Full-Length Article

The Relationship Between Music, Exercise, Self-Reported Health, and Health Behaviours Among Cardiac Rehabilitation Patients

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Abstract

This study examined the perceived health-benefits of music among avid-music listeners and non-avid music listeners with exercise, and compared these perceptions with self-reported more established population indicators of health. A cross-sectional survey was administered to 300 patients who were currently participating or previously participated in an outpatient cardiac rehabilitation program, evaluating perceptions of the role of music in exercise and health. Patients were categorized as avid-music listeners and non-listeners based on their self-reported frequency of music-listening during exercise work-outs. Among the 149 patients who completed the survey (49.7% response rate), avid-music listeners were significantly more likely to perceive a positive impact of music on their exercise behaviours (i.e., frequency, duration, and intensity) and on their overall health than did those who listened rarely or not at all ($p = 0.001$). However, self-reported health status and exercise behaviours did not significantly differ between avid-music listeners and non-listeners. Tendencies to over-perceive positive health-benefits of music may exist among avid-music listeners, which in turn may suggest an underlying "healthy placebo- effect." The long-term health and behavioral implications associated with positive health-music tendencies require further study.

Keywords: ***Cardiac Rehabilitation, Music, Perceptions, Health Outcomes, Placebo-Effects***

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Introduction

Several studies have demonstrated that music listening results in improved psycho-social, physiological and emotional health status for cardiac patients [1-4]. Accumulating evidence suggests that when used while exercising, music can modulate physiological indicators, such as heart rate, blood pressure, respiratory rate, myocardial oxygen demand, and neuro-hormonal levels [5-10]. Studies have also shown that when incorporated with exercise, music can have important psychological effects, by reducing perceptions of exertion, anxiety, fatigue, and improving quality of life [6,11,12]. However, inconsistencies in results have existed across studies, [11,13-15] leading some to argue that tendencies to over-perceive the health benefits of music may suggest the presence of a 'healthy placebo-effect' among avid-music listeners [16-20]. Music placebo-effects, if present, might inform music-medical neural mechanisms. Moreover, placebo-effects may impact the design and interpretation of music-medicine research.

Accordingly, the objective of this study was to compare the health perceptions of music between avid and non-avid music-listeners during exercise, and to evaluate the extent to which such music-health perceptions are congruent or incongruent with more established self-reported indicators of population health. We examined such perceptions among a sample of current and past participants of a cardiac rehabilitation program. Cardiac rehabilitation serves as an ideal test-case setting for several reasons. First, cardiac rehabilitation programs are associated with an irrefutable survival benefit (reduced morbidity and mortality) which is

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attributable to improvements in health and health behaviors [21-23]. Second, there have been several small, randomized clinical trials examining music therapy interventions in cardiac rehabilitation, which have yielded inconsistencies in health outcomes [11,13-15]. Such heterogeneity may result from psychosomatic amplification of music's effects on health status. Third, cardiac disease remains a leading cause of death for men and women in the United States and other Westernized countries [24]. Should the incorporation of music in cardiac rehabilitation be shown to improve exercise behaviors and health, it may ultimately serve as an innocuous and safe strategy that may confer outcome benefits to those at highest mortality and morbidity risk.

Methods

Context

Cardiac rehabilitation is defined by the World Health Organization [25] Expert Committee as the "sum of activities required to influence favorably the underlying cause of the disease, as well as to ensure the patients the best possible physical, mental and social conditions so that they may, by their own efforts, preserve, or resume, when lost, as normal a place as possible in the life of the community" [25]. In recent years, the field has focused its efforts on developing, structuring and implementing innovative behavior modification approaches. The key goal in cardiac rehabilitation is to modify individuals' risk factor profiles, through a wide array of risk factor approaches and behavior modification techniques, and through structured exercise and education programs. Set in an interdisciplinary framework, cardiac rehabilitation programs are delivered predominantly to patients with established heart disease or those at high-risk for heart disease (e.g., diabetes, metabolic syndrome, multiple risk-factors). Randomized clinical trials have demonstrated that cardiac rehabilitation is associated with a 20% reduction in mortality as compared to usual care [26-28]. Available evidence has also shown that cardiac rehabilitation improves cardiovascular risk-factor control, quality of life, self-management behavior, and physical fitness [29].

