothesize that the positive interdependence characterizing this group activity may increase the level of cohesion among participants (e.g. Densley & Andrews, 2021). Through the observation of flow and group atmosphere, we aim to provide a more in-depth description of the impact of choral activities.

Concerning the concept of ‘flow’, it can be defined as a psychological state in which individuals become fully absorbed in an activity. It is important to note that flow has been shown to contribute to psychological well-being (Bryce & Haworth, 2002), reduce stress (Csatari & Antheil, 1996), and improve quality of life (QoL; Asakawa, 2004). Our hypothesis is that a choral experience could promote a state of flow, thereby improving the QoL. As regards the concept of “atmosphere”, it could be defined as the impact of an experience such as singing in a chorus on emotional wellbeing and social connectedness within the general population (Densley & Andrews, 2021) and, for our purposes, within the singing group of Dedalo Vola.

2. Method

2.1. Study design

The initial study design aimed to be a pre-post randomized controlled trial, where volunteers would be recruited and randomly assigned to a treatment group (choral participation in the upcoming weeks) and a control group (choral participation after the study concluded). However, we encountered difficulty in recruiting a sufficient number of participants, resulting in a pre-post comparison of a twelve-week program led by a choir director (GG) without a control group (prospective non-controlled trial). This change in the study design was necessary as it allowed for gathering evidence using a method perhaps less robust than an RCT, without a control group, but still valid. Moreover, results from a pre-post comparison is of interest for clinical and community practice. Furthermore, deciding to proceed ensured that participants could benefit from the program without experiencing delays and postponements. Prior to the first lesson and after the final lesson, participants completed a questionnaire and provided a blood sample to measure physical parameters. Additionally, at the end of each session, a trained observer evaluated the flow and group atmosphere.

2.2. Participants and recruitment

The inclusion criteria were as follows: i) age ≥ 40 years, extending our study to a broader age range that can better account for the aging process; ii) residency in the city of Vercelli where the course was conducted. Participants were recruited through advertisements in a local newspaper and flyers. There were no limitations in terms of demographic variables, ethnicity, or similar factors.

Twenty-three adults (range age 44–72 years) volunteered to participate in this study. The characteristics of the enrolled sample are thoroughly described in Table 1. The sample was predominantly composed of women, with a mean age of 59.65 years with a medium-high

Table 1
Sample characteristics ($N = 23$).

Characteristic	N (%)
Demographics	
Age, years	
Mean (SD)	59.65 (8.09)
Sex	
Women	21 (91.30)
Men	2 (8.70 %)
Education	
Middle school	6 (26.09)
High school	11 (47.83)
Degree or more	6 (26.09)
Marital status	
Single	3 (13.04)
Married or living with a partner	12 (52.17)
Divorced	8 (34.78)

education level. Of 23 subjects, only 19 were followed for the entire period but physical parameters and blood samples were available only for 18 of them.

2.3. Procedure and materials

The study received approval from the Ethical Committee of the Hospital of Alessandria (Italy; Protocol No. 0004807, 01/03/2022). Data collection took place from April to July 2022. Prior to participating in the study, all participants provided written informed consent wherein the data processing procedures were explained, and all participants were required to read and sign the document before commencing the collection of physical and psychosocial variables. The choral singing course consisted of 12 weekly sessions, each lasting 90 min, held at the lecture hall of “Ospedale Sant’Andrea”, Vercelli, Italy. The first survey (t_0) was conducted approximately one week before the course started, and the second survey (t_1) took place approximately one week after its completion. The questionnaire remained consistent across both surveys, with the only additional component in the follow-up being an assessment of satisfaction with the choir program. Before and after the course, participants underwent physiological measurements (weight, height, oxygen saturation, blood pressure, and heart rate), as well as haematochemical tests to examine glycated hemoglobin, cholesterol, and triglyceride levels. The parameters and the blood samples were collected by trainee nurses under the supervision of a nurse tutor, within specifically dedicated rooms for the study, provided by the hospital; the laboratory analyses were conducted by qualified professionals from the hospital. Additionally, participants completed a questionnaire - two psychologists were responsible for administering the questionnaires - that included the Italian versions of the hereinafter described instruments. The Perceived Stress Scale (PSS - 10; Cohen & Williamson, 1988; translated by Fossati, n.d.) for measuring the perception of stress; it consists in 10 items (e.g. “Were you upset because of something that happened unexpectedly?”) to assess stress level over the past month and high scores indicate high levels of stress. The Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS; Costa et al., 2018) consisting of 24 items addressing two macro-dimensions: satisfaction (e.g. “I feel a sense of choice and freedom in the things I undertake”) and the frustration of the psychological needs in one’s life (e.g. “I feel forced to do many things I wouldn’t choose to do”). High scores on the first scale indicate greater satisfaction, whereas high scores on the second one indicate greater frustration. According to the Self-determination theory (SDT; Deci & Ryan, 1985), the BPNSFS allows to assess the degree to which people manage to satisfy three universal and psychological needs - autonomy, relatedness, and competence - whose satisfaction is positively associated with well-being (e.g. Ryan et al., 2010). Since our goal

