Primary Care in Supplementary Health: impact on care costs of elderly patients with heart disease

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Abstract

Introduction: Population aging has been changing the epidemiological profile in the World. Cardiovascular diseases are the leading cause of death in many countries and have an impact on health spending.

Objectives: To identify factors that influence health care costs in elderly patients with heart disease treated at a Supplementary Primary Health Care (PHC) unit in Brazil.

Methods: Retrospective cohort of 223 patients with heart disease aged ≥ 60 years from one year before and one year after PHC implantation. Data were obtained from electronic medical records and the costs in the total cost of care database (hospital, outpatient and home). Patients were classified according to the Clinical-Functional Vulnerability Index (CFVI-20).

Results: There was no reduction in total costs, but it occurred in hospitalization expenses after the implementation of PHC for the whole sample (mean $\pm$ SD, US\$ 698.43 $\pm$ US\$ 3,500.76, $p=0.011$), with a significant reduction among (p=0.023), pre-diagnosis of acute myocardial infarction (AMI) (p=0.023), eutrophic BMI (p=0.027), non-smokers (p=0.020), and robust according to the CFVI-20 (p=0.013). There was a decrease in the frequency of hospitalization for the whole sample (p=0.006), among males (p=0.014), age between 71 and 80 years (p=0.001), robust (p=0.025) and AMI (p= 0.027). There was a reduction in the frequency of consultations in the Emergency Department among fragile elderly (p=0.011).

Conclusions: There was a reduction in the frequency and cost of hospitalization in elderly patients with heart disease in follow-up at PHC, in addition to reducing the frequency of consultation in PHC in the fragile elderly.

Introduction

The Brazilian population is aging sharply. In 2016 life expectancy at birth was 75.8 years, which meant an increase of 30.3 years for both sexes, compared to 1940 (Brasil 2016). According to WHO statistics projections, between 1950 and 2025, the group of elderly people in the country should have increased fifteen times, while the total population should have increased five times (Brasil 2010). Population aging, in particular, has been modifying the epidemiological profile in Brazil, with an increase in mortality due to chronic non-communicable diseases (CNCDs), to the detriment of infectious and parasitic diseases (Ministério da Saúde, 2016). Fewer than 10% of people aged 65 years or over are free of any chronic health problems, and more than 10% report at least five concomitant chronic diseases (Ministério da Saúde 2016).

Among the CNCDs, cardiovascular diseases enhance the morbidity and mortality rates in Brazil and in the world (Teodoro et al. 2014). Among the main chronic cardiovascular diseases are coronary artery disease (CAD) and heart failure (HF). These diseases, in addition to being highly incapacitating, lead the way in

medical services, especially in the elderly population (Teodoro et al. 2014; Xavier et al. 2015). In 2015, specifically, the CAD held a prominent position and was responsible for 47.7% of global cardiovascular mortality (Mozaffarian et al. 2015).

The Alma Ata conference in 1978 established the consensus that primary care would be the main strategy and main entrance of the health system with the capacity to address 80% of the population's health problems (Starfield, 2002). Strategies that strengthen the capacity of primary care and emphasize health promotion tend to improve health status and reduce costs (Onocko-Campos et al. 2012). The organization of care centered on primary care and the continuum of care yields the best health outcomes (Ministério da Saúde 2016). With this in mind, the São Francisco Xavier Foundation (FSFX, acronym in Portuguese), in December 2014, started operations at the first Primary Health Care Unit (PHC), called Usifamília, in the city of Ipatinga-MG, inspired by the model of Primary Care of the Cambridge Health Alliance (CHA), Boston (USA) (Moraes 2016). The model of Comprehensive Care for Patient-Centered Health (CISP, acronym in Portuguese) has emerged in the US and worldwide progressively, bringing the guiding principles for transforming the traditional model as integrality of care, understanding the complexity of the experience of chronic illness from the perspective of the patient, reliability and extended access, triple objective (Moraes 2016). This resulted in a mixed model of health care based on the assumptions of primary health care and the elderly health paradigm, called Management of Health Centered on the Elderly (GISCI, acronym in Portuguese) (Moraes 2016). This model aims to better manage the health of the beneficiaries and their families through a technically qualified team and the PHC model, a differentiated physical structure and a patient-centered flow of care (Moraes 2016),.

The objective of this study is to identify factors that influence health care costs in elderly patients with heart disease in the supplementary health care, according to the Clinical-Functional Vulnerability Index-20 (CFVI-20) for the classification of the elderly population.