Setting

The current study was conducted at the Cardiac Rehabilitation and Secondary Prevention Program at the Toronto Rehabilitation Institute (TRI), the largest ambulatory cardiac rehabilitation institute in Canada and one of the largest such institutions worldwide (servicing approximately 1,800 patients per year). Patients were referred to the TRI from acute care hospitals, community practices and other health care settings. At the time of this survey, the program consisted of 24-26 supervised exercise classes once a week, for a period of 6-9 months. An individualized exercise prescription (aerobic and resistance training) was prescribed to each patient based on their functional capacity, assessed objectively by a cardiopulmonary exercise test at baseline. Exercise prescriptions were increased in duration and/or intensity every 2-weeks as indicated. In addition to the on-site supervised classes, patients were expected to comply with their exercise protocol off-site at a frequency of 4 additional days per week for 30-60 minutes per day, with an additional 2 days per week dedicated for resistance training. Each patient was cared for within an inter-professional health team setting, comprised of physicians, exercise specialists, nurses, physiotherapists, occupational therapists, dietitians, psychologists, social workers, and diabetes educators. Patients were assigned to an exercise case-manager who monitored clinical symptoms, on-site exercise prescription, and off-site activity compliance (as assessed through activity logs). Counseling sessions with a psychologist or social worker were offered to overcome personal issues and dieticians were available to develop personalized nutritional plans. Former cardiac rehabilitation patients participated in monthly evening education seminars, designed to keep patients motivated, and up to date on exercise, cardiology and heart health. Neither music, nor music therapy were implemented or integrated into the program in any way at the time of the study.

Participants

The study approached a consecutive sample of 300 current and/or former cardiac rehabilitation participants. The responses did not significantly differ between former and current participants of cardiac rehabilitation, and were therefore combined for the two groups. Written informed consent was obtained from each participant prior to study inclusion, and the study received Institutional Research Ethics Board approval.

Survey eligibility necessitated the following criteria: 1) The patients were over the age of 18 and enrolled in the Cardiac Rehabilitation Program; 2) Patients had a good understanding of English and were competent to fill in the questionnaire; 3) Patients have a history of coronary artery disease (i.e., hospitalizations for acute coronary syndromes, recent percutanous coronary angioplasty or coronary artery bypass surgery, chronic stable coronary artery disease prior hospitalization for a myocardial infarction) structural heart disease (a history of valvular heart disease, congenital heart disease, or congestive heart failure), diabetes, or have been diagnosed with two or more cardiac risk factors.

Questionnaire

Surveys administered to current patients took place at an on-site exercise class, whereas surveys administered to former patients took place at one of the monthly educational seminars geared to those who had previously completed cardiac rehabilitation. Questionnaires were administered once to each patient. Patients were reminded on a telephone call and in person to complete the survey, but no formal re-administrations of surveys were undertaken to increases response-rates from non-respondents. This quantitative self-administered cross-sectional survey consisted of 26-questions (Appendix). Where possible, the survey incorporated

validated questions which were adapted from national population health surveys [30-33] The survey consisted of questions which examined socio-demographic factors (age, gender, educational attainment), self-reported race/ethnicity, exercise behaviors (i.e., frequency; exercise activities of daily living; self-reported overall health, as well as sadness, anxiety, and optimism. The questions pertaining to self-reported health status and sadness were taken from the SF-12 short-form health-survey. Self-reported health status was assessed by patients' responses to a five-scale question: "Please rate your overall state of health?" Health was defined as, "not only the absence of disease or injury but also physical, mental and social well-being." This measure has been widely used in medical and psychological literature, for its ability to consistently predict mortality and survival in longitudinal studies [34], its high test-retest reliability across different population subgroups [35], and ease of measurement [36]. Questions regarding optimism incorporated the 10-item Life Orientation Test-Revised (LOT-R) questionnaire, which has been well-validated. Each health question included in the survey has been shown to be associated with health outcomes of survival or quality of life [37].