is to assess subjective and psychological well-being, we decided to consider the scores of the dimensions of satisfaction and frustration need. The Mental Health Continuum-Short Form (MHC-SF; Petrillo et al., 2015) consisting of 14 items (e.g. “You felt happy”) concerning the level of well-being on emotional and psychosocial level over the last month. The higher the scores on this scale, the better the health condition. The demographic section aimed to detect socio-demographic variables (e.g. age, sex, etc.).

The last part of the survey also included questions related to the personal evaluation of the singing program and group participation. Specifically, participants were asked whether they found the course interesting, worth repeating, enjoyable, and challenging, and whether they enjoyed participating in the lessons with the rest of the group (from 1 = completely disagree to 5 = completely agree).

Qualitative observation is informed by Daniel Stern’s (2011) Forms of Vitality (FV) theory. In Stern’s theory, vitality is conceptualized as an integral part of individual experience, encompassing four interdependent dimensions of FV: time, space, force, and direction/intentionality. These dimensions are associated with emotions, thoughts, and bodily sensations, showcasing their dynamism and observable through outward signs of body language. In the context of our study, these outward signs enabled the observer to focus their attention and collect data on the atmosphere and flow using two questionnaires. The use of questionnaires as an observation grid allowed for increased standardization and objectivity in the observation process, providing a structured and uniform framework to assess observable events. This contributed to ensuring a more accurate and comparable evaluation of experiences, minimizing potential subjective interpretations. A student in philosophy was trained in observing group behavior and in completing questionnaire grids. This observational activity allows to a deeper understanding of the participant’s experience. It has been utilized the Group Climate Questionnaire (GCQ; MacKenzie, 1981; version of Bilican & Mceneaney, 2017) that assesses group climate in group psychotherapy and that we have used for an equally structured although non-clinical context; we specifically considered the items related to: caring behavior, involvement, disclose and compliance. It consists of 9 items: tension/anxiety, friction/rage, rejection/distrust, detachment/retreat, caring behavior, involvement/actual participation, willingness to disclose personal life anecdotes and stories, compliance with director’s instructions and sense of acceptance. It is important to specify that the GCQ has been adapted for use by an observer, as it was originally intended as a self-report instrument: the items of atmosphere ‘perception of importance’ and ‘sense of participation’ have been reduced to ‘actual participation’. Its advantage is to ensure a direct observation, whereas observing an inner perception would be impossible. Furthermore, it has been utilized the Flow Observational Grid (FOG; Tordet et al., 2021) considering the dimensions of: concentration, joy and frustration.

2.4. Analysis

Descriptive statistics were conducted, reporting absolute and percentage frequencies for categorical variables, and mean with standard deviation or median with interquartile range for numerical variables, as appropriate. Differences between post and pre values were reported, and changes over time were compared using paired t -tests or nonparametric alternatives (Wilcoxon signed-rank test), as appropriate. Particularly, normality assumption was checked and graphical representation of distributions for each variable were performed. The significance threshold was set at 0.05 (two-tailed), and all analyses were performed using SAS 9.4.

For the qualitative observation, the categories of atmosphere and flow were taken into account. As previously mentioned, after each lesson, the observer assessed the dimensions outlined in the questionnaires. Each dimension was utilized to describe the dynamics of the interactions. Through this method, we aimed to achieve our third goal as objectively as possible. The results of the observation were not directly

analyzed by the observer but by the independent statistician who was responsible for all the statistical analyses.

