Cardiometabolic comorbidities and associated patterns of healthcare utilization and quality of life: results from the Study on Global AGEing and Adult Health (SAGE) Wave 2 in Ghana

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Research Article

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Abstract

Background

Understanding the patterns of comorbidities, defined as the co-occurrence of more than one chronic condition, is important for planning health system capacity and response. In this study, we identified classes of adults with cardiometabolic comorbidities and assessed the association of different comorbidity combinations with healthcare utilization and quality of life (QoL).

Methods

Data were from the World Health Organization (WHO) study on global AGEing and adult health Wave 2 (2015) conducted in Ghana. We analysed the clustering of cardiometabolic diseases including angina, stroke, diabetes, and hypertension with unrelated conditions such as asthma, chronic lung disease, arthritis, cataract and depression. Healthcare utilization was measured as the frequency of outpatient visits and hospitalization in the past 12 months. The QoL index was constructed using the WHOQoL instrument and recorded in tertiles labelled as poor, moderate and high. The clusters of adults with comorbidities were identified using latent class analysis (LCA). We used negative binomial regression and ordinal logistic regression to determine the association of comorbidity combinations with healthcare utilization and QoL.

Results

Data from 1,538 adults aged over 50 years who had used outpatient care in the 12 months preceding the survey were analysed. LCA identified three distinct patterns of comorbidities: minimal cardiometabolic comorbidities (72.3%), hypertension and arthritis (18.9%), and cardiopulmonary diseases, hypertension, angina, chronic lung disease, and asthma (8.9%). Relative to the minimal comorbidity class, hypertension and arthritis comorbidity was associated with a higher frequency of outpatient visits [β = 0.2; 95% CI 0.1 to 0.4] and hospitalization [β = 0.7; 95% CI 0.2 to 1.2]. However, cardiopulmonary comorbidity was associated with a higher frequency of hospitalization [β = 1.1; 95% CI 0.2 to 1.9] and not outpatient visits. Compared to the participants with minimal cardiometabolic comorbidities, the odds of moderate and high quality of life were lower among participants with hypertension and arthritis comorbidity [aOR = 0.5; 95% CI 0.3 to 0.6] and cardiopulmonary comorbidities [aOR = 0.3; 95% CI 0.2 to 0.5].

Conclusion

Our findings show that cardiometabolic comorbidities among older persons in Ghana cluster together in distinct patterns that differ in healthcare utilization. This evidence may be used in healthcare planning to optimize treatment and care.

Background

Sub-Saharan Africa is undergoing more rapid ageing than high-income countries (1). This poses potential critical challenges for older persons, central among them is the burden of chronic diseases (2). People living with chronic conditions often have multiple rather than a single condition, commonly referred to as comorbidity (3). In Ghana, three in every five older persons aged above 50 years live with comorbidity (4). Cardiometabolic diseases such as hypertension and diabetes account for the highest burden of comorbidity in Ghana (5). Importantly, cardiometabolic diseases often coexist with other chronic diseases with unrelated pathophysiology such as mental illnesses, chronic lung diseases and musculoskeletal disorders (6–8). This phenomenon is referred to as discordant comorbidity (9).

The management of comorbidities is complex and demanding for healthcare systems in Ghana (10, 11). This is because the current chronic disease management guidelines were developed when having a single chronic disease was common and focuses on a single disease (12, 13). The recent World Health Organization (WHO) guidelines on multimorbidity question this single-disease management approach and highlight the need for accounting for all comorbidities when informing the patient about available treatment options (14). However, studies conducted in Ghana show that people living with comorbidities face several challenges such as fragmented appointments, difficulties with access to information, and a lack of coherence or coordination of care (15, 16). Furthermore, therapeutic interventions for comorbidities are a major challenge due to polypharmacy and poor medication adherence (17). Integrated management of comorbidities and a shift of the treatment goals towards medical care that is less disruptive may partly lower the treatment burden (18).

