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Review of Literature

Cardiac autonomic modulation related to prayer may contribute to the reduced cardiovascular mortality associated with religiosity/spirituality

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ABSTRACT

Cardiovascular disease is the leading cause of morbidity and mortality worldwide. During the past few decades, several studies have demonstrated an association between religiosity/spirituality and beneficial effects on mental and physical health. Longitudinal studies have found significant association between regular attendance at religious services and reduced all-cause and cardiovascular mortality. Among the several potential pathways of higher religiosity/spirituality, there are biological mechanisms such as decrease the inflammatory cytokines and cortisol levels, enhance of parasympathetic activation and attenuation of sympathetic nervous system activity. Prayer can be a possible mediator of the positive religiosity/spirituality effects in the cardiovascular system. The objective of this article is to review the potential mechanisms by which prayer interferes in the cardiovascular system, and which would explain its influences in cardiac mortality and morbidity. We found that prayer was associated with a lower prevalence of coronary artery disease. Studies have demonstrated that prayer was associated with a parasympathetic activity increase and decrease in the sympathetic nervous system component. In conclusion, prayer had been linked to higher levels of cardiac autonomic, a condition that is associated with a reduced risk of cardiac arrhythmias, and cardiac mortality. Scientific research on the health benefits of prayer should be expanded, aiming to obtain a clearer understanding of the possible positive action of prayer on the cardiovascular system, especially in the cardiac autonomic modulation. Although there is no recommendation of prayer prescription by cardiologists, the pivotal effects of this spiritual practice should be known within the cardiology.

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Introduction

Cardiovascular disease is the leading cause of morbidity and mortality worldwide [1, 2]. The understanding regarding the impact of psychosocial risk factor in heart disease has grown in the last decade [3-5]. Psychosocial stressors such as depression and chronic stress can lead dysregulation of autonomic nervous system function, endothelial dysfunction, and persistent hypothalamic pituitary adrenal axis activation in patients with cardiovascular disease or even previously cardiac healthy individuals [6-9]. In these people, behavioral factors and

involvement in health promotion activities have also been implicated among the mechanisms responsible for the higher rate of cardiovascular mortality [10, 11]. In the INTER-HEART study, psychosocial stressors including depression, locus of control and perceived stress (defined as tension or anxiety due to external influences) were independently associated with increased risk of acute myocardial infarction, suggesting that approaches aimed at changing these factors should be developed [12, 13].

During the past few decades, several studies suggested a positive

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association between religiosity/spirituality and benefits associated with the mental and physical health [14-18]. *Koenig* et al. have defined spirituality as “the personal quest for understanding answers to ultimate questions about life, about meaning and about relationship to the sacred or transcendent, which may (or may not) lead to or arise from the development of religious rituals and the formation of community” [3]. According to *Puchalski* et al. spirituality is “the aspect of humanity that refers to the way individuals seek and express meaning and purpose and the way they experience their connectedness to the moment, to self, to others, to nature, and to the significant or sacred” [4]. Alternatively, religiosity is often defined as the adherence to beliefs, doctrines, ethics, rituals, texts, and practices associated with a higher power either alone or among organized groups [19-21]. Although religiosity and spirituality are distinct constructs, the overlap between them is consistent and remarkable. Thus, the term religiosity/spirituality (R/S) has been widely used in the literature [16,18].

There is a growing interest in researching the association between religiosity/spirituality and health, stimulated by the finding that people who regularly attend religious services have a decrease in all-cause and cardiovascular mortality of almost 30% [22-25]. Several case-control and prospective cohort studies have linked R/S with reduced cardiovascular morbidity and mortality [24-28]. Previous meta-analyses showed the protective effect of R/S on mortality due to cardiovascular disease [16, 29]. This protective effect in healthy population studies persisted even after controlling for major behavioral covariates such as smoking abstinence, exercising, drinking moderately, lower dietary fat intake, and better sleep quality [19, 30]. Another potential interpretation is that R/S contributes to reduced mortality by increasing social support or by buffering psychological distress [19, 31]. Nevertheless, the persistence of associations in meta-analyses of studies that controlled for social support or negative affect was that the protective effect of R/S on mortality is at least partly independent of social support and negative affect [16, 18]. Prayer is considered a widely used spiritual and religious practice and could be a possible mediator of the beneficial effects of religiosity/spirituality in the cardiovascular system. This article aims to review the potential mechanisms by which prayer interferes in the cardiovascular system, and which would explain its influences in mortality and morbidity.