3. Results

We will discuss the results starting from the biological parameters and proceeding with the psychosocial variables, following the outcomes shown in Table 2. We will explore the change over time (trend) and any potential statistical significance. At the baseline, subjects had a median height of 164.5 [IQR 160;168] cm and a BMI of 27.65 [IQR 22.15;33.25] with a waist circumference of 108.5 [IQR 88;116], these parameters showed that the population considered were overweight. Normal oxygen saturation was observed (97, IQR 96; 98) and blood pressure was among 130 [IQR 120;140] for the systolic value and 80 [IQR 70;90] mmHg for the diastolic, while heart rate was 88.5 [IQR 81;100]. Interestingly, statistical significant improvements ($p < 0.05$) emerged in terms of weight reduction (-1; IQR -3; 0) and consequently of the waist circumference [-9; IQR -11; 0]. Moreover, we observed a BMI decrease (-0.4; IQR -1.12; 0) and the Waist-to-height ratio reduction (-0.05, IQR -0.07; 0.00). The same positive tendency was observed for oxygen saturation (1 IQR -1;2) and heart rate (-6 IQR -23;0), whereas no significant difference in terms of pressure was observed. Concerning the parameters considered through the haematochemical test, positive, non-significant trends emerged for total cholesterol and triglycerides (-10.5; IQR -13;5 and 2, IQR -29;20, respectively). Negative trends emerged for glycated hemoglobin (significantly increase of 1 [IQR 0;3]). Therefore, concerning physical parameters, results indicated improving trends, significant for BMI and waist-to-height ratio, oxygen saturation and heart rate.

Despite the statistical significance not all the parameters had a clinically significant difference.

Stress levels have decreased over time, although the difference is not statistically significant. Participants showed an increase (this effect was the only statistically significant for the psychosocial variables) of needs satisfaction, but a worsening for the needs frustration. Mental health showed positive trends for all dimensions.

On average, participants gave positive evaluations to both the choral singing course ($M = 4.76$; $DS = 0.72$) and the group experience ($M = 4.79$; $DS = 0.92$).

Concerning the observation, regarding the atmosphere categories, the analysis revealed that the structure of the lessons made it difficult to observe caring behavior. However, before or after the lessons, a spontaneous and progressive level of cooperation emerged during the course. The involvement and actual participation improved in terms of harmony among the choristers and between the choristers and the choir director. There was a propensity for dialogical exchange regarding experiences and singing technique. Active participation was mostly evident through the immediate and enthusiastic reception of improvisation proposals by the choir director. Participants' willingness to share personal life anecdotes and stories demonstrated how the singing experience motivated introspection, and there was a high frequency of compliance with the director's instructions.

Regarding the flow questionnaire, the observed level of concentration remained relatively consistent, leading to progressive technical improvement. As can be seen in Fig. 1, the trend of the variables with a positive valence of the group climate increases over time, whereas that relating to the variables with a negative valence remains unchanged.

The positive responses on climate would show a good functioning of the group in terms of effective involvement/participation, willingness to reveal personal anecdotes and stories, and a sense of acceptance. An overall analysis of these responses (positive and negative) suggests that the choral activity had a positive effect. However, the data does not allow statistical significance to be detected. Enjoyment, indicated by smiles, was observed from the first lessons and showed an increase in enthusiasm over time. The upper body exhibited hetero-directed movements, while the lower body demonstrated outward signs such as

Table 2

Pre and post values both with differences in time of the analyzed parameters. Median and interquartile ranges are reported both with p- values for the 19 participants who completed both the baseline and the follow-up assessments.