Previous studies show a positive association between the number of co-existing chronic conditions and frequency of outpatient visits, longer hospital stays, and poor health-related quality of life (4, 19–22). However, the comorbidity counts or indices used in the vast majority of existing studies do not provide adequate information on specific disease clusters to guide integrated care interventions (23, 24). Although the use of disease count is important in establishing the prevalence of comorbidity, clusters of conditions that tend to co-occur non-randomly is more useful for clinical practice and health policy. Thus, a deeper insight into the comorbidity burden on healthcare utilization that goes beyond counting the number of coexisting chronic conditions is needed (25). Understanding comorbidity clusters and healthcare utilization patterns is important for planning health system capacity and response to optimise healthcare resources and accommodate patient needs.

The aim of this study was to identify classes of adults with cardiometabolic comorbidities and determine the association of different comorbidity combinations with healthcare utilization and quality of life (QoL).

Methods

Study design

The data for this study are from the WHO Study on Global AGEing and Adult Health (SAGE) Wave 2 survey conducted in Ghana in 2015 (26). The WHO SAGE aims to provide reliable evidence on the health and well-being of older persons aged over 50 years in low and middle-income countries (27). The study design is provided elsewhere (28). In brief, a stratified multistage cluster sampling method was used to collect data from a nationally representative sample of adults aged 50 years and older. Detailed descriptions of sampling methods and data collection procedures have been previously published (26). The original study sample comprised 3,575 older persons aged over 50 years. This analysis included participants who had used outpatient care in the 12 months preceding the survey. Participants who did not seek outpatient care (n = 2,037) in the last 12 months were excluded. Thus, the final analytical sample size comprised 1,538 participants.

Data collection

Data used in the current study were collected using interviewer-administered structured questionnaires (26). Detailed information on the study tools has been published (28). Data were collected on socio-demographic characteristics, chronic conditions, healthcare utilization and QoL. The chronic conditions comprised cardiometabolic diseases such as angina pectoris, stroke, diabetes, and hypertension, and unrelated conditions such as arthritis, asthma, chronic lung disease, depression, and cataracts.

Measurement and definition of variables

Outcome variable.

The outcome variables were frequency of outpatient visits, hospitalization and QoL. The frequency of outpatient visits was measured as the number of times a participant had an outpatient visit in the preceding 12 months while hospitalization frequency was measured as the number of overnight stays in the hospital that lasted for at least one night, in the past 12 months. An 8-item World Health Organization Quality of Life (WHOQOL) instrument was used to assess the QoL score (29). The WHOQOL comprises two questions across each of the four main life domains: physical, psychological, social, and environmental (29). Using a five-point Likert scale, ranging from very satisfied to very dissatisfied, the respondents rated their satisfaction with life domains such as health, ability to perform daily activities and meet basic needs, relationships, and environment. The composite score of QoL is the sum of the 8 items from the four domains expressed as a percentage. The QoL score was recorded into tertiles with categories labelled as poor, moderate, and high.

Explanatory variables

The main explanatory variable was cardiometabolic comorbidity defined as the coexistence of at least two cardiometabolic diseases including angina, stroke, diabetes, hypertension or a discordant comorbidity comprising at least one cardiometabolic disease and an unrelated chronic disease such as asthma, chronic lung disease, arthritis, cataract and depression.

Self-reported history of diagnosis by a healthcare professional was extracted for cardiometabolic diseases comprising angina, stroke, diabetes, hypertension and other conditions such as arthritis, asthma, chronic lung disease, depression, and cataract. The WHO symptomatology algorithms (30–32) were used to screen for angina pectoris, arthritis, asthma, chronic lung disease, and depression. Online supplementary file 1 shows the details of the symptomatology algorithms. Physical measurements comprised screening for blood pressure (BP). Hypertension was defined as systolic BP ≥ 140mmHg and/or diastolic BP ≥ 90 mmHg and/or previous diagnosis of hypertension by a professional health care provider and/or being on hypertensive therapy (33). Participants with a previous history of clinical diagnosis or treatment for any of the chronic conditions by a healthcare professional but screened negative based on the symptomatology algorithms or physical measurements were considered to have the condition.

