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A Biopsychosocial Model Predicting Myocardial Infarction

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Abstract: Myocardial infarction is one of the main causes of death, and cardiovascular risk factors (CVRF) are always considered when studying it. However, although it is known that other social and psychological variables, and especially frailty, can increase the risk of infarction, their simultaneous effect has not been extensively studied. This study is based on data from the SHARE project (latest wave, 8), with a representative sample of 46498 participants, aged 50 or older (M = 70.40, SD = 9.33), 57.4% were females. Statistical analyses included a full structural equation model that predicts 27% of infarction occurrence and evidences the significant effect of well-being, depression, and social connectedness on frailty. Frailty in turn explains 15.5% of the variability of CVRF. This work supports the need to study these physical, social, and mental health factors together to intervene on frailty, and in turn improve cardiovascular outcomes.

Keywords: biopsychosocial approach; coronary artery disease; cardiovascular disease; SHARE survey; aging

1. Introduction

Myocardial infarction is caused by decreased or complete cessation of blood flow to a portion of the myocardium, which can be silent and go undetected, or it could be a catastrophic event leading to hemodynamic deterioration and sudden death [1]. Cardiovascular diseases are the leading cause of death globally, an estimated 17.9 million people died from a cardiovascular disease in 2019, representing 32% of all global deaths. Of these deaths, 85% were due to myocardial infarction and stroke [2]. Age is an independent non-modifiable cardiovascular risk factor, that may be compounded by additional modifiable factors, including frailty and diabetes, which are known to complicate and enhance cardiovascular risk factors associated with the onset of advanced age [3].

Frailty is considered a geriatric syndrome in which there is increased individual vulnerability for developing dependence or death when exposed to minor stressors [4]. According to the Fried criteria, the frailty phenotype is defined as the presence of at least three of the following conditions: unintentional weight loss, self-reported exhaustion, slow gait speed, low energy expenditure and weak grip strength [5]. Moreover, the presence of frailty syndrome increases the risk for faster onset of any type of cardiovascular disease (regardless of classical cardiovascular risk factors) and adds about 4-fold the risk of death from cardiovascular causes [6].

Recent studies have focused on associations between frailty and psychosocial factors, such as loneliness and/or social isolation. Loneliness refers to subjectively perceived deficits in social support or social connections, whereas social isolation is a more objective measure of the lack of social contact [7]. All these studies [8,9] demonstrate a robust bidirectional relationship between frailty and the aforementioned psychosocial indicators, thereby suggesting the need to delve deeper into these areas. Additionally, the research to date has indicated a strong reciprocal relationship between depressive symptoms and frailty, this holds across different study designs, regions, gender, and confounder

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variables used, but the extent, type, and mechanism underlying this relationship have yet to be deciphered [10]. Lastly, multidimensional frailty was associated with a higher risk of mortality and significantly lower quality of life [11].

Hence, the objective of this research was to study the occurrence of myocardial infarction from a holistic and psychosocial approach, to address the relationship between frailty and cardiovascular risk factors, thereby appreciating frailty through a psychosocial lens. Improving the existing information since the simultaneous effect all these variables in the cardiovascular risk factors and myocardial infarction has not been extensively studied.

2. Materials and Methods

2.1. Sample and Procedure

The data for this study comes from the 8th wave of the Survey of Health, Ageing and Retirement in Europe (SHARE), the most recent gathered data collected between 2019 and 2020. SHARE has a probability-based method aimed at populations aged 50 or more across 26 European countries and Israel. More information about the SHARE survey design is available elsewhere [12,13]. The Study on Health, Aging and Retirement in Europe (SHARE) project is subject to continuous ethical review, and the wave 8 was approved by the ethics council of Max Planck Society in Munich. The present study involved 46498 participants; their sociodemographic description, such as age and gender can be found in Table 1.

Table 1. Means, standard deviations or percentages of all the observed variables in the model.

Variable	Mean or Percentage	SD
Age	70.40	9.33
Mobility	1.74	1.10
Handgrip strength	31.92	11.28
Loneliness	3.99	1.44
Social connectedness	1.98	0.90
Economic status	2.77	1.01
Quality of life	37.29	6.32
Depressive symptomatology	2.01	1.92
Gender	*Male*= 42.6% *Female*= 57.4%	
Myocardial infarction	*No*= 86.9% *Yes*= 13.1%	
Hypertension	*No*= 54% *Yes*= 46%	
High cholesterol	*No*= 74.8% *Yes*= 25.2%	
Diabetes	*No*= 85.2% *Yes*= 14.8%	
Slowness	*No*= 87.2% *Yes*= 12.8%	
Appetite	*No*= 90.4% *Yes*= 9.6%	
Fatigue	*No*= 63.9% *Yes*= 36.1%	

2.2. Instruments

Frailty assessment was performed by the SHARE-Frailty Index (SHARE-FI) [14,15] based on the Fried criteria,[5] it includes five measures: self-perceived fatigue, diminution of appetite and energy (slowness) in the last month, moderate physical activity, and handgrip strength.