	NRA	Pre-test ^a	Post-test ^a	Difference	p-Value
Physical parameters					
Weight (kg)	17	74 [64; 83]	70 [62; 84]	-1 [-3;0]	0.0059
Waist circumference (cm)	17	108 [94; 115]	97 [86; 109]	-9 [-11;0]	0.0011
BMI (kg/m ²)	17	27.61 [22.15; 32.89]	26.99 [22.15; 31.11]	-0.4 [-1.12;0]	0.0029
Waist-to-Height ratio (cm/cm)	17	0.64 [0.57; 0.73]	0.59 [0.51; 0.66]	-0.05 [-0.07;0.00]	0.0012
Saturation (%)	17	97 [96; 98]	97 [97; 98]	1 [-1;2]	0.0405
Systolic pressure (mmHg)	17	130 [120; 140]	128 [120; 132]	-2 [-14;2]	0.0962
Diastolic pressure (mmHg)	17	80 [70; 80]	80 [75; 86]	-1 [-5;12]	0.7527
Heart rate (bpm)	17	90 [81; 105]	80 [75; 87]	-6 [-23;0]	0.0105
Blood analysis					
Glycated hemoglobin (mmol/mol)	17	36 [33; 38]	37 [35; 38]	1 [0;3]	0.0332
Triglycerides (mg/dl)	18	115 [96; 178]	99 [65; 135]	-2 [-29;20]	0.5710
HDL p-cholesterol (mg/dL)	18	71.50 [55; 87]	65 [50; 82]	-5 [-10;-1]	0.0017
LDL p-cholesterol (mg/dL)	18	110.5 [88; 128]	110 [105; 126]	0.5 [-2;9]	0.2154
Total p-cholesterol (mg/dL)	18	207 [184; 234]	206.5 [189; 221]	-10.5 [-13;5]	0.0645
Psychological variables					
PSS-10	18	18 [12; 21]	15.5 [11; 21]	-2 [-6;2]	0.1313
BPNSFS					
Satisfaction	18	46 [36; 53]	48 [42; 52]	4 [-1;6]	0.0162
Frustration	16	23 [18.5; 26]	26 [19.5; 27.5]	2.5 [-5; 6.5]	0.5028
MHC					
Emotional	15	10 [8; 11]	10 [8; 12]	0 [-1;2]	0.6719
Social	15	10 [7; 12]	9 [7; 14]	1 [-1;4]	0.3354
Psychological	15	20 [16; 22]	19 [15; 21]	1 [-2;2]	0.9146
Total MHC	13	40 [35; 44]	41 [34; 47]	2 [-3; 6]	0.6396

Note: The "NRA" column refers to Number of Responses Analyzed due to possible missing data or absence of the participant during the collection of physiological parameters. The "Pre-test" column refers to the subjects who completed the initial measurement, the "Post-test" column refers to the subjects who completed the follow-up measurement, and the "Difference" column indicates the differences between pre-test and post-test scores calculated using the nonparametric Wilcoxon signed-rank test, only for subjects who had both pre-test and post-test data available. PSS-10 = Perceived Stress Scale; BPNSFS = Basic Psychological Need Satisfaction and Frustration Scale; MHC = Mental Health Continuum. Statistically significant differences are in bold.

^a Median.

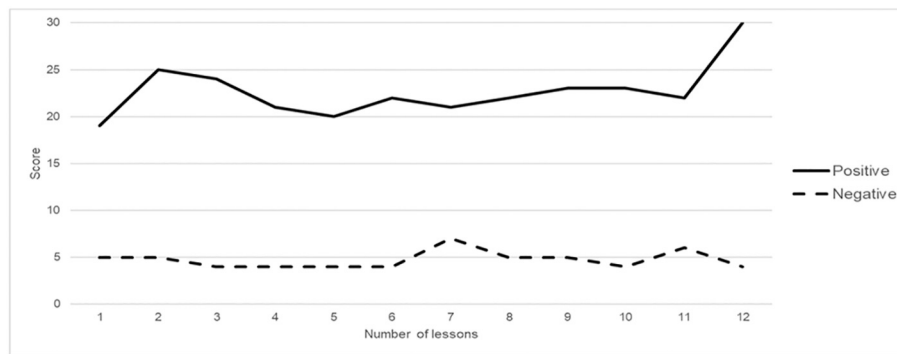


Fig. 1. Frequencies related to the group climate detected after the 12 choral singing lessons in relation to the valence.

tapping the feet, indicating engagement and enjoyment. During the twelfth lesson, participants expressed their experience as a sense of deeper engagement, enjoyment, or pleasure, or as a response to external entertainment. The frustration category did not yield significant results, except for a single dispute between participants regarding singing performance, the presence of a participant with asthma, and another participant's perceived insecurity about her singing abilities. On the other hand, the flow results show that the participants' experience is characterized more by the positive dimensions of concentration and enjoyment rather than frustration (Fig. 2). The choral activity appeared to be mostly enjoyable and this attitude tends to progressively increase throughout the choral course. The levels of concentration and frustration undergo a slight decrease, especially those related to this latter factor. These results suggest that the choral activity had a relatively constant positive effect.

