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The causes of death of professional musicians in the classical genre

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Abstract

Objective Music practice has been reported to have favourable effects on human health. To obtain more information about the effect of exposure to music from early childhood, we examined the causes of death of professional musicians in the classical genre.

Methods We used the standardized mortality ratios (SMR) for Finnish performing artists (N= 5,780) and church musicians (N= 22,368) during 1981–2016. We examined the deaths from cardiovascular diseases, cancers, neurodegenerative and alcohol-related diseases. The diagnoses were based on the ICD-10, and the data were obtained from Statistics of Finland.

Results Overall, SMR for all-cause mortality was 0.59 (95% CI: 0.57–0.61) for church musicians and 0.75 (95% CI: 0.70–0.80) for performing artists, suggesting a protective effect of music for health. In contrast, we found increased mortality in alcohol-related diseases among female performing artists (SMR 1.85, 95% CI: 1.06–2.95) and in neurodegenerative diseases among male performing artists (1.46; 95% CI: 1.13–1.84). Additionally, we found higher SMRs for female than male church musicians for cancers ($SMR_{females}$ 0.90; 95% CI: 0.83–0.97; SMR_{males} 0.60 95% CI: 0.54–0.67) and cardiovascular diseases ($SMR_{females}$ 0.75; 95% CI: 0.68–0.82; SMR_{males} 0.58; 95% CI: 0.54–0.64).

Conclusions Our results show that the causes of death differ among professional musicians in classical genre. Performing artists are not protected from neurodegenerative diseases or alcohol-related deaths. The study calls for further study on the working life of musicians.

Keywords: standard mortality rate, SMR, professional musician, classical genre

Section 1: The scientific knowledge on the topic before

- music listening and practice has been shown to affect human brain structure and function, and have beneficial effect on human health
- empirical data is largely missing about the effects of music on human bodies

Section 2: What this study adds

- Our study suggests that music practice does not prevent from dementia
- Studies on the life-long effects of profession in music are required

Introduction

Practicing music is a complex cognitive activity requiring simultaneous auditory and visual perception skills, precise timing and extended control over motor behaviour. There is abundant evidence that music listening and practice affect human brain structure and function.[1-3] Listening to music has been shown to cause physiological changes in cerebral blood flow, cardiovascular and muscle function, and enhance dopamine secretion in the human brain.[1 2] Musical practice has also shown to improve cognitive performance.[4] There are various brain areas that are activated during playing; especially those processing auditory, visual, and motor information, but also those involved in emotions, attention, learning and memory.[2 3 5 6] A large number of studies in the literature show that music has beneficial effects on human health,[7] and music intervention studies have been conducted in neurological and neuropsychiatric conditions.[8 9] Recent genomics studies have suggested that listening to music and music performance affect human gene expression profiles.[10 11] Although much is already known, empirical data is scarce about the biological effects of music on the bodies of professionals or novice musicians.

Being a professional musician in the classical genre requires the musician to control an instrument with a high level of precision, and it is not possible to acquire this level without long-term everyday practice, starting in early childhood. Having a drive for music may be one of the pre-requisites for choosing music as a profession, suggesting that music training is enjoyable and rewarding and offers opportunities to develop as an artist and express artistic skills. Several biological and environmental factors such as genetic background, early detection of an interest towards music, and support from family and society may facilitate this development.[12] Since professional musicians in the classical genre have an exceptionally intense drive and a long exposure to music, we hypothesize that in this group of musicians, the biological effects of music could be most easily detected. In order to obtain more information about the biological effects of music we examined the causes of death among Finnish professional musicians.

Study population and methods

We investigated two groups of classical professional musicians for the study: 1) Church musicians (*church)* and 2) Orchestral musicians and performing artists *(performers),* including musicians working in radio- and television, as independent artists, and as theatre- and opera musicians (see Table 1). The selection of the groups was based, first, on the fact that in these groups musical training usually begins early and continues throughout the musician's lifetime. Secondly, we chose these two groups because the characteristics of the professions differ.