Methods

This study was carried out based on Electronic Medical Record and total cost on database (hospital, outpatient and home care) - Electronic Data Transfer (EDT) (Floriani 2012).

This was a retrospective cohort that included all subjects aged ≥ 60 years who had the first care at a Supplementary Primary Health Care (PHC) Usifamília from 01/01/2015 to 12/31/2015 and had heart failure (HF), angina and acute myocardial infarction (AMI). Patients who did not have heart disease, who did not have a previous heart disease, or at least 12 months of follow-up in PHC after the first medical consultation have been excluded.

The data were obtained in the electronic medical record looking at the medical evolution of the first care in the PHC and cardiologists consultations before that date. The variables selected were sex, age, weight, height, smoking, clinical history (HF, angina, AMI), date of first PHC care, date and reason for PHC loss of follow-up, CFVI-20 rate, death, total cost of care (hospital, outpatient and home) and the frequency of use of Emergency Department (ED) and hospital admissions.

The CFVI-20 is a questionnaire that considers multidimensional aspects of the health condition of the elderly and is considered a tool for screening and classification of fragility and loss of functional capacity in the elderly population and aims to direct the geriatric action, prevent repeated hospitalizations, increase quality of life and, in some cases, prevent early death (Moraes et al. 2016). Consisting of twenty questions distributed in eight dimensions: age (1 question), self-perception of health (1 question), functional disabilities (4 questions), cognition (3 questions), humor (2 questions), mobility (6 questions), communication (2 questions) and multiple comorbidities (1 question) (Moraes et al. 2016). Each dimension has specific punctuation that makes up a maximum value of forty points. The higher the value obtained, the greater the risk of clinical and functional vulnerability of the elderly, which can be classified as 0 to 6 points (robust elderly), 7 to 14 points (elderly at risk of fragility) and ≥ 15 points (frail elderly) (Moraes et al. 2016). At the PHC Usifamilia, this questionnaire is routinely applied by nursing technicians, and the application time is approximately 10 minutes.

In order to calculate the BMI, the cut-off points proposed by Lipschitz and the Ministry of Health were used, taking into account the changes in body composition that occur with aging, when compared with adult individuals according to the cut-off points proposed by WHO (Souza et al. 2013, Brasil 2009). The individuals were classified as low weight with $\text{BMI} \leq 22\text{kg/m}^2$; eutrophic or adequate weight, BMI between 22kg/m^2 and 27kg/m^2 ; and overweight, with $\text{BMI} \geq 27\text{kg/m}^2$ (Souza et al. 2013, Brasil 2009).

For cost evaluation (hospital, outpatient and home care), the costs in the 12-month periods prior to the date of admission in the PHC and 12 months later were considered. Outpatient costs refer to elective medical consultations, ED appointments, and laboratory tests. There was no monetary correction of the values, since each patient in the sample had a different date of admission into PHC. Only direct costs were taken into account in this study. All costs were originally calculated in the national currency (Brazilian real [BRL]). These values were converted to US dollars according to data provided by the Central bank corresponding to 10/04/2020 (dd/mm/yy) (1US\$ =4.60 BRL).

The study was approved by the Research Ethics Committee of the Faculty of Medical Sciences of Minas Gerais (FCM-MG), report No. 1,820,568 and CAAE No. 59792216.2.0000.5134 on 11/16/2016.

Statistical analysis

Qualitative variables were presented as absolute and relative frequencies, and quantitative as mean $\pm$ standard deviation and median. The quantitative variables were submitted to the Shapiro-Wilk normality test. To evaluate the association between categorical variables, the chi-square test of independence was used. For the comparison of two means between independent samples the Wilcoxon Mann-Whitney test was used. The comparison of three or more averages was performed using the Kruskal-Wallis test. For multiple comparisons the Dunn test was adopted. The comparison of the data before and after the implementation of PHC was performed via Wilcoxon test for paired samples. The analyzes were developed in the free program R, version 3.2.2, and a significance level of 5% was adopted.

Results

The sample consisted of 223 beneficiaries in the period from 01/01/2015 to 12/31/2015, of which 60.1% were male. The mean age was 73.84 ± 7.89 years, of which 40.4% were between 60 and 70 years. The mean BMI was 29.14 ± 4.87 kg/m², and 67.5% were overweight. Regarding the clinical history, 77.1% had AMI; 18.4% HF; and 9% angina. Only 9.6% were smokers, and 3.1% died (Table 1).