4. Discussion

The aim of this study was to explore whether active participation in choir singing is associated with physical and psychosocial well-being improvement among adults.

The main results appear to confirm this relationship: in the post-test, after 12 weeks of choir activity, participants showed a loss of 1 kg of body weight, 9 cm in waist circumference and 0.4 BMI points.

Improvements were also observed in triglyceride and total cholesterol levels, while there were worsening trends in glycated hemoglobin, HDL (both statistically significant) and LDL (non-statistically significant). However, these results, although statistically significant, are not clinically relevant. For instance, a difference of 2 points in the

triglycerides levels does not alter the clinical status of patients. The same concept is applicable for the other parameters of blood analysis parameters. Therefore, it is reasonable to conclude that the intervention did not meet the initial expectations regarding improvements in biomarkers.

Regarding well-being-related variables, positive trends are observed in 3 out of 4 dimensions: stress, needs satisfaction and mental health. However, there is a non-statistically significant worsening in needs frustration.

It is noteworthy that participants positively assessed both the experience of choral singing and the act of participating in a group. In particular, the positive evaluations reflect an interest in choral singing activities and a desire to repeat this experience, as well as the importance of group interaction.

These seemingly favourable results from the intervention have some relevant limits. The absence of a control group and the small sample size undermine the study's robustness, necessitating caution in interpreting results. As mentioned earlier, the originally planned randomized controlled trial (RCT) could not be conducted due to a low number of volunteers. Despite extensive advertising through media and social channels, this difficulty occurred due to the ongoing pandemic, or due to the type of proposed activity that may not appeal to everyone, or due to the fact that participation in the choir also involved participation in a research.

It is necessary to underline that the significant weight loss over time could indeed be linked to the possibility that some overweight participants left the study prematurely. Moreover, the reduction in weight between the pre-test (spring) and the post-test (summer) could be influenced by seasonal bias, although studies in the literature show only

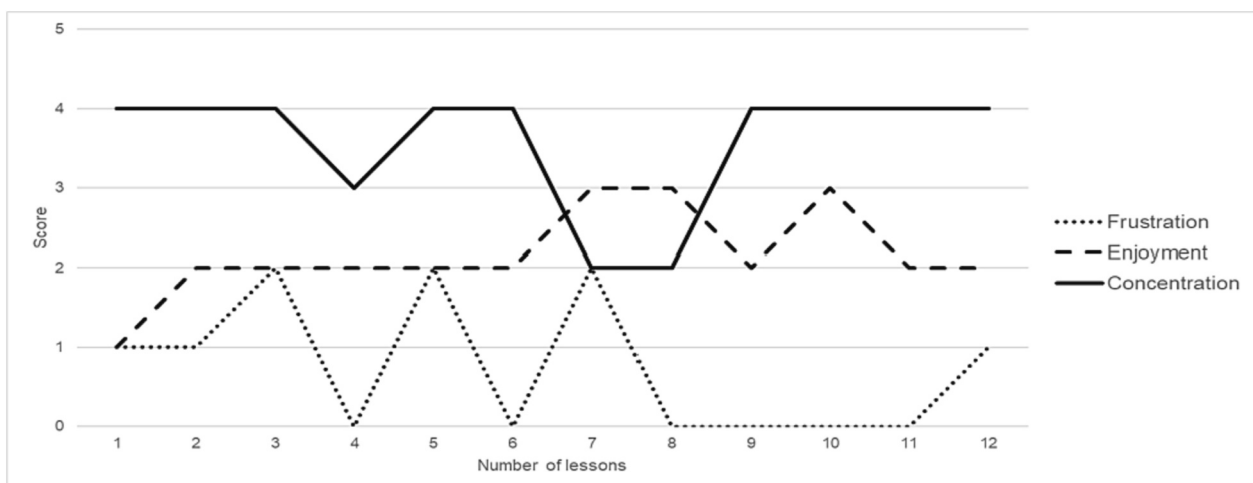


Fig. 2. Frequencies related to the three dimensions of the flow state detected after the 12 choral singing lessons.