The selection was based on the Finnish classification of professions in Statistics of Finland (www.stat.fi). When selecting the participants, we checked both the occupational category and the standard industrial classification; in addition, we checked the degrees in music obtained by church musicians. Since the position as a performing soloist, in an orchestra, or at the opera is based on audition, we did not check the degree for performers. The work history of the subject covered the years between 1970 and 2016. Since the categorization used in the Statistics of Finland has changed between 1970 and 2016, we chose the following occupational categories for church musicians in the Evangelical-Lutheran and Orthodox Church: 'cantor', 'organist', 'cantor-organist', and 'church musician'; and the following for performers: 'conductor', 'choir conductor', 'singer', 'opera-singer', 'opera-musician', 'choir-singer', 'cellist', 'violinist', 'pianist', 'composer', 'musician or singer in the classical genre'. The whole population of

Finland (current population 5.5 million inhabitants) during the same time period was chosen as a control group.

We calculated cumulative work years in the study population mentioned above and grouped the individuals according to the first profession in which they had worked for ten years. In the case of a tie, we grouped them first as church musicians and then as performers. The follow-up started when ten years of professional experience had been accumulated and ended in 2016 or on the subject's death which ever occurred first.

We studied the following causes of death using data obtained from the Statistics of Finland (permission TK-52-557-18): cancers (ICD10 C00-C97); neurodegenerative diseases (F01, F03, G30, R54); cardiovascular diseases including ischemic heart diseases (I20-I25), cerebrovascular diseases (I60-I69), and other diseases of the circulatory system (I00-I15, I26-I28, I70-I99); and alcohol related diseases and accidental poisoning by alcohol (V01-X44, X46-Y89, V01-X44, X46-X59, Y10-Y15, Y85-Y86). More specifically, diagnosis of neurogenerative diseases was based on the most common neurodegenerative diseases of the brain, that is, Alzheimer's disease, Lewy body disease, frontotemporal dementia and multiple systems atrophy (MSA) (see Appendix Table 3).

We calculated all-cause and cause-specific standardized mortality ratios (SMR) assuming a Poisson distribution.[13-15] Age, sex, and calendar year adjusted SMRs were calculated using the R-language[16] package popEpi[17].

Results

The study population consisted of 28,148 individuals (56.9% female) (Table 1). A total of 22, 368 church musicians and 5,780 performing artists were found who had worked for 10 years or more in their profession. SMR for all-cause mortality was 0.59 (95% CI: 0.57–0.61) for church musicians and 0.75 (95% CI: 0.70–0.80) for performing artists when the study population was compared to general population of Finland (Table 2 and Figure 1). Based on the results, the professional musicians in the classical genre do not represent a homogeneous group. Overall, the SMRs of performing artists were higher than SMRs of church musicians in all diagnostic categories (Table 3).

The analyses of cause-specific SMRs revealed that deaths of alcohol-related diseases were especially rare in church musicians (Table 3). With performing artists, the SMRs were approximately the same as with the general population. (Table 3). When the cause-specific SMRs were analysed separately for females and males, there was an increase in SMR for female performing artists of alcohol-related mortality (SMR 1.85, 95% CI: 1.06–2.95) compared to that in general population and in church musicians and male performing artists (Table 4 and Figure 1).

For neurodegenerative diseases, no difference was found in SMRs between the church musicians and the general population (Table 3). However, we found that performing artists had a slightly higher SMR of 1.29 (95% CI: 1.06–1.54) compared to the general population. The increase was seen especially in males (1.46; 95% CI: 1.13–1.84) (Table 4).

For cardiovascular diseases, SMR was lower among professional musicians compared to the general population (Table 3). Among church musicians the SMR for cardiovascular diseases was higher in females (SMR 0.75; 95% CI: 0.68–0.82) than in males (SMR 0.58; 95% CI: 0.54–0.64) (Table 4). For cancers, lower SMRs were identified in both musician groups compared to the general population (Table 3). As with cardiovascular diseases, a clear gender difference in SMRs for cancers was detected between female church musicians (SMR 0.90; 95% CI: 0.83–0.97) and male church musicians (SMR 0.60; 95% CI: 0.54–0.67). With performing artists, the SMRs were at the same level as those of the female church musicians (Table 4 and Figure 1).

Discussion

We have performed a comprehensive study about the mortality of professional musicians in the classical genre. The study is related to a wider question about the biological effects of music in general and gives new information about the causes of death of professional musicians. The lower all-cause mortality in professional musicians compared to the general population supports the previous findings[1 8 9] that music has beneficial effects on human health. However, there are some caveats. The SMRs varied depending on profession in the classical genre; church musicians and performing artists differed from each other in several diagnostic categories and gender differences were also common. Below we will discuss each diagnostic category separately, and we begin with comparisons between the study groups and the general population and follow with comparisons between genders within the study group.