Regarding CFVI-20 rate, 25 elderly individuals were considered fragile, 85 were at risk of fragility and 113 were robust. The fragile elderly were older ($p < 0.001$), with a higher proportion of females ($p < 0.001$) and HF ($p = 0.002$) and a lower proportion of AMI ($p < 0.001$). The robust elderly presented a higher proportion of males ($p < 0.001$), AMI ($p < 0.001$) and smokers ($p < 0.001$) (Table 1).

The reduction of the total cost after the implementation of PHC was not significant for the whole sample (mean $\pm$ SD, US\$ 269.90 $\pm$ US\$ 2,517.43, $p = 0.368$), nor among the subgroups analyzed. There was no significant difference in the reduction of total costs by sex, age, clinical history, BMI, smoking and classification of CFVI-20 (Table 2).

However, there was a significant reduction in hospital admission costs after the implementation of PHC for the whole sample (mean $\pm$ SD, US\$ 698.43 $\pm$ US\$ 3,500.76, $p = 0.011$). When stratifying the groups, a significant difference was observed in hospitalization costs among males ($p = 0.041$), age between 71 and 80 years ($p = 0.005$), who had AMI ($p = 0.023$), with eutrophic BMI ($p = 0.027$), non-smokers ($p = 0.020$) and classified as robust in CFVI-20 ($p = 0.013$) (Table 3 and Fig. 1).

There was a reduction in the frequency of hospital admissions with the implementation of PHC for the entire sample ($p = 0.006$), and among males ($p = 0.014$), aged between 71 and 80 years ($p = 0.001$), classified as robust by CFVI-20 ($p = 0.025$), and who had AMI ($p = 0.027$). There was a reduction in the frequency of consultations in EDs among the elderly classified as fragile in CFVI-20 ($p = 0.011$) (Table 4).

Discussion

In this study, patients were mostly males and the mean age was 73.84, of which (40.4%) were between 60 and 70 years. The majority (67.5%) was overweight and (3.1%) had died. More AMI patients were observed (77.1%) and the majority were classified as robust according to the CFVI-20. The frail elderly was older, mostly female, with HF and there was lower proportion of patients with AMI. A statistically significant reduction was observed in the number of medical consultations in EDs for the fragile elderly and a reduction on total hospitalizations with the implementation of PHC. The robust elderly were mostly males, with AMI and were smokers. The reduction of the total cost after the implementation of PHC was not significant; however, there was a significant reduction in costs and frequency of hospital admissions after the implementation of PHC for the whole sample, and in males, aged 71 to 80 years, who had AMI, eutrophic BMI, who were not smokers, but were robust. These results allowed evaluating the elderly profile in the PHC Usifamília and the impact on the conduction and health management in the population of elderly patients with heart disease.

Regarding the results of this study, and for the purpose of comparison, it is interesting to mention that reduction of hospital admission was also observed by a supplementary health operator in Belo Horizonte (Brasil 2018a), which registered a 13% reduction in hospital admissions after the implementation of PHC; however, it should be pointed out that in this case, unlike the practice in this study, the results were obtained among all individuals, without any type of classification, and that made up a certain portfolio of clients in relation to all individuals of another client's portfolio without the implementation of PHC of this same plan, not following-up the same individual, as in the case of this study. However, both in the PHC Usifamília case and in the aforementioned plan, we observed the impact of PHC on the reduction of hospital admissions.

Another point that deserves to be emphasized in relation to the conduct and management of the health of elderly patients with heart disease is that many chronic conditions are linked to the aging, but they also derive from the citizens' lifestyle, characterized by unhealthy habits in addition to genetic predisposition (Ministério da Saúde 2016). A higher proportion of overweight elderly (67.5%) was observed in this study when compared to Vigitel's data for 2016, in which (57.7%) of the elderly aged 65 years or over were overweight (Brasil 2018a). Regarding smoking, the proportion was lower (9.6%), compared to the IBGE data for 2013 (13.7%) in the Southeast region (Brasil 2013). It is known that the control of risk factors is responsible for at least 50% in the reduction of cardiovascular disease mortality (França 2014).