Questions regarding the perceived effects of music were developed de novo by a multidisciplinary team consisting of a physician (cardiologist), an exercise scientist, a clinical epidemiologist, a music therapist, a music-educator, and a neuroscientist. These questions were created to ascertain perspectives regarding music-listening and its' perceived effects (if any) on exercise behaviors and health. Specifically, the survey asked respondents to rate the effects that music had on exercise frequency, motivation, intensity and duration, as well as its' perceived effects on an individual's overall health. Prior to the study, the survey was tested for face validity among patient volunteers.

Statistical analyses

Patients were categorized in accordance to their self-reported frequency of using music when exercising. Specifically, those who reported listening to music while exercising "all the time" or "most of the time" were categorized as avid music listeners, while those who reported incorporating music "rarely" or "never" into their exercising routine were categorized as non-avid music listeners. The self-reported categorization of music-listening to exercise also corresponded to the sample median.

A series of 2*2 tables were constructed which examined the perceived impact of music on health and exercise behaviors in relation to a patient's self-reported music-avidity with exercise. Descriptive statistics were used to measure the frequency of responses for each question. The recoding of question answers into discrete numbers allowed for the calculation of mean, and standard deviation for each question. A series of Chi square analyses examined differences in self-reported health, health-behaviors, and perceived music's effects on health across music avidity with exercise (i.e., avid vs. non-avid music listening). Wilcoxon rank sum tested for significant differences in answer responses for continuous variables. Each question was re-coded to facilitate quantitative analysis. Anomalous values were checked statistically and visually. Pearson correlation coefficients were used to assess the association between music-listening with exercise and music-listening with activities of daily-living. All questions

Variable	Former	Current	Total	p-value*
	n=60	n=89	n=149	
Age, mean ± SD	65.33±10.29	66.44±11.86	65.99±11.23	0.392
Age				0.646
18-35, *n (%)*	1(1.7%)	3 (3.4%)	4 (2.8%)	
40-54, *n (%)*	6 (10.3%)	9 (10.3%)	15 (10.3%)	
55-64, *n (%)*	20 (34.5%)	26 (29.9%)	46 (31.7%)	
65-74, *n (%)*	20 (34.5%)	24 (27.6%)	44 (30.3%)	
>75, *n (%)*	11 (19.0%)	25 (28.7%)	36 (24.8%)	
Sex				0.004
Male, *n (%)*	34 (57.6%)	70 (79.5%)	104 (69.8%)	
Female, *n (%)*	25 (42.4%)	18 (20.5%)	43 (29.3%)	
Education				0.992
< High school, *n (%)*	5 (8.5%)	7 (8.5%)	12 (8.5%)	
High school, *n (%)*	6 (10.2%)	10 (12.2%)	16 (11.3%)	
College, *n (%)*	11 (18.6%)	14 (17.1%)	25 (17.7%)	
Incomplete university, *n (%)*	7 (11.9%)	11 (13.4%)	18 (12.8%)	
University, *n (%)*	30 (50.8%)	40 (48.8%)	70 (49.6%)	

Table 1. Demographic characteristics of graduates (n=60) and current (n=89) cardiac rehabilitation patients; *: values were generated using Chi-Square and Wilcoxon Rank Sum for dichotomous and continuous outcomes respectively.

were assessed for missing values and a pair-wise data deletion approach was used. All of the variables were checked for normality, both statistically and visually. Means, standard deviations, with proportions +/- 95% confidence intervals were reported, where appropriate. Statistical significance was defined as a 2-tailed P-value <0.05 for the purposes of this study. The statistical Package for the Social Sciences (SPSS) or Predictive Analytics Software (PASW) 19.0 was used to perform the quantitative analyses.