Alcohol-related diseases

There was a clear difference between the SMRs for alcohol-related diseases in church musicians and performing artists. The SMRs for alcohol-related diseases were very low for church musicians. It has been shown that there is a connection between low-level alcohol use and religiousness, especially in rural areas.[18] With performing artists, by contrast, the mortality rates adjusted for age, sex and calendar year were approximately the same as for the general population (Table 3). It should however be noted that female performing artists had higher SMRs than males (Table 4 and

Figure 1). Performing artists obtain their work by public auditions and competitions. The work is characterized by constant performances and preparing for them, and the performances are exposed to public critic which may cause stress. The use of alcohol is known to ameliorate anxiety and stress[19] that are likely to be aggravated with long working hours.[20] It is known that females are more sensitive to the harmful effects of alcohol than males.[21] With performing musicians in the classical genre we did not find the increase in deaths of liver diseases, suicides, drug abuse and accidents that has earlier been found among professional musicians in pop music.[22]

According to the current understanding, music and alcohol partially share the same neurocircuits, increase dopamine secretion and mediate the rewarding effects in the brain thus reinforcing each other. Compatible with this, dopamine secretion improves the creative thinking and goal-directed modes of work,[23] important for performing musicians. There is evidence that the trait of sensation-seeking has been associated with increased alcohol misuse in female musican performers of certain genres, including classical, folk, jazz and blues.[24] The result calls for further study of alcohol use in the group of performing artists.

Neurodegenerative diseases

Based on our results, the mortality to neurodegenerative diseases is increased in male performing artists in this study (Table 4; Fig.1). Age, common diseases (diabetes, obesity, hypertension, dyslipidemia), genetic liability and life style (alcohol, smoking) are known risk factors for neurodegenerative diseases whereas education, healthy diet, leisure and physical activities protect from them.[25] In addition, work-related stress has been shown to increase mild cognitive impairment, dementia and Alzheimer disease.[26 27] Musicians go through a number of examinations already during their studies, and the field exposes them to professional competition. Musicians' personal and artistic expectations are high and subjected to public critic. The work of performing artists is characterized by an all-encompassing devotion to the profession, and individuals are deeply engaged in their work possibly complicating their social lives due to a lack of time. These stressors combined with irregular working hours (the concerts usually take place in the evenings, disturbing the normal circadian rhythm) in performing artists have been well described; for example, Vervainioti and Alexopoulos[28] recognized 19 stressors and classified them into seven categories. Adrenocortical activation has an important role in coping with physical and psychogenic stressors and is the risk factor for neuronal damage in hippocampus that affects the memory.[27] To our knowledge, studies about the effects of music training on brain structure and function are only available for young musicians (average age 25 years).[5 29] Increased SMRs for neurodegenerative diseases found in this study raise the question of whether exposure to music really can ameliorate dementia. Again, further studies are warranted concerning the course of events leading to neurodegeneration as well as sex difference for susceptibility to neurodegenerative diseases in performing artists.

Cardiovascular diseases and cancers

Overall, both the musician groups had lower SMRs for cardiovascular diseases than the general population. Additionally, the church musicians had lower SMRs for cancers. (Table 3.) Cardiovascular diseases and cancers share common risk factors such as age and life-style (diet, harmful use of alcohol, smoking, physical inactivity).[30 31] In addition to music, these factors may have a favourable effect on the musicians' body but the effect of education cannot be excluded.[32] It has to be noted that the study groups had a higher education (up to a university degree) and a higher socioeconomic status in their field, and these are known to be associated to lower mortality.[33]

Even though church musicians' SMRs for cardiovascular diseases and cancers were lower than those for the general population (Table 3), the results showed clear differences in SMRs between male and female church musicians (4 and Figure 1). Males are usually more susceptible to cardiovascular diseases than females.[34] Interestingly, in in this study female church musicians had higher SMR than males. Similar gender difference was obtained also with cancers. These differences cannot be explained by the work as such. There is some evidence that female musicians might be more conscientious than males[32] and thus more sensitive to public opinion. Church musicians have also unconventional working hours and work fragmentation,[35] which restrict every-day life more in female than male church musicians and cause abnormal day rhythms that are known to increase morbidity.[36 37] Additionally, exogenous stressors are known to influence mood and cardiovascular regulation.[38]