In Brazil, non-communicable diseases (NCDs) accounted for 72% of the causes of death in 2007, and the most affected individuals were the elderly (Schmidt et al. 2011). In the last decade, cardiovascular diseases (CVDs) accounted for 50% of the mortality of all NCDs (Goulart, 2011). In 2008, the NCDs were the most important cause of death in Brazil and accounted for 40.8% of deaths in individuals aged 60 and over (Muller et al, 2017). In Brazil, according to data from the Mortality Information System (SIM) of 2014, the elderly mortality, considering the proportion of deaths by sets of defined causes, was 36.3% for circulatory system diseases followed by neoplasms (18.6%) and respiratory system diseases (15.5%) (Brasil 2016).

CVDs are the leading cause of death in Brazil (Neto et al. 2016). Among them, CAD is one of the main causes (31%), followed by cerebrovascular disease (30%) and HF (18%) (Bahia et al, 2018). CAD is considered the main cause of death in the world, being considered one of the biggest clinical and financial impact (Teodoro et al. 2014; Teich et al. 2015). In Brazil, in the adult population, the prevalence of CAD is estimated in 5 to 8% (Teodoro et al. 2014; Neto et al. 2016). In addition, CAD is one of the predisposing risk factors in the general population that is more relevant in patients with HF (Fonseca et al. 2018). Likewise, HF is an increasingly common condition among the elderly, and its prevalence increases with age, thus being one of the main causes of hospitalization and search for emergency services among the elderly, in Brazil and in the world (Mozaffarian et al. 2015; Azad & Lemay 2014).

In view of this context, the main heart diseases – AMI, angina and HF were selected for the present study. AMI presented a higher proportion between groups (77.1%), followed by HF (18.4%) and angina (9%). HF

showed a higher proportion in frail elderly, a fact expected, since HF is a predictor of dependence in hospitalized elderly and increases five times the chance of functional loss (Mozaffarian et al. 2015).

There is a great concern for maintaining the quality of health care for the elderly without losing control of costs or providing the necessary treatments. The high rates of hospitalization of the elderly shows the impact of Brazilian population aging on the health sector and represents great challenge for the health systems, given the risk of not offering the necessary assistance to the demands of this group (Ministério da Saúde 2016).

Nunes (2004) demonstrated that the higher health costs of the elderly are mainly due to repeated hospitalizations. In 2009, the elderly were responsible for 21% of hospitalizations in Brazil (Pagotto et al. 2013). In Brazil, according to data from the National Household Sample Survey (PNAD) of 2003, at the age of 60, hospitalization coefficients increased from 9.9% to 18.2% for the elderly aged 80 and over (Castro 2006). In Brazil, it has been noticed that the hospitalization coefficient, the hospitalization rates and the hospitalization cost of the Brazilian Unified Health System (SUS) are higher for 60-year-old people or older, including the greatest number of recurrence of hospitalizations (Costa et al, 2000).

Data from the Supplementary Health Information Exchange (TISS, acronym in Portuguese) referring to indicators of in-hospital care in the second half of 2015 show that 12.3% of the elderly covered by supplementary health care are responsible for 13.6% of supplementary emergency health care. Many of the health problems that lead this population to seek this service involve, for the most part, acute chronic conditions, mainly of the cardiovascular system (Ministério da Saúde 2016). Analyzing the data on the admissions of elderly people in 2014, in the private hospitals that attend the supplementary health care network, it is observed that the main causes of hospitalization among the elderly (80 years old or more) were the circulatory system diseases (Ministério da Saúde 2016). In a study carried out in the elderly of PHC in the SUS, diseases of the circulatory system were also the main cause of hospitalization (28.4%) (Pagotto et al, 2013). The hospitalizations for HF and coronary revascularization were responsible for the largest portion of costs in the SUS (Teich et al, 2015). From 1998 to 2010, the historical series of hospitalizations for AMI, angioplasty and revascularization, DATASUS estimated the average costs per patient in US\$ 1,138,26 in the public system and US\$ 3,675.00 in private systems (Pagotto et al, 2013). It is worth noting that the average cost of hospitalization for AMI prior to the implementation of PHC Usifamília was US\$ 1,769.18 ± 2,124.49 and represents an intermediate value between those cited in the analysis above for SUS and for private systems. On the other hand, the mean cost of US\$ 1,048.42 ± 1,877,60 (p=0.023) with this same type of hospitalization after the PHC Usifamília implantation shows a clear decrease, compared to those referred to in the SUS and the private systems.

In this context, the monitoring of the elderly in PHC services proposes patient-focused care in order to reduce the frequency of hospital admissions and/or reduce the demand for ED services. Avoiding hospitalizations in the elderly is relevant, both for health and quality of life issues and for cost reduction.