Myocardial infarction was measured with the question "Have you ever had a heart attack". Additionally, several cardiovascular risk factors were assessed with being diagnosed (yes/no) with high blood pressure or hypertension, high cholesterol, and diabetes or high blood sugar.

Depressive symptoms were measured with several indicators of the EURO-D scale [16], these were depressed mood, pessimism, suicidality, guilt, sleep, (lack of) interest, irritability, (lack of) concentration, (lack of) enjoyment and tearfulness. Two items from the original scale were removed

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(fatigue and appetite) to avoid overlapping, since they are part of the frailty index. The internal consistency of the scale was α =.66, ω= .67 in this analysis.

Loneliness was assessed with the UCLA scale [17], which contains three items related to the frequency of feeling lack of companionship, excluded, and isolated. Responses ranged from 1 (hardly ever or never) to 3 (often), with α =.76 and ω=.76.

Quality of life was measured with the CASP-12 [18]. It included four domains: control, autonomy, self- realization, and pleasure, which can be combined in a total quality of life score. The scale is composed by 12 items answered in a 4-point Likert scale ranging from 1 (never) to 4 (often), with α = .83 and ω= .83.

As a measure of social isolation, we used the Social Connectedness scale [19]. It combines the following aspects: network size, proximity (number of social network members living within 25 km), frequency of contact (number of cited persons with weekly or more contact), emotional closeness (number of cited persons with very or extremely close emotional ties), and diversity (the different types of relationships in the network) with lower values reflecting higher social isolation. The transformed values of the scale ranged from 0 to 4, and it had adequate internal consistency (α =.89, ω=.90).

Furthermore, several socioeconomic control variables were considered to minimize confounding effects, that include: age, gender, that was dichotomous (female = 1, male = 0); and economic states, measured with the question "Thinking of your household's total monthly income, would you say that your household is able to make ends meet?" answered in a 4-point Likert scale ranging from 1 (with great difficulty) to 4 (easily).

2.3. Statistical Analyses

For the purposes of this study, a full structural equation model (SEM) was estimated using MPlus 8.7 [20] to test a model relating social and psychological variables as antecedents of frailty, and cardiovascular risk factors and myocardial infarction as consequences. SEM models were used to relate variables in a multivariate context, so this procedure enables the analysis of latent variables, such as frailty and cardiovascular risk factors, without measurement errors and simultaneously their predictive power to explain the myocardial infarction and their relationships.

We used Weighted Least Squares with Mean, and Variance corrected (WLSMV) as the method of estimation, adequate for the non-normal and ordinal nature of some the data [21]. In order to declare model fit acceptable, we employed the criteria of Comparative Fit Index (CFI) of at least .90, a Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR) below .08 [22].

3. Results

Table 1 shows the descriptive statistics of all observed variables involved in the model. For quantitative and semi-quantitative variables, mean and standard deviations are shown, whereas for categorical variables percentages of all categories are presented.

The structural model in Figure 1 theoretically posits age, gender, and economic status in the household as potential predictors of the psychosocial variables (quality of life, depressive symptoms, loneliness, and social connectedness). These psychosocial variables are supposed to affect frailty status, which in turns affects the likelihood of cardiovascular risk factors. Finally, the more the cardiovascular risk factors, the higher the probability of suffering a myocardial infarction. The model showed good data fit: $\chi^2(85) = 3617.87$, $p< .001$; RMSEA= .030, 90% CI [.029, .031]; CFI= .933; SRMR= .044.

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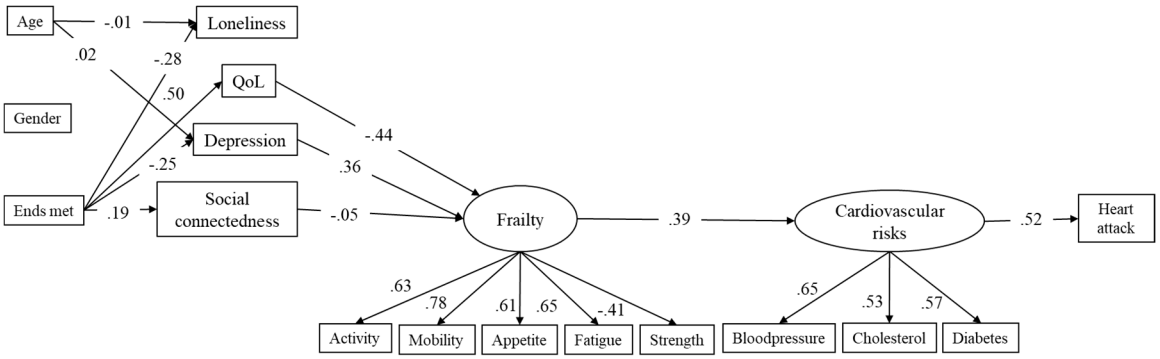

Figure 1. Standardized parameter estimates of the structural model to predict heart attack. *Notes*: Only statistically significant estimates (p<.05) are shown for the sake of clarity; correlations among antecedents and among psychosocial factors not shown for clarity.