We acknowledge several limitations in this study. First, professional musicians in this study may have been working in different positions during their lives. It is possible that especially the performing artists have been categorized into the occupational category of music teachers and were hence not found in our study. In addition, no information was available about the musical practices of individuals in the control group. Further, the diagnostic criteria of neurodegenerative diseases have been developed during the study period and may not be the same for all cases. In an observational study, it is not possible to determine if associations are really due to exposure, in this study occupational category, or if there are confounding factors causing association. It is quite possible that there is selection bias in this study. This means that there are several characteristics connected to personal and other characteristics of musician that determine to which group he or she will belong. These same unmeasured characteristics may also be connected to mortality.

Conclusions

Our study was the first one to examine causes of death in musicians of the classical genre. The strengths of our study are the whole Finnish cohort of church musicians and performing artists working between 1970 and 2016 as well as the ICD-10-based causes of deaths.

Although cardiovascular diseases, cancers, and neurodegenerative diseases share many common risk factors, our results showed higher SMRs for neurodegenerative diseases than for the other two diagnostic groups in professional musicians. This may suggest that the brain is sensitive to environmental effects, such as stress. Our results indicate that the effect of performance-related stress may contribute to the overall higher SMRs of performing artists in all diagnostic categories compared to the church musicians and the differences between male and female musicians.

Music can be considered as an environmental enrichment[39] that improves brain function.[3 4 6 7] In this study, this effect could not be demonstrated; instead, it seems that there are other factors in musicians' profession, for example performance-related stress that may have contributed to the differences in SMRs between male and female musicians of our study. The results can be used to inform health care professionals, musicians, and music students about the risk factors.

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Contributors TK designed the study, selected the study material and wrote the manuscript. JH performed the statistical analyses and wrote the manuscript. LM advised the study design. IJ got the idea for the study, selected the diagnoses, and wrote the manuscript. All authors approved the final version of the manuscript.

Competing interests None declared.

Patient consent Not required.

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Figures and tables

Figure 1. Standardized mortality ratios (SMR) and 95% confidence intervals of four causes of death, separately for males and females in the two study groups.