Other explanatory variables comprised sociodemographic and health characteristics such as sex, age, education, employment, health insurance coverage, primary source of care (private, public, faith-based/charity hospital) and place of residence (urban or rural).

Data analysis

Descriptive statistics comprising frequencies, means, standard deviations, and Pearson's chi-squared tests were used to summarize the characteristics of the study participants while accounting for sampling weights.

Latent class analysis

Latent Class Analysis (LCA) was used to place participants in a number (K) of clinically meaningful classes of cardiometabolic comorbidities. The number of comorbidity classes was defined a priori using the adjusted Bayesian information criterion (BIC), a model selection method that balances fit with parsimony (34). Five plausible LCA models were delineated, characterized by increasing numbers of chronic disease classes from one to five (Online supplementary file 2). The model with the lowest value of the BIC index was selected as the best-fitting model considering interpretability and clinical judgment (34, 35). Posterior probabilities were used to determine the likelihood of class membership. Finally, the participants were grouped into the comorbidity classes with the highest-class probability (36).

Regression analysis

We used negative binomial regression to determine the association of comorbidity combinations with outpatient visits and hospitalization frequency. Negative binomial regression has inbuilt parameters that account for the overdispersion problem of modelling healthcare utilization frequency (37). Since the QoL variable assumes an increasing order (i.e., low, moderate and high), ordinal logistic regression was used to assess the association of cardiometabolic comorbidity classes with QoL. Bivariable negative binomial regression and ordinal regression with the frequency of outpatient visits, hospitalization, and QoL as the outcome variables, were first fitted for each of the comorbidity classes followed by a multivariable model

adjusting for socio-demographic characteristics namely age, sex, education, employment status, health insurance coverage, and place of residence. Because of the clustered design of the sample, robust variance estimates (Huber-White sandwich estimator) were used for the correction of standard errors to adjust for the correlation among responses within the same household (38). The critical assumption of parallel slopes was not violated in the ordinal regression model following the Brant test. The goodness of fit of the bivariate and multivariable models were assessed using the likelihood ratio test.

All statistical analyses were carried out using Stata 17.0 (StataCorp LP, Texas, USA) and accounted for the complex sampling design used in the WHO SAGE survey.

Results

Characteristics of participants

The sociodemographic and health characteristics of the study participants are presented in Table 1. In total, 1,538 participants were included in the analysis. The mean age was 62.7 (standard deviation ± 10.1) years. In general, most of the participants were women (60.2%), had no formal education (41.4%), lived in rural areas (52.5%), sought care from public facilities (62.9%) and had health insurance cover (53.8%). The most prevalent chronic diseases were hypertension (36.0%) and arthritis (24.1%).

Table 1
Sociodemographic and health characteristics of the study participants

Characteristics	Percent (N = 1538)
Age, mean ± SD	62.7 ± 10.1
Sex	
Male	39.8 [36.6, 43.0]
Female	60.2 [57.0, 63.4]
Education	
No formal education	41.4 [37.9, 45.0]
Primary	25.2 [22.0, 28.8]
Secondary	28.9 [25.6, 32.3]
Tertiary	4.5 [3.2, 6.4]
Employment	
Employed	77.0 [73.0, 80.5]
Unemployed	23.0 [19.5, 27.0]
Place of residence	
Urban	47.6 [43.9, 51.3]
Rural	52.5 [48.7, 56.1]
The primary source of care	
Private	17.4 (14.3, 21.0)
Public	62.9 (59.0, 66.7)
Faith-based	6.1 (3.9, 9.2)
† Others	13.7 (11.5, 16.1)
Health insurance coverage	
Yes	53.8 (49.5, 58.1)
No	46.2 (41.9, 50.5)
Chronic diseases	
Hypertension	36.0 [32.9, 39.2]
Arthritis	24.1 [21.0, 27.5]

Characteristics	Percent (N = 1538)
Angina	11.0 [8.9, 13.4]
Cataract	9.7 [8.2, 11.5]
Asthma	8.0 [6.4, 10.0]
Depression	6.4 [4.9, 8.2]
Chronic lung disease	5.4 [4.1, 7.0]
Diabetes	2.7 [1.9, 3.8]
Stroke	1.4 [0.9, 2.3]
Cells are weighted percentages unless otherwise specified	
† Other sources of primary care comprise local pharmacies and traditional healers.	