Results

Among the 300 patients who were approached to participate, 149 patients participated in, and responded to, the survey (49.7% response rate). The final sample of respondents was comprised of 89 current and 60 former cardiac rehabilitation patients. The mean age was 66 (±11.23) years**,** 29% were female; 50% attained a university degree. The distribution of baseline characteristics among current and former cardiac rehabilitation patients was similar. Almost half of all patients (49%) listened to music at least occasionally during exercise (*Table 1*). Avid music listeners with exercise were more likely to listen to music during activities of daily living (Pearson correlation between music-listeners with exercise vs. activities of daily living, $r < 0.40$, $p < 0.001$).

Table 2 illustrates the perceived effects of music for avid music listeners vs. non-avid music listeners while exercising. Patients who utilized music with exercise were significantly more likely to report that music-listening improved their own health, ($p = 0.004$), and had positive effects on their exercise frequency, intensity and duration ($p < 0.001$). In addition, avid music exercise listeners who reported playing a musical instrument or singing (making music) were significantly more likely to perceive that music-making improved their own health than were avid music exercise listeners who were not involved in music-making ($p = 0.004$). Avid music exercise listeners were also more likely to advocate for music implementation into cardiac rehabilitation programs ($p = 0.002$), and were also more likely to perceive music as having a greater effect on mood ($p = 0.028$) than were their non-avid music-listening counterparts (*Table 2*).

In contrast to the perceived effects of music on health, none of the self-reported health measures varied according to whether or not patients actually listened to music with exercise (*Table 3*). Specifically, avid music-listeners during exercise had similar self-rated health, self-rated stress/anxiety, and self-rated optimism scores as non-avid music counterparts ($p > 0.1$ for all).

Discussion

Our study demonstrated that music avid-users were significantly more likely to perceive that music exerted positive benefits to health and health behaviors than their non-avid music counterparts. The self-reported positive benefits of music among avid music listeners applied to overall health and to improvements in perceived exercise frequency, duration, and intensity. However, unlike the perceived effects of music on health and exercise behaviors which differed significantly between avid and non-avid music listeners, measures of self-rated health, optimism, and exercise frequencies as assessed independently were similar irrespective of music-listening avidity.

To the best of our knowledge, ours is the first study to examine the impact of music on perceived and self-reported health within the context of cardiac rehabilitation and exercise health. Previous studies have demonstrated that music affects perceptions of exercise exertion and fatigue, but does not impact on self-reported exercise frequency or adherence [11,14]. For example, [14] Cho conducted a rehabilitative upper extremity exercise program, and found that the use of music during exercise significantly reduced perceived exertion and enhanced mood but had no effect on the compliance or the efficacy of exercise, as defined by the number of exercise repetitions and range of motion respectively. Such findings suggest that music may modulate physiological perceptions during exercise, without necessarily modifying exercise behaviors per se. The discordance between perceived and more objective measures of health and/or health behaviors is consistent with our findings. In our study, while avid-music respondents acknowledged a perception that music improved health and exercise behaviors, self-rated health and exercise frequencies did not differ between music avid and non-avid users.

In our study, we did not collect data on the details of the music used by the respondents. It was participant-selected, and therefore, variable. Respondents who indicated that they were avid music listeners while exercising did not feel that music altered mood, stress or anxiety as compared with their non-avid music counterparts. Moreover, the proportions of individuals who had negative mood or conversely, were optimistic, were similar between avid and non-avid music listeners with exercise. Accordingly, any self-reported effects of music on perceived health or health behaviors did not seem to be modulated through mood responsiveness per se.