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Multiple researchers proposed that direct physiological pathways might also be involved [14, 17-19]. Religiosity/spirituality might lead to a reduction in heart rate or blood pressure [17, 32, 33]. In some studies, R/S has also been related to decrease the inflammatory cytokines levels, lower cortisol responsiveness or circulating cortisol levels, and may thereby contribute to reduced risks for a range of health outcomes [34-37]. It is also possible that R/S may be associated with reduced mortality by increasing positive emotions such as life satisfaction, happiness, and cheerfulness [38-41]. Therefore, psychoneuroimmunology and neuropsychiatric studies have advanced the knowledge on the social, psychological, biological, and behavioral mechanisms that mediate the positive association between R/S and health [19]. So there is an extensive literature relating a protective and preventive effect exerted by religious/spiritual practices on a variety of health conditions [18, 19].

Prayer is considered one of the most frequent religious or spiritual practice, used by individuals involved with all theistic faiths and even by

those who do not belong to a particular religious tradition [42, 43]. Praying may be regarded as a strategy to cope and connect with a higher source providing hope and meaning [42, 44]. The personal prayer of patients has been shown to positively correlated with their physical and mental well-being [45, 46]. Besides the fact that prayer may be a resource to positively transform the patient's experience of their illness, this spiritual practice has been linked with higher levels of cardiac autonomic control, a condition that in turn has been associated with a reduced risk of cardiac arrhythmias and cardiovascular mortality [47-54]. This may be explained because the heart autonomic nervous system (ANS) is a crucial component in the physiological function and pathological responses of the cardiovascular system. Sympathetic and parasympathetic nervous system are the two branches of the autonomic system, and both orchestrates many events that allow for appropriate heart rate, blood pressure, and vasoregulatory responses to routine daily stimuli [50, 53, 55]. Dysregulation of this system contributes to cardiovascular pathology, including hypertension, ischemic heart disease, arrhythmias, and congestive heart failure. Hence, autonomic imbalance often contributes to fatal outcomes [53, 55]. The acute physiological changes occurring during prayer and meditation have been extensively researched and show a reduction of sympathetic nervous system activity decrease, oxygen consumption, minute ventilation, and respiratory rate [32-54]. Prayer has been linked with higher levels of cardiac autonomic control and increased baroreflex sensitivity, conditions that are associated with a reduced risk of cardiac arrhythmias and cardiac mortality [5, 53, 57].

A cross-sectional study that involved 3,148 individuals of a rural population in India has shown that men engaged in regular prayer had a significantly lower prevalence of coronary heart disease after adjustment for coronary risk factors. The education and prayer habit was considered protective for the disease of coronary arteries [6]. *Burazeri* et al. conducted a case-control study with Muslim and Christian people, and there was included 467 nonfatal consecutive acute coronary syndrome patients. Religious observance was inversely associated with these cardiac events. Among the items tapping this form of religiosity, the strongest and most consistent findings were the frequency of prayer and fasting [7]. Few studies have investigated the effects of prayer in the cardiac autonomic system balance by the heart rate variability (HRV) [47, 48]. The HRV analysis is a reliable reflection of the physiological factors modulating the normal heart rhythm [8]. The heart rate variability provides a powerful means of observing the interplay between the parasympathetic and sympathetic systems [47, 60, 61]. Hence, this analysis has become a popular noninvasive tool for assessing cardiac autonomic modulation [60-62].