Findings Of Latent Class Analysis

The comorbidity classes are shown in Fig. 1. We compared LCA models with 1 to 5 classes (online supplementary file 2). The three-class model was selected as the best-fit solution. Although the 2-class model had a slightly lower BIC index than the three-class (BIC_{2class} = 8587.0 vs. BIC_{3class} = 8592.6), further inspection showed that the three-class model exhibited clearer separation between latent classes thus the three-class model was finally selected. Class one comprised participants with minimal cardiometabolic comorbidities (72.3%). Class two comprised participants with high ‘probabilities of hypertension and arthritis (18.9%). Class three (cardiopulmonary diseases) comprised participants with high probabilities of angina, chronic lung disease, asthma and hypertension (8.8%).

Frequency Of Healthcare Utilization And Quality Of Life

The patterns of healthcare utilization and QoL is presented in Table 2. In general, the participants who visited outpatient clinics more than three times and hospitalized at least once in the previous 12 months were mostly older, women, unemployed, lived in urban settings, sought primary care from faith-based or charity organizations, had hypertension and arthritis comorbidity and cardiopulmonary comorbidities. Other participants who visited outpatient clinics more than three times in the previous 12 months mostly comprised those with tertiary-level education and health insurance coverage. QoL was lowest among older participants, females, unemployed, those with no formal education and health insurance cover, living in urban settings, seeking care from faith-based or charity organizations, and participants with hypertension and arthritis comorbidity and cardiopulmonary comorbidities.

Table 2
Healthcare utilization and quality of life (n = 1538)

Characteristic	Outpatient visits		Hospitalized		Quality of life			
	≥ 3 times	P-value	Yes	P-value	Low	Moderate	High	P-value
Age, years		0.56		0.61				< 0.001
50–59	22.6		5.5		28.2	27.1	44.7	
60–69	24.9		6.3		37.2	27.2	35.6	
70+	25.2		7.1		59.7	20.5	19.8	
Sex								
Male	8.5	0.09	2.1	0.39	12.8	9.5	17.4	< 0.001
Female	15.4		4.0		25.7	16.0	18.6	
Education		0.06		0.80				
No formal education	20.7		5.8		50.1	24.5	25.4	< 0.001
Primary	24.3		7.2		39.5	23.1	37.4	
Secondary	26.8		6.0		24.2	30.4	45.5	
Tertiary	32.9		4.6		17.6	18.3	64.1	
Employment		0.45		0.29				< 0.001
Employed	23.4		5.7		35.2	27.1	37.7	
Unemployment	25.7		7.5		49.4	20.2	30.5	
Residence		< 0.001		0.06				0.05
Urban	13.9		7.5		16.9	11.5	19.2	
Rural	10.0		4.9		21.6	14.0	16.8	
Primary source of care		0.06		0.01				0.07
Private facility	26.8		6.2		29.9	24.9	45.2	
Public facility	22.3		6.9		39.9	24.3	35.8	
Faith-based/charity hospital	37.4		10.1		41.1	32.4	26.4	

Characteristic	Outpatient visits		Hospitalized		Quality of life			
	≥ 3 times	P-value	Yes	P-value	Low	Moderate	High	P-value
† Others	21.7		0.9		41.6	29.0	29.4	
Health insurance cover		0.12		0.99				0.11
Yes	25.7		6.1		35.4	26.0	38.7	
No	21.8		6.2		42.1	25.0	32.9	
Comorbidity clusters								
Class 1: Minimal comorbidities	21.3	< 0.001	5.1	0.01	30.9	28.0	41.2	< 0.001
Class 2: Hypertension & arthritis	31.7		10.0		54.0	21.4	24.6	
Class 3: Cardiopulmonary comorbidities	28.6		6.5		67.6	14.4	18.0	
Total	23.9		6.2		38.5	25.5	36.0	
Cells are weighted row percentages								
Other sources of primary care comprise local pharmacies and traditional healers								