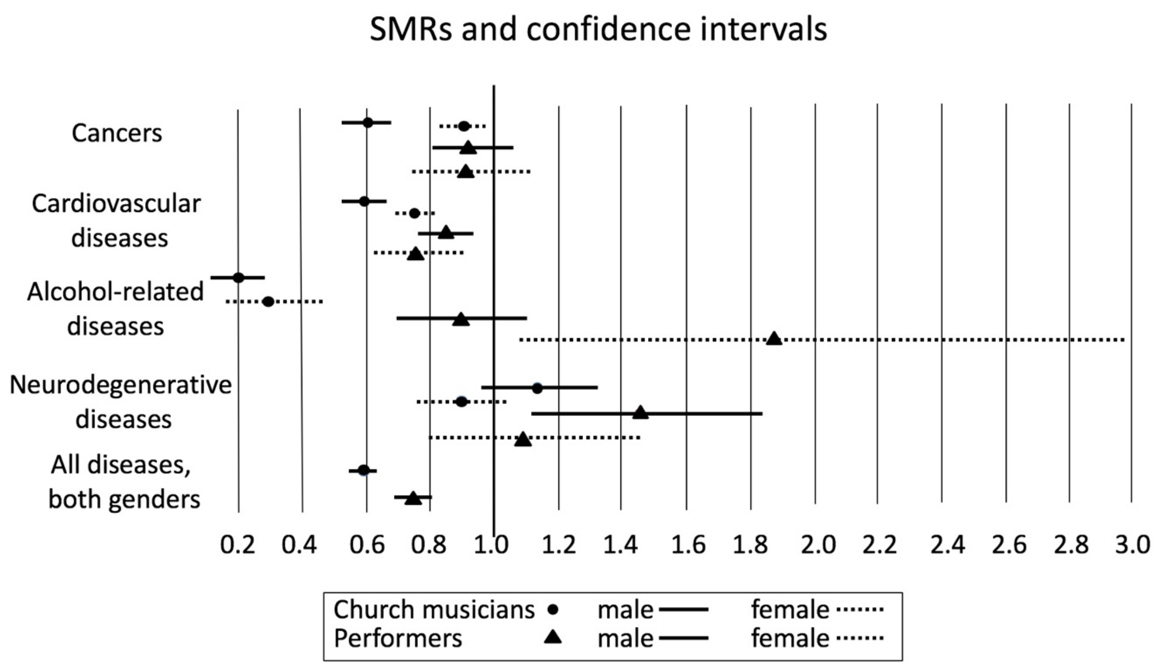

Table 1. Basic characteristics of the study population at the start of the follow-up.

		Church	Performers	All
Sex	Male	8348(37.3%)	3780(65.4%)	12128 (43,1%)
	Female	14020(62.7%)	2000(34.6%)	16020 (56.9%)
	All	22368(100%)	5780(100%)	28148 (100.0%)
Age in start of follow-up	40 or under	9434(42.2%)	2774(48.0%)	12208(43.4%)
	40≤50	6404(28.6%)	1674(29.0%)	8078(28.7%)
	50≤60	4890(21.9%)	896(15.5%)	5786(20.6%)
	over 60	1640(7.3%)	436(17.5%)	2076(7.4%)
	All	22368(100%)	5780(100%)	28148(100%)

Table 2. Observed and expected number of deaths and standardized mortality ratios (SMR) with 95% confidence interval. Comparison to general population of Finland.

Category	**Observed**	**Expected**	**SMR**	**95% CI**	
Church	2336	3961	0.59	0.57	0.61
Performers	939	1255	0.75	0.70	0.80

Table 3. Observed and expected number of deaths in four diagnostic groups and standardized mortality ratios (SMR) with 95% confidence interval. Comparison with the general Finnish population and adjusted for age, sex, and calendar year. The SMRs and confidence intervals that differ from the general population are in bold print.

Cause of death	Category	Observed	Expected	SMR	95% CI	
Cancers	Church	954	1261	**0.76**	**0.71**	**0.81**
	Performers	334	361	0.93	0.83	1.03
Neurodegenerative diseases	Church	317	317	1.00	0.89	1.11
	Performers	109	85	**1.29**	**1.06**	**1.54**
Cardiovascular diseases	Church	1017	1558	**0.65**	**0.61**	**0.69**
	Performers	419	510	**0.82**	**0.75**	**0.90**
Alcohol-related diseases	Church	48	211	**0.23**	**0.17**	**0.30**
	Performers	77	79	0.98	0.78	1.21

Table 4. Sex-specific observed and expected number of deaths in four diagnostic groups and standardized mortality ratios (SMR) with 95% confidence interval. Comparison to the general Finnish population and adjusted for age, sex, and calendar year. The SMRs and confidence intervals that differ from the general population are in bold print.

Cause of death	Category	Sex	Observed	Expected	SMR	95% CI	
Cancers ICD10 C00-C97	Church	male	365	604	**0.60**	**0.54**	**0.67**
	Church	female	589	657	**0.90**	**0.83**	**0.97**
	Performers	male	243	262	0.93	0.81	1.05
	Performers	female	91	99	0.92	0.75	1.13
Neurodegenerative diseases F01, F03, G30, R54	Church	male	146	126	1.16	0.98	1.36
	Church	female	171	191	0.89	0.77	1.03
	Performers	male	66	45	**1.46**	**1.13**	**1.84**
	Performers	female	43	39	1.09	0.80	1.45
Cardiovascular diseases I00-I15, I20-I25, I26-I28, I60-I69, I70-I99	Church	male	529	906	**0.58**	**0.54**	**0.64**
	Church	female	488	653	**0.75**	**0.68**	**0.82**
	Performers	male	322	383	**0.84**	**0.75**	**0.94**
	Performers	female	97	127	**0.76**	**0.62**	**0.92**
Alcohol-related diseases V01-X44, X46-Y89, V01-X44, X46-X59, Y10-Y15, Y85-Y86	Church	male	29	145	**0.20**	**0.14**	**0.28**
	Church	female	19	66	**0.29**	**0.18**	**0.44**
	Performers	male	62	71	0.88	0.68	1.12
	Performers	female	15	8	**1.85**	**1.06**	**2.95**