The standardized parameter estimates are presented in Figure 1. Age and gender had no relevant effects on the psychosocial factors. On the contrary, psychosocial factors had a substantial impact on frailty status. Overall, the four psychosocial factors were able to predict 50.3% of the variability of frailty status. The main predictors of frailty were well-being (β= -.44, p< .01) and depression (β= .35, p< .01), while the effect of social connectedness was significant but low (β= -.05, p< .05), and the effect of loneliness was not statistically significant (β= .01, p> .05). Frailty had a moderate effect on cardiovascular risk factors (β= .39, p< .01), that explained 15.5% of the variability of cardiovascular risk factors. In the end, cardiovascular risk factors increased the likelihood of having a myocardial infarction (β= .52). 27.2% of the variability of myocardial infarction is associated to the cardiovascular risk factors.

Regarding the correlations among the antecedents, only age and gender were significantly related, but with a very low value (r= -.019, p< .01). The psychosocial factors were also correlated, however, for ease of understanding, the associations are not shown in Figure 1. The correlations that were significant and moderate to large in size were: loneliness with depression (r= .40, p< .01); loneliness with well-being (r= -.47, p< .01); and depression with well-being (r= -.46, p< .01).

4. Discussion

This work is intended as a contribution to the prediction of the occurrence of MI from a holistic and processual approach. Regarding the holistic condition, to approach study of cardiovascular disease we should assess psychological risk factors and simultaneously the role of frailty [8,9]. In addition, the processual aspect reveals that there are variables to control, such as some socio-demographics, but also psychosocial factors that can trigger frailty in older adults. Indeed, frailty is a debilitating state that may exacerbate cardiovascular risk factors, which may in turn improve cardiovascular outcomes. Finally, the accumulation of cardiovascular risk factors increases the likelihood of suffering myocardial infarction.

The model provides evidence on the important effects of social connectedness, depression and psychological quality of life or well-being on frailty, which in turn indirectly affect cardiovascular risk factors. This processual model in the end may predict 27% of the occurrence of myocardial infarction.

With this empirical research we have clarified the negligible effect of gender in this process and connected more pieces in the picture puzzle of cardiovascular health, starting with the predictive capacity of an indicator of socioeconomic status on psychological aspects such as depression, loneliness, but not restricting to this relationship. Our results support previous findings, as depression increases the mortality and morbidity of cardiovascular disease [23] or those of the American Heart Association which concluded that depression should be considered a risk factor for poor prognosis among patients with acute coronary syndrome [24]. Our findings also have practical

implications, such as the potential benefits of easily applicable interventions to achieve improvements in frailty [25] at the same time as preventing cardiac problems.

This study also has limitations as its cross-sectional nature or the non-inclusion of other variables that can have potential influence on this context as spirituality [26] due to the omission of its measurement in the SHARE protocol. Second, as further research we could additionally improve the predictive power and the understanding of the process attending to the use of drugs such as antidepressants. The side effects of most antidepressant drugs are a problem for people at risk of cardiovascular disease and therefore it is necessary to assess their coexistence [27].

5. Conclusions

In conclusion, by integrating frailty, mental health, social and economic indicators with cardiovascular health, this study encourages a realistic relatively simple community-based approach to tackle the widespread problem of cardiovascular disease. Moreover, should be mentioned that urges a coordinated intervention in these physical, social, and mental health factors that are associated with myocardial infarction, with special emphasis, actions aimed at preventing frailty in adulthood.

Author Contributions: José M. Tomás: Methodology & Formal analysis, **Amparo Oliver:** Writing - review & editing, **Zaira Torres:** Writing - Original Draft, **Janhavi Parker:** Writing – Original Draft, **Elena Marques:** Conceptualization & Visualization, **Trinidad Sentandreu-Mañó:** Conceptualization & Supervision. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The Study on Health, Aging and Retirement in Europe (SHARE) project is subject to continuous ethical review, and the wave 8 was approved by the ethics council of Max Planck Society in Munich.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data that support the findings of this study are available at the SHARE Research Data Center to the entire research community free of charge (www.share-project.org). Restrictions apply to the availability of these data, which were used under license for the current study, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of the SHARE Project (http://www.share-project.org/data-access/user-registration.html?L=).

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