Cardiometabolic Comorbidity Classes And Associated Healthcare Utilization Patterns And Qol

Figure 2 shows the association of different comorbidity combinations with healthcare utilization and QoL. Relative to the minimal comorbidity class, hypertension and arthritis comorbidity was associated with a higher frequency of outpatient visits [β = 0.2; 95% CI 0.1 to 0.4] and hospitalization [β = 0.7; 95% CI 0.2 to 1.2]. However, cardiopulmonary comorbidity was associated with a higher frequency of hospitalization [β = 1.1; 95% CI 0.2 to 1.9] and not outpatient visits. Compared to the participants with minimal cardiometabolic comorbidities, the odds of moderate and high quality of life were lower among participants with hypertension and arthritis comorbidity [aOR = 0.5; 95% CI 0.3 to 0.6] and cardiopulmonary comorbidities [aOR = 0.3; 95% CI 0.2 to 0.5].

Discussion

In this study, we identified classes of adults with cardiometabolic comorbidities and assessed the association of different comorbidity combinations with healthcare utilization and QoL. Our findings show three distinct patterns of comorbidities: minimal cardiometabolic comorbidities, hypertension and

arthritis comorbidity, and cardiopulmonary comorbidity. Hypertension and arthritis comorbidity was associated with a higher frequency of outpatient visits and hospitalization compared to the minimal comorbidity cluster while cardiopulmonary comorbidity was associated with a higher frequency of hospitalization and not outpatient visits. Participants with hypertension and arthritis and cardiopulmonary comorbidities had poorer quality of life compared to those with minimal cardiometabolic comorbidities.

The comorbidity clusters identified in our study are similar to those in previous studies (39, 40). A systematic review of comorbidity patterns from 39 studies conducted in 12 countries identified hypertension and arthritis as the most frequent comorbidity combination (40). Another study conducted in South Africa found two distinct comorbidity clusters comprising hypertension and diabetes and cardiopulmonary diseases such as angina, asthma and chronic lung disease (39). In our study, 72.3% of the participants were classified under minimal comorbidity, 18.9% under hypertension and arthritis class and 8.9% under cardiopulmonary class. The clustering of cardiopulmonary diseases such as hypertension, angina, chronic lung disease and asthma could be partly explained by inflammation, stress processes, hypoxia, and environmental risk factors such as air pollution and smoking (41, 42). However, comorbidity clusters such as hypertension and arthritis without well-established pathogeneses should be studied in the future.

Our findings show that the comorbidity patterns among older adults in Ghana are distinct with important differences with respect to healthcare utilization and QoL. Having arthritis and hypertension was associated with higher levels of healthcare utilization than cardiopulmonary or minimal comorbidity. However, both arthritis and hypertension cluster and cardiopulmonary comorbidity were positively associated with higher levels of hospitalization and poor quality of life compared to participants with minimal comorbidities. Although these findings are consistent with previous studies conducted in low and middle-income countries (4, 20, 22), it is important to note that the existing studies were based on comorbidity counts without adequate information on specific disease clusters to guide primary care. Unlike the comorbidity counts, where all morbidities are equally scored irrespective of their relationships, our approach provides crucial insight into the burden of specific comorbidity clusters that goes beyond counting the number of coexisting chronic conditions. Several underlying mechanisms could explain the association of comorbidity clusters identified in our study with the frequency of healthcare utilization and QoL. In line with previous studies (4, 43–45), there is a possibility that QoL may have deteriorated, partly due to treatment burden including medication intake, drug management, self-monitoring, lifestyle changes and hospitalization. However, future studies should focus on identifying the underlying causal pathways connecting distinct cardiometabolic comorbidity clusters, healthcare utilization patterns and QoL.