Available evidence has demonstrated inconsistent effects of music on mood, anxiety and psychosocial distress [13,15,38]. For example, Annesi and colleagues [13] demonstrated that combined music and personal television while exercising resulted in significantly lower dropout, longer exercise sessions and greater cardiorespiratory improvements in adults. However, changes in exercise behaviors resulting from music and television did not strongly correlate with improvements in self-reported motivation or distress. Previous studies have also shown that music alone, as well as music during exercise, lowers stress and anxiety levels in patients with cardiovascular heart disease, [39-42] and lowered beta endorphin levels, psychosocial distress, and fear among patients participating in a coronary sport group [43]. Nonetheless, the mechanism(s) mediating the neuro-psycho-physiologic effects of music on health behavior remain elusive.

Variable	Avid-music listeners*	Non-avid music listeners**	Total	p-value***
	n=72	n=75	n=147	
Perceived effects of music on health				0.002
Significantly improved health, *n (%)*	18 (28.1%)	6 (12.5%)	24 (21.4%)	
Moderately improved health, *n (%)*	26 (40.6%)	11 (22.9%)	37 (33.0%)	
Unchanged health, *n (%)*	20 (31.3%)	31 (64.6%)	51 (45.5%)	
Moderately worsened health, *n (%)*	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Significantly worsened health, *n (%)*	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Don't know, *n (%)*	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Perceived effects of music making on health				0.004
Excellent improvement in health, *n (%)*	10 (21.7%)	1 (2.7%)	11 (13.3%)	
Good improvement in health, *n (%)*	20 (43.5%)	11 (29.7%)	31 (37.3%)	
No change in health, *n (%)*	16 (34.8%)	25 (67.6%)	41 (49.4%)	
Marginally worse health, *n (%)*	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Significantly worse health, *n (%)*	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Perceived effects of passive listening on health				0.004
Excellent improvement in health, *n (%)*	10 (16.1%)	4 (7.7%)	14 (12.3%)	
Good improvement in health, *n (%)*	39 (62.9%)	22 (42.3%)	61 (53.5%)	
No change in health, *n (%)*	13 (21.0%)	26 (50.0%)	39 (34.2%)	
Marginally worse health, *n (%)*	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Significantly worse health, *n (%)*	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Perceived effects of music on daily stress and anxiety				0.681
Significant increase in stress and anxiety, *n (%)*	1 (1.5%)	2 (3.6%)	3 (2.5%)	
Slight increase in stress and anxiety, *n (%)*	1 (1.5%)	1 (1.8%)	2 (1.7%)	
No effect on stress and anxiety, *n (%)*	16 (24.6%)	18 (32.1%)	34 (28.1%)	
Slight decrease in stress and anxiety, *n (%)*	25 (38.5%)	22 (39.3%)	47 (38.8%)	
Significant decrease in stress and anxiety, *n (%)*	22 (33.8%)	13 (23.2%)	35 (28.9%)	
Perceived effects of music on mood				0.028
Significant effect on mood, *n (%)*	19 (27.9%)	12 (19.4%)	31 (23.8%)	
Moderate effect on mood, *n (%)*	29 (42.6%)	16 (25.8%)	45 (34.6%)	
Slight effect on mood, *n (%)*	13 (19.1%)	19 (30.6%)	32 (24.6%)	
No effect on mood, *n (%)*	7 (10.3%)	15 (24.2%)	22 (16.9%)	
Perceived effects of health on music preference				0.300
Significant effects on music preferences, *n (%)*	14 (20.9%)	5 (9.3%)	19 (15.7%)	
Moderate effects on music preferences, *n (%)*	19 (28.4%)	15 (27.8%)	34 (28.1%)	
Negative effects on music preferences, *n (%)*	11 (16.4%)	9 (16.7%)	20 (16.5%)	
No effects on music preferences, *n (%)*	23 (34.3%)	25 (52.1%)	48 (39.7%)	

Table 2. The relationship between the avidity of music with exercise and perceived self-reported indicators of health; * Respondents who listened to music all of the time, most of the time, or occasionally while exercising; **: Respondents who listened to music rarely or never while exercising; ***: p values were generated using Chi-Square and Wilcoxon Rank Sum for dichotomous and continuous outcomes respectively.