And, in this study, there was a significant reduction in hospitalization costs after the implementation of PHC, for the whole sample, and in males, aged 71 to 80 years, who had AMI, eutrophic BMI, non-smokers,

and robust. In addition, it was observed, after the implementation of PHC, that there was no increase in total costs, but a significant reduction in the need for hospitalization and, consequently, a reduction in hospital admission costs. The implementation of PHC Usifamilia allowed greater investment in elective consultations, diagnostic exams, prevention, reflecting on better health. These actions, taken together, make it possible to improve the health system efficiency and allow inferring quality of life improvement in the elderly.

It was also verified in this study that the fragile elderly presented a reduction in the number of medical consultations in ED ($p=0.001$) and lower costs (total and hospitalizations) with the implementation of PHC; however, no statistically significant differences were observed in this group of individuals. In addition, it can be inferred from the results obtained that the fragile elderly are more subject to prolonged admissions, successive readmissions, and worse prognosis.

One of the study limitations is that only the elderly with a confirmed diagnosis of AMI, HF and Angina, who were included in the evolution of the first PHC care, were included in the study. It is possible that some elderly people who presented these heart diseases were disregarded from the study due to lack of registration in the evolution of the first care.

Conclusions

In follow-up, it was observed a clear reduction in the frequency and costs of hospitalization in elderly patients with heart disease in PHC. In addition, there was also a decrease in the frequency of medical consultations in ED, and lower total costs with the implementation of PHC, although the reduction was not statistically significant in relation to the total costs. These results suggest that the implementation of PHC has improved the quality of care for elderly with cardiac conditions, reducing the frequency and expenses of complications that require immediate emergency care. It is clear, therefore, the need to act in order to focus the PHC teams on the follow-up of the fragile elderly, especially regarding the monitoring of the time to return to the care, in addition to intensifying preventive actions, in order to identify early risk factors for cardiovascular diseases. Such follow-up would enable the reduction of disability and improve the quality of life of the elderly with cardiopathy. The results allow us to broaden our understanding of the elderly care network, making it possible to plan strategies to identify the elderly with potential for hospital admission and ED appointments.

Knowledge of the profile of the Brazilian elderly population may allow strategies to be developed for the implementation of health care systems aimed at the health care of these individuals, thus allowing a quality of life improvement as well as a decrease in health expenditures in this population.

Declarations

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Not applicable

Conflicts of interest/Competing interests

The authors declare no potential conflict of interest with respect to the research, authorship, and publication of this article.

Ethics approval

The study was approved by the Research Ethics Committee of the Faculty of Medical Sciences of Minas Gerais (FCM-MG), report No. 1,820,568 and CAAE No. 59792216.2.0000.5134 on 11/16/2016. The study was performed in accordance with the ethical standards presented in the 1964 Declaration of Helsinki

Consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and material

Not applicable

Code availability

Not applicable

Authors' contributions

The main individual contribution of each author can be seen below:

Geórgia Silva Marques: Conceptualization, investigation, data curation, formal analysis and writing and editing of the original draft.

Alessandra Maciel Almeida: Conceptualization, Formal analysis, Investigation, methodological supporting, project administration, supervision, validation and revision of the original draft.

Isabel Cristina Gomes: Conceptualization, statistical analysis, methodological supporting, validation and revision of the original draft.

Michele Renata Barbosa da Silva: Data curation, statistical analysis and revision of the original draft.

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Tables

Table 1. Characteristics of elderly cardiac patients treated at the Primary Health Service. Ipatinga, 2015.