Stanley investigated the effects of five types of prayer on HRV [9]. The following definitions were used for each kind of prayer: supplication, one-sided, directed petitions; devotion, rote prayers such as the rosary or Jesus prayer; intercession, open mutual and directed conversation with God; gratefulness, focus on gratitude and thanksgiving; and centering prayer, one kind of contemplative prayer that is a quiet and imageless prayer form similar in many ways to meditation. In this research, it was found that all prayers elicited varying degrees of improve of HRV. However, the specific prayer forms produced different actions in the HRV analysis. The gratefulness and centering prayer resulted in a higher level of benefits seem with system-wide synchronization between the parasympathetic and sympathetic branches of the nervous system. Gratefulness elicits a degree of emotional, psychological, spiritual, and

physical unity both inwardly and outwardly, creating a unique heart rate variability pattern seemingly distinct from general positive emotions such as happiness or contentment [10, 11]. In this uncontrolled study, the greatest physiological benefit was associated with prayers of gratefulness and contemplative showed a trend toward greater benefit with more meditative and relational forms of prayer [9, 12].

Doufesh et al. investigated the HRV and electroencephalography signals of 30 healthy young, Muslim men [13]. It was aimed to explain the effect and the possible link among the power spectral analysis of alpha band frequency in the electroencephalography and ANS activities represented by the frequency bands of HRV during *salat*, an Arabic term of Islamic Prayer. It was observed a notable increase in a wave activity at the parietal and occipital regions of both brain hemispheres. The production of alpha brainwave is usually promoted by the parasympathetic nervous system activity with suppression of sympathetic nervous system action [14]. These findings strongly suggest that the high degree of alpha waves activity during *salat* is associated with more upper relaxation, reduced tension, and sustained focus [65, 66]. There was a relatively stronger parasympathetic mobilization. The increased electroencephalography occipital and parietal alpha wave power during *salat* suggests that this Islamic prayer produces positive changes in brain function and human well-being. These changes were associated with a parasympathetic activity increase and decrease in the sympathetic nervous system component.

It is curious, because at first glance, patient prayer practices may not seem relevant to health professionals, including cardiologists. We believe that the findings found in this review may be useful for clinical practice because praying would be considered as a strategy not only to cope and connect with a larger source, providing meaning and hope [12, 15-17], but it can also have a positive influence on the cardiovascular system. However, elucidation of potential mechanisms and clinical significance of the association between prayer and cardiovascular disease requires further research. As previously described, it is well known that increased frequency of attendance at religious services and greater spiritual well-being have been related to lower cardiovascular mortality and reduction in several negative clinical outcomes [22-25, 27]. However, it is still unknown what are the real mechanisms involved in this relationship between spirituality/religiosity and mortality or cardiovascular outcomes. It is possible that prayer practice may be an important mediator, but the elucidation of potential mechanisms and clinical significance of the association between prayer and cardiovascular disease requires further research.

Conclusion

Prayer has been linked with higher levels of cardiac autonomic control, condition associated with a reduced risk of cardiovascular events and cardiac mortality. Therefore, within the cardiological practice, scientific research on the health benefits of prayer should be expanded, aiming to investigate the positive action of prayer as a potential mediator of religion/spirituality on the cardiovascular system. According to this review, it seems important that health professionals recognize this potential benefit of personal prayer, especially in the cardiac autonomic modulation. Although there is no recommendation of prayer prescription by cardiologists, the pivotal effects of this spiritual practice should be known within the scientific community as a possible complementary aid to medical therapy.

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Declaration of conflicting interests

The authors declare that there is no conflict of interest.

Author contributions

Julio Tolentino (JT), and Ricardo Bedirian (RB) contributed to the overall conception and design of the work. JT, and RB drafted the manuscript. All authors critically revised the manuscript and gave final approval. All agree to be accountable for all aspects of work ensuring integrity and accuracy

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