Variable	Avid-music listeners *	Non-avid music listeners **	Total	p-value ***
	n=72	n=75	n=147	
Inclusion of music into cardiac rehabilitation programs				0.002
Always include, *n (%)*	28 (45.2%)	10 (18.2%)	38 (32.5%)	
Frequently Include, *n (%)*	26 (41.9%)	23 (41.8%)	49 (41.9%)	
Occasionally Include, *n (%)*	8 (12.9%)	17 (30.9%)	25 (21.4%)	
Rarely include, *n (%)*	0 (0.0%)	3 (5.5%)	3 (2.6%)	
Never include, *n (%)*	0 (0.0%)	2 (3.6%)	2 (1.7%)	
Music's effect on exercise frequency				<0.001
Significantly improved, *n (%)*	12 (16.9%)	2 (6.9%)	14 (14.0%)	
Moderately improved, *n (%)*	15 (21.1%)	2 (6.9%)	17 (17.0%)	
No effect, *n (%)*	37 (52.1%)	19 (65.5%)	56 (56.0%)	
Moderately decreased, *n (%)*	1 (1.4%)	1 (3.4%)	2 (2.0%)	
Significantly decreased, *n (%)*	0 (0.0%)	1 (3.4%)	1 (1.0%)	
Don't know, *n (%)*	6 (8.5%)	4 (13.8%)	10 (10.0%)	
Music's effect on exercise intensity				<0.001
Significantly improved, *n (%)*	19 (26.4%)	3 (10.7%)	22 (22.0%)	
Moderately improved, *n (%)*	29 (40.2%)	5 (17.9%)	34 (34.0%)	
No effect, *n (%)*	19 (26.4%)	16 (57.1%)	35 (35.0%)	
Moderately decreased, *n (%)*	1 (1.4%)	1 (3.6%)	2 (2.0%)	
Significantly decreased, *n (%)*	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Don't know, *n (%)*	4 (5.6%)	3 (10.7%)	7 (7.0%)	

Table 2. (continued) The relationship between the avidity of music with exercise and perceived self-reported indicators of health; * Respondents who listened to music all of the time, most of the time, or occasionally while exercising; **: Respondents who listened to music rarely or never while exercising; ***: p values were generated using Chi-Square and Wilcoxon Rank Sum for dichotomous and continuous outcomes respectively.

The amplified perceptions associated with the health benefits of music as observed in our study may suggest an underlying 'healthy placebo-effect' associated with music-listening.

While placebo-effects imply the absence of true physiologic treatment effects on disease biology, they may still influence or modulate one's perceptions of symptoms or disease, and accordingly, impact on directly or indirectly on health-behaviors [44, 45]. Other research, such as studies examining the impact of music-listening following stroke, for instance, suggests that music-listening may have neurocognitive effects through changes in sensory processing [46].

The majority of respondents regardless of their avidity to listen to music during exercise acknowledged that music should be more formally integrated into cardiac rehabilitation programs. Even if it is ultimately proven that music were to have no direct physiological effects on health outcomes, music may still have implications for self-management music therapy and/or music therapeutic intervention protocols within the cardiac and personal health care context. For example, available evidence has demonstrated that personalized interventions can be delivered more efficiently and effectively when incorporating more holistic interventions [47]. Moreover, available evidence has demonstrated that music can serve as an aid to self-monitoring, and can induce neural entrainment and improve gait and coordination [48-51]. Music can serve as a catalyst for health promotion and prevention simply through personal enjoyment [1-4].

Research has supported the effectiveness of music therapy in a wide variety of health-care settings, including pre-surgical, pediatric, general medical, oncology and autism programs, as well as in palliative care and mental health programs [52,53]. In fact, research suggests a broader place for music in medicine.