Characteristics	The entire sample (n=223)	IVCF-20 Rating Fragile (n=25)	At risk (n=85)	Robust (n=113)	P-value
Sex					<0,001^Q
Female	89 (39,9%)	15 (60%)	48 (56,5%)	26 (23%)	
Male	134 (60,1%)	10 (40%)	37 (43,5%)	87 (77%)	
Age (years)	73,84 ± 7,89	82,16 ± 7,40 ^{†,€}	74,85 ± 7,49 ^{†,¶}	71,24 ± 6,82 ^{€,¶}	<0,001^K
60 to 70 years	90 (40,4%)	1 (4%)	34 (40%)	55 (48,7%)	
71 to 80 years	83 (37,2%)	11 (44%)	24 (28,2%)	48 (42,5%)	
81 years and over	50 (22,4%)	13 (52%)	27 (31,8%)	10 (8,8%)	
BMI (kg/m²)[#]	29,14 ± 4,87	30,83 ± 5,26	29,40 ± 5,11	28,61 ± 4,54	0,110 ^K
Lowweight	11 (5,3%)	-	7 (9%)	4 (3,8%)	
Eutrophic	56 (27,2%)	5 (22,7%)	15 (19,2%)	36 (34%)	
Overweight	139 (67,5%)	17 (77,3%)	56 (71,8%)	66 (62,3%)	
Clinical history					
HF	41 (18,4%)	11 (44%)	14 (16,5%)	16 (14,2%)	0,002^Q
Angina	20 (9%)	4 (16%)	8 (9,4%)	8 (7,1%)	0,363 ^Q
AMI	172 (77,1%)	12 (48%)	65 (76,5%)	95 (84,1%)	<0,001^Q
Smoking*	18 (9,6%)	1 (4,8%)	7 (10%)	10 (10,4%)	<0,001^Q
Death	7 (3,1%)	2 (8%)	3 (3,5%)	2 (1,8%)	-

CFVI-20: Clinical-Functional Vulnerability Index-20; HF: heart failure; AMI: acute myocardial infarction; BMI: body mass index.

[#]Variable has missings (BMI n=17, smoking n=36)

The p-values refer to ^Qqui-square tests of independence, ^KKruskal-Wallis, with multiple Dunn comparisons. The symbols ^{†,€,¶} indicate pairs with significant differences

Table 2. Total cost before and after the implementation of the program according to the characteristics of elderly patients with heart disease at the Primary Health Care Service. Ipatinga, 2015.

Characteristics	Before (US\$)			After (US\$)			Difference (US\$) [#]	(before-after)	P-value
The entire sample	1,116.79 (276.74)	±	2,025.22	846.88 (245.05)	±	1,644.77	269.91 ± 2,517.43	(-0,01)	0,368 ^{Wp}
Sex							0,999 ^W		
Female	1,327.81 (421.93)	±	2,215.74	1,041.81 (284.99)	±	1,899.00	286.00 ± 2,744.38	(-0,01)	0,515 ^{Wp}
Male	976.63 (234.77)	±	1,883.64	717.41 (192.81)	±	1,444.71	259.22 ± 2,365.32	(-0,02)	0,574 ^{Wp}
Age (years)							0,692 ^K		
60 to 70 years	1,032.17 (256.93)	±	1,933.93	701.00 (194.65)	±	1,461.62	331.18 ± 2,439.27	(-1,19)	0,652 ^{Wp}
71 to 80 years	1,150.04 (395.38)	±	1,971.11	664.73 (219.61)	±	1,170.18	485.30 ± 2,013.95	(-0,01)	0,189 ^{Wp}
81 years and over	1,213.89 (231.96)	±	2,294.02	1411.83 (286.58)	±	2,379.85	-197.94 ± 3,287.71	(-0,01)	0,623 ^{Wp}
Clinical history							-		
HF	1,648.11 (479.76)	±	2,801.57	1,324.32 (477.07)	±	2,161.07	323.79 ± 3,518.40	(-0,01)	0,564 ^{Wp}
Angina	1,582.21 (597.65)	±	2,319.09	1,087.46 (355.95)	±	2,208.26	494.74 ± 3,189.16	(131,73)	0,189 ^{Wp}
AMI	943.19 (232.88)	±	1,703.63	693.29 (204.52)	±	1,350.04	249.90 ± 2,076.86	(-0,02)	0,766 ^{Wp}
BMI							0,535 ^K		
Low weight	613.27 ± 122,58 (200.72)			567.50 (189.85)	±	735.81	45.77 ± 1,080.88	(-7,24)	0,465 ^{Wp}
Eutrophic	882.18 (365.23)	±	1,217.05	612.09 (220.18)	±	1,124.86	270.09 ± 1,570.42	(34,49)	0,107 ^{Wp}
Overweight	1,198.25 (258.50)	±	2,248.55	958.90 (254.15)	±	1,872.09	239.35 ± 2,882.75	(-2,37)	0,935 ^{Wp}
Smoking							0,539 ^W		
No	1,121.19 (279.31)	±	2,089.31	798.86 (257.11)	±	1,535.68	322.33 ± 2,464.30	(-0,01)	0,362 ^{Wp}
Yes	828.03 (204.00)	±	1,692.24	685.56 (93.35)	±	1,272.09	142.47 ± 1,630.40	(-18,16)	0,393 ^{Wp}
CFVI-20 Rate							0,314 ^K		
Fragile	2,691.82 (1,214.08)	±	3,451.45	1,813.05 (689.75)	±	2,726.62	878.77 ± 4,261.70	(145,90)	0,300 ^{Wp}
At risk	894.95 (253.00)	±	1,747.32	856.45 (245.06)	±	1,663.13	38.50 ± 2,485.40	(-2,37)	0,671 ^{Wp}
Robust	935.19 (236.93)	±	1,631.83	625.92 (196.37)	±	1,198.72	309.27 ± 1,977.89	(-0,01)	0,340 ^{Wp}