Strengths And Limitations

This study has three main strengths. First, data are from a nationally representative population-based survey using a standardised WHO-SAGE protocol. Thus, the findings are generalizable to the population of persons aged 50 years and above in Ghana. Second, screening for chronic diseases was based on objective measures comprising direct physical measurement of BP, symptomatology algorithms and self-reports. Third, the use of LCA in the identification of distinct cardiometabolic comorbidity clusters provides crucial insights into the patterns of non-random co-occurrence of comorbidities that goes beyond simple counts used in the majority of previous studies.

The current study has some limitations. First, the screening questions for chronic diseases were partially based on self-report. This may have resulted in the underestimation of the true prevalence of chronic diseases. Second, the number of chronic diseases in the LCA was limited to those included in the SAGE survey in Ghana. This may have excluded other common chronic conditions among older persons, such as dementia and cancers, resulting in an underestimation of the comorbidity burden. Future studies need to include more chronic diseases to increase the external validity. Finally, the cross-sectional design of the data used in this analysis implies a lack of conclusions regarding the temporality or causation between the comorbidity classes, healthcare utilization patterns and QoL. Further studies based on longitudinal analysis need to estimate the incidence of transitions between latent classes of cardiometabolic comorbidities and their impact on healthcare utilization patterns and QoL.

This study has two key policy implications. First, we identified distinct comorbidity combinations comprising hypertension and arthritis and cardiopulmonary comorbidities. This may inform the design of comorbidity treatment guidelines and primary care interventions for cardiometabolic diseases. Given that most of the existing guidelines for the management of chronic diseases in Ghana are single-disease-focused (13), there is a need for a policy discourse on integrated care of discordant cardiometabolic comorbidities to enable patients to benefit from minimally disruptive care. Second, these results are useful for identifying target populations of people living with cardiometabolic diseases at high risk of outpatient visits, hospitalizations and poor QoL. This is important for planning service delivery capacity, optimization of resources and health system response.

Conclusions

Our results provide insight into the cardiometabolic comorbidity clusters and the associated patterns of healthcare utilization and QoL. The findings of this study show that cardiometabolic comorbidities among older persons in Ghana cluster together in distinct patterns that differ in healthcare utilization and QoL. This evidence may be used in healthcare planning and the design of appropriate clinical guidelines for the management of cardiometabolic comorbidities. Our findings form the basis for, future research on the aetiology and pathogenesis of discordant comorbidity clusters, and improved policies to address healthcare access and QoL for older persons living with cardiometabolic comorbidities in sub-Saharan Africa.

Abbreviations

BIC: Bayesian Information Criterion;

aOR: Adjusted Odds Ratio

CI: Confident Interval

BP: Blood pressure

LCA: Latent class analysis

SAGE: Survey of ageing and adult health

WHO: World Health Organization

WHOQoL: World Health Organization Quality of Life instrument

Declarations

Ethics approval and consent to participate

All methods were carried out in accordance with the relevant guidelines and regulations. This study was approved by the World Health Organization's Ethical Review Board (reference number RPC149) and the Ethical and Protocol Review Committee, College of Health Sciences, University of Ghana, Accra, Ghana. The respondents went through an informed consent process and their participation was voluntary and anonymous. Written consent was provided before participation.

Consent for publication

Not required.

Availability of data and materials

Data used in the current study are publicly available on the microdata repository of the WHO (https://apps.who.int/healthinfo/systems/surveydata/index.php/catalog).

Competing interest

The authors declare that they have no competing interest

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Authors' contributions

PO conceptualized the study, reviewed the literature, and analysed the data. GA, CW, WW, and CA made substantive contributions to the conceptualization of the study, and data analysis and reviewed the manuscript. All authors read and approved the final manuscript.