Variable	Avid-music listeners*	Non-avid music listeners**	Total	p-value***
	n=72	n=75	n=147	
Average number of days exercising, *mean ± SD*	4.63±1.18	4.29±1.55	4.45±1.39	0.193
Self-reported health				0.135
Excellent, *n (%)*	12 (17.1%)	6 (8.3%)	18 (12.7%)	
Good, *n (%)*	41 (58.6%)	41 (56.9%)	82 (57.7%)	
Fair, *n (%)*	15 (21.4%)	19 (26.4%)	34 (23.9%)	
Poor, *n (%)*	1 (1.4%)	6 (8.3%)	7 (4.9%)	
Downhearted/blue				0.128
All of time, *n (%)*	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Most of time, *n (%)*	0 (0.0%)	2 (2.8%)	2 (1.4%)	
Good bit time, *n (%)*	5 (7.1%)	7 (9.7%)	12 (8.5%)	
Some of time, *n (%)*	14 (20.0%)	14 (19.4%)	28 (19.7%)	
A little time, *n (%)*	33 (47.1%)	21 (29.2%)	54 (38.0%)	
No time, *n (%)*	18 (25.7%)	28 (38.9%)	46 (32.4%)	
Daily stress/anxiety				0.763
Always, *n (%)*	2 (2.9%)	4 (5.7%)	6 (4.3%)	
Usually, *n (%)*	10 (14.3%)	10 (14.3%)	20 (14.3%)	
Occasionally, *n (%)*	31 (44.3%)	32 (45.7%)	63 (45.0%)	
Seldom, *n (%)*	18 (25.7%)	19 (27.1%)	37 (26.4%)	
Never, *n (%)*	9 (12.9%)	5 (7.1%)	14 (10.0%)	
Optimism				
Life Orientation Test-Revised score, *mean ± SD*	23.76± 4.30	22.79± 4.80	23.31±4.55	0.296

Table 3. The relationship between the avidity of music with exercise and traditional self-reported indicators of health; * Respondents who listened to music all of the time, most of the time, or occasionally while exercising; **: Respondents who listened to music rarely or never while exercising; ***: P values were generated using Chi-Square and Wilcoxon Rank Sum for dichotomous and continuous outcomes respectively.

The integration of humanities in the medical education curriculum could help physicians and other health providers improve analytical and synthetic reasoning, observation, empathy, and communication to enhance the interdisciplinary patient-centric application of holistic strategies to medicine [54]. The arts represent a source of insight into patients' experiences, and initial integration of the humanities into medicine has been done with the aim of fostering clinical competence and professional development [55]. Accordingly, we advocate for further research in order to refine, quantify, and translate such potential music-health applications, so that music can be used as an aid or optional tool, within the management tool-box available to health care providers and their patients. Music therapists may also assist other health-care providers and their patients in the formulation of optimal music and health regimes.

Our study has several noteworthy limitations. First, we did not objectively measure health and health behaviors, but rather assessed these through validated self-reported surveys. Nonetheless, one can reasonably hypothesize that the reliance of self-report for both *perceived* and *objective* health and health behavioral measures allowed for more direct comparisons since both were assessed using similar methodologies where the biases associated with self-report (e.g. negative affectivity bias, social desirability bias, recall bias etc.) would have presumably affected responses within the same individual in an identical, similar and/or comparable manner. Second, our study design was cross-sectional, which may have accounted for the discordance music's perceived vs. true effects on health and health behaviors. Indeed, recent evidence suggests that positive health perceptions may have a long-term positive impact on health outcomes [56]. Accordingly, a prospective longitudinal study design and/or randomized clinical trials would be needed to better examine the effectiveness of music on health and health behaviors. Finally, our survey was administered to a sample of cardiac rehabilitation participants, where the participation rate was 50%. The extent to which our findings can be generalized to other populations, other diseases, and other settings is unclear. That said, this is the first and largest study of its kind, where music-health perspectives were ascertained from one of the largest cardiac rehabilitation programs in North America. Moreover, the response-rates observed in our study are comparable with many published surveys in the literature.

In conclusion, tendencies to over-perceive positive health-benefits of music may exist among avid-music listeners, which in turn may suggest an underlying 'healthy placebo- effect.' The long-term health and behavioural implications associated with positive health-music tendencies require further study.

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