CFVI-20: Clinical-Functional Vulnerability Index-20; HF: heart failure; AMI: acute myocardial infarction; BMI: body mass index.

Data presented as mean ± SD (median).

[#]Difference = cost before - cost after

^WWilcoxon's Mann-Whitney test for independent samples, ^{Wp}Wilcoxon's test for paired samples, ^KKruskal-Wallis test

Table 3. Average annual cost of hospital admissions before and after PHC implantation, according to the characteristics of elderly patients with heart disease at the Primary Health Care Service. Ipatinga, 2015.

Characteristics	Before (US\$)		After (US\$)		Difference (US\$) [#]		(before-after)		P-value
The entire sample	1,936.14 (972.98)	±	2,520.72	1,237.71 (303.43)	±	2,130.92	698.43 ± 3,500.76	(702.63)	0,011^{Wp}
Sex							0,550 ^W		
Female	2,024.55 (774.49)	±	2,579.98	1,377.02 (664.58)	±	2,278.90	647.53 ± 3,484.77	(489.17)	0,150 ^{Wp}
Male	1,860.58 (1,166,70)	±	2,490.30	1,118.67 ± 2,009.41	(0)		741.92 ± 3,545.88	(1,147.30)	0,041^{Wp}
Age (years)							0,484 ^K		
60 to 70 years	1,920.86 (552.80)	±	2,527.21	1,053.78 ± 2,060.63	(0)		867.08 ± 3,705.94	(552.80)	0,129 ^{Wp}
71 to 80 years	1,789.95 (1,175.35)	±	2,451.27	705.22 ± 1,548.91	(0)		1,084.73 ± 2,609.11	(991.38)	0,005^{Wp}
81 years and over	2,209.42 ± (821.80)		2,709.13	2,430.94 ± (1,515.57)	±	2,660.08	-221.52 ± 4,391.62	(477.36)	0,944 ^{Wp}
Clinical history							-		
HF	2,275.03 (935.74)	±	3,244.79	1,612.62 (749.01)	±	2,285.84	662.42 ± 4,196.29	(558.35)	0,328 ^{Wp}
Angina	2,410.56 (1,182.49)	±	2,694.63	1,514.63 ± 2,870.70	(0)		895.93 ± 4,396.68	(1,166.70)	0,320 ^{Wp}
AMI	1,769.19 (954.58)	±	2,124.50	1,048.42 ± 1,877.60	(0)		720.77 ± 3,017.05	(681.10)	0,023^{Wp}
BMI							0,588 ^K		
Low weight	1,573.91 (544.45)	±	2,270.97	761.39 ± 725.57	(839.32)		812.52 ± 1,800.90	(544.45)	0,750 ^{Wp}
Eutrophic	1,451.90 ± (1,219.43)		1,415.93	792.96 ± 1,454.39	(0)		658.94 ± 2,141.68	(1,171.03)	0,027^{Wp}
Overweight	2,005.38 ± (869.10)		12,779.82	1,386.25 ± (281.93)	±	2,392.71	619.14 ± 3,954.96	(417.02)	0,217 ^{Wp}
Smoking							0,964 ^W		
No	1,997.85 (972.98)	±	2,652.08	1,184.11 (401.92)	±	2,115.79	813.74 ± 3,531.65	(719.79)	0,020^{Wp}
Yes	2,015.16 ± (855.58)		2,505.79	1,173.43 (318.44)	±	1,590.93	841.73 ± 2,855.73	(855.58)	0,563 ^{Wp}
CFVI-20 Rate							0,280 ^K		
Fragile	3,333.12 (2,338.10)	±	3,595.54	2,133.13 (835.27)	±	2,958.77	1,199.99 ± 4,799.24	(790.74)	0,275 ^{Wp}
At risk	1,391.63 (529.47)	±	2,117.40	1,185.36 (527.12)	±	2,010.89	206.27 ± 3,331.63	(307.90)	0,556 ^{Wp}
Robust	1,806.11 ± (1,182.49)		2,100.12	903.85 ± 1,725.99	(0)		902.25 ± 3,002.48	(1,182.49)	0,013^{Wp}

CFVI-20: Clinical-Functional Vulnerability Index-20; HF: heart failure; AMI: acute myocardial infarction; BMI: body mass index.