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Figures

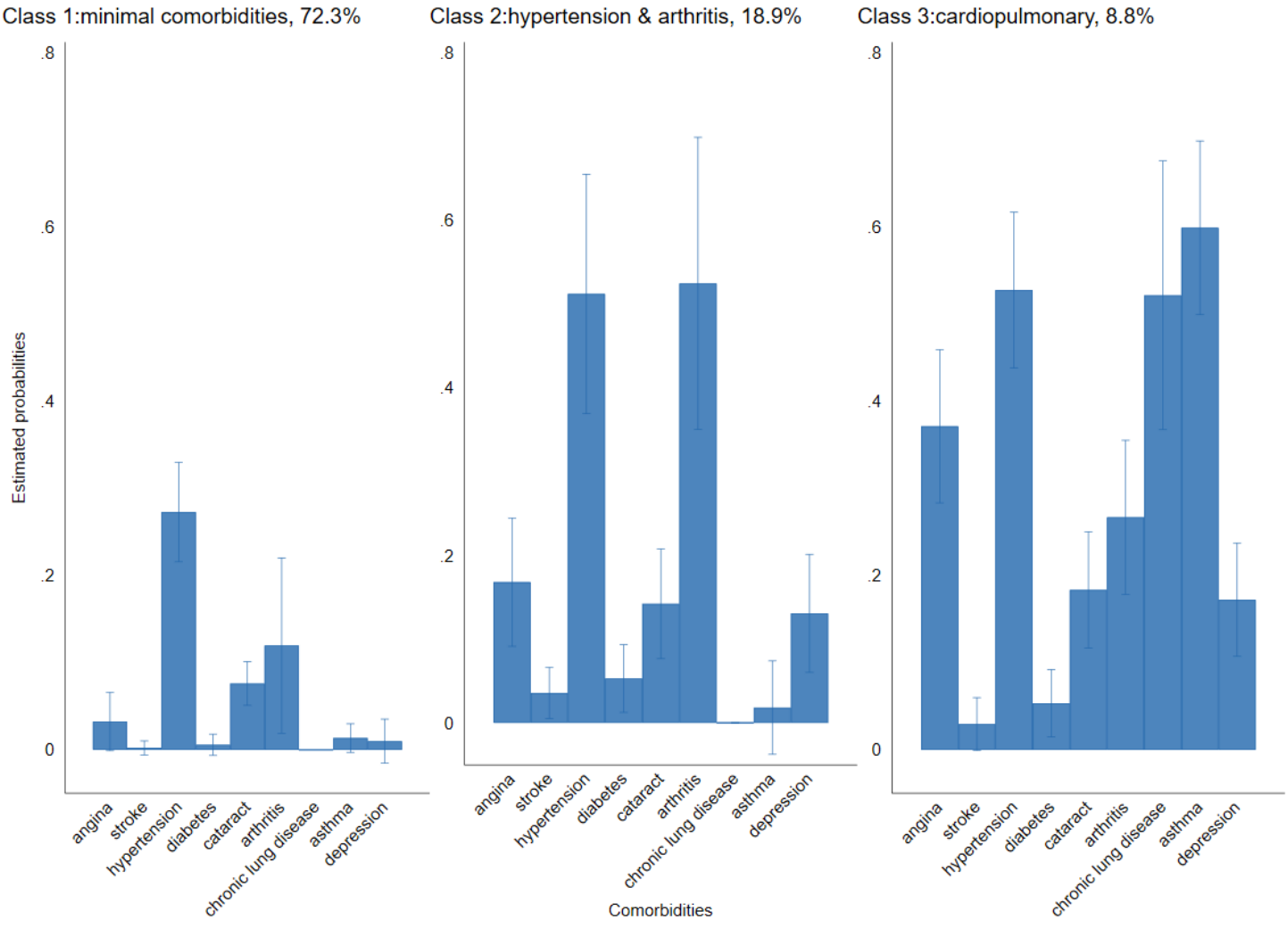

Figure 1

Latent classes of cardiometabolic comorbidities

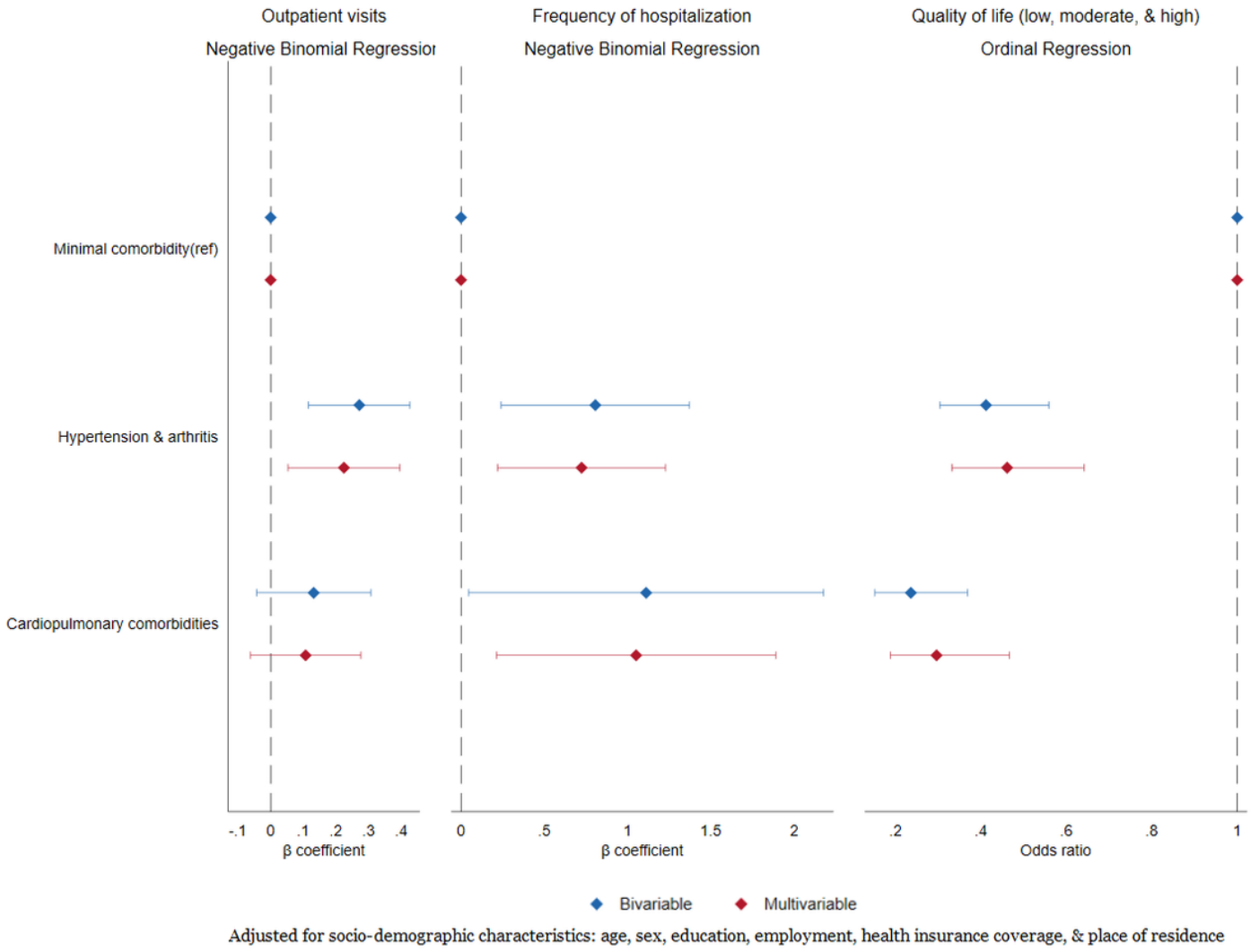

Figure 2

Association of cardiometabolic comorbidity combinations with healthcare utilization and QoL

Supplementary Files

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- Onlinesupplementaryfile1Symptomatologyalgorithms.pdf
- Onlinesupplementaryfile2Comparisonbetweenlatentclassmodels.pdf