small seasonal variations (Marti-Soler et al., 2014). In Western countries, the increase in spring and summer temperatures exposes the body more, potentially leading to increased concerns about fitness and a greater likelihood of following weight-loss diets (Rodgers et al., 2022). For instance, Ma et al. (2006) found that both diet and physical activity change with the seasons, resulting in a slight influence on body weight. In their study of individuals aged 20–70 years (mean age = 47.6), they observed a significant weight difference of 2 kg between spring and summer.

Even when considering different factors, these results are consistent with previous observations that demonstrate various positive effects of choral singing on the domains considered: physiological factors, such as cardiorespiratory functions, immune system functioning, cortisol, and amylase (e.g., Bernardi et al., 2017; Bullack et al., 2018; Sanal & Gorsev, 2014; Schladt et al., 2017), as well as psychological and social aspects (e.g., Clift & Hancox, 2010; Moss et al., 2018; Sanal & Gorsev, 2014).

Regarding the psychosocial dimension, despite methodological heterogeneity, various studies on choral singing have demonstrated improvements in mental health, interest in life, social contact and psychological well-being (e.g. Daykin et al., 2018; Coulton et al., 2015; Johnson et al., 2020; Bullack et al., 2018; Stewart & Lonsdale, 2016). Our study shows a similar trend when considering similar variables related to well-being.

The observational results show that the choristers felt highly engaged in and with the group, and interested in the activities during the classes. These two aspects are particularly noteworthy as they suggest the fulfilment of the needs for relatedness and competence. These needs are two of the three basic psychological needs outlined in the Basic Psychological Need Theory, and their satisfaction is associated with well-being (Ryan & Deci, 2017; Vansteenkiste et al., 2020). These findings support our previous quantitative analyses, although the satisfaction of needs is the only psychological dimension that showed improvements at the limits of statistical significance. The observations seem to emphasize the enjoyable nature of the choral singing program. This aspect raises the possibility that these experiences may have an immediate impact on the emotional dimension. Therefore, future studies should explore the effects of these activities in a timely manner, in addition to examining their medium and long-term effects. Particularly, long-term follow-ups are needed to understand the validity and strength of the results obtained. Finally, in our study, four participants did not complete the program, but we were unable to determine the reasons. In the future, it will be crucial to consider this option to prevent or minimize dropouts. Moreover, there is significance in endeavoring to develop a randomized controlled trial or a study design that incorporates a control group (perhaps a waiting list) to accurately assess the efficacy and effects of this type of activity on health. A more robust study design could prove invaluable in establishing compelling evidence regarding the impact of group singing on health.

4.1. Implications and conclusions

Together, these findings suggest that choral singing may serve as a means to promote health and well-being in non-clinical populations. A strength of this study was the utilization of the biopsychosocial approach, which is rarely employed in this type of research and represents a valid and reliable method for comprehending the impact of choral activity on various health aspects.

The most significant message from this study, for both the health and cultural sectors, is that accessible and preventive strategies can contribute to enhancing the quality of life. However, this study had several limitations. Future research should aim to establish the causal impact of this activity on well-being, and this evidence could be valuable for public health policies, which can utilize new tools and inclusive methodologies to promote health and well-being for all individuals.

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CRediT authorship contribution statement

Erica Viola: Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization. **Marco Martorana:** Writing – review & editing, Writing – original draft, Data curation. **Chiara Airoidi:** Writing – review & editing, Writing – original draft, Formal analysis. **Silvia Caristia:** Visualization. **Daniele Ceriotti:** Visualization, Conceptualization. **Marta De Vito:** Visualization, Conceptualization. **Riccardo Tucci:** Writing – review & editing, Writing – original draft, Data curation. **Cristina Meini:** Visualization, Project administration, Conceptualization. **Giorgio Guiot:** Visualization, Methodology. **Fabrizio Faggiano:** Supervision, Resources, Project administration, Funding acquisition, Conceptualization.

Declaration of competing interest

No potential conflict of interest was reported by the authors.

Data availability

The data that has been used is confidential.

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