Data presented as mean $\pm$ SD (median).

#Difference = cost before - cost after

^WWilcoxon's Mann-Whitney test for independent samples, ^{Wp}Wilcoxon's test for paired samples, ^KKruskal-Wallis test

Table 4. Annual frequency of hospital admissions and consultations to Emergency Department (ED), before and after PHC implantation, according to sex, age, CFVI-20 rate and clinical history. Ipatinga, 2015.

Characteristics	Nº of hospitalizations		P-value	Nº of ED Consultations		P-value
	Before	After		Before	After	
The entiresample	1,25 $\pm$ 1,31 (1)	0,77 $\pm$ 0,90 (1)	0,006	1,36 $\pm$ 1,42 (1)	1,06 $\pm$ 1,09 (1)	0,139
Sex						
Female	1,28 $\pm$ 1,21 (1)	0,96 $\pm$ 1,02 (1)	0,165	1,55 $\pm$ 1,43 (1)	1,16 $\pm$ 1,15 (1)	0,162
Male	1,22 $\pm$ 1,40 (1)	0,62 $\pm$ 0,76 (0)	0,014	1,21 $\pm$ 1,40 (1)	0,99 $\pm$ 1,05 (1)	0,461
Age (years)						
60 to 70 years	0,84 $\pm$ 0,73 (1)	0,57 $\pm$ 0,69 (0)	0,180	1,09 $\pm$ 1,14 (1)	1,09 $\pm$ 1,03 (1)	0,919
71 to 80 years	1,61 $\pm$ 1,69 (1)	0,66 $\pm$ 0,91 (0)	0,001	1,64 $\pm$ 1,62 (1)	1,02 $\pm$ 1,14 (1)	0,060
81 yearsand over	1,25 $\pm$ 1,11 (1)	1,29 $\pm$ 1,00 (1)	0,774	1,23 $\pm$ 1,33 (1)	1,10 $\pm$ 1,14 (1)	0,887
CFVI-20 Rate						
Fragile	2,32 $\pm$ 2,00 (2)	1,16 $\pm$ 1,07 (1)	0,086	2,76 $\pm$ 2,08 (2)	0,88 $\pm$ 1,32 (0)	0,011
At risk	0,95 $\pm$ 0,80 (1)	0,79 $\pm$ 0,78 (1)	0,430	1,16 $\pm$ 1,08 (1)	1,06 $\pm$ 1,01 (1)	0,581
Robust	1,04 $\pm$ 1,07 (1)	0,60 $\pm$ 0,89 (0)	0,025	1,14 $\pm$ 1,24 (1)	1,11 $\pm$ 1,11 (1)	1,000
Clinicalhistory						
HF	1,77 $\pm$ 2,12 (1)	1,23 $\pm$ 1,14 (1)	0,472	1,78 $\pm$ 1,98 (1)	1,19 $\pm$ 1,35 (1)	0,267
Angina	1,45 $\pm$ 0,69 (2)	0,91 $\pm$ 1,14 (0)	0,224	1,73 $\pm$ 1,33 (1)	1,33 $\pm$ 1,18 (1)	0,492
AMI	1,07 $\pm$ 1,00 (1)	0,67 $\pm$ 0,78 (0)	0,027	1,21 $\pm$ 1,23 (1)	0,98 $\pm$ 0,97 (1)	0,286

CFVI-20: Clinical-Functional Vulnerability Index-20; HF: heart failure; AMI: acute myocardial infarction; BMI: body mass index.

Data presented as mean $\pm$ SD (median).

The p-values refer to the Wilcoxon test for paired samples.

Figures

Figure 1

Box plot for the average of the annual costs with hospitalizations per patient, in United States Dollars (US\$), before and after the implantation of Primary Care in Supplementary Health(a) for the whole sample and according to the classification of the Clinical-Functional Vulnerability Index: (b) frail elderly, (c) elderly at risk and (d) robust elderly. The p-value refers to the Wilcoxon test for paired samples.