



Association between Multimorbidity and Quality of Life among Adults Attending Outpatient Clinics in the Ashanti Region: A Cross-Sectional Study

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Abstract

Multimorbidity, the coexistence of two or more chronic conditions in an individual, is increasingly prevalent worldwide, posing significant challenges for healthcare systems and patient well-being. This cross-sectional study aims to investigate the association between multimorbidity and quality of life (QoL) among adults attending outpatient clinics in health facilities within the Ashanti Region of Ghana. **Method:** A sample of $n = 400$ participants were recruited using convenience sampling. Data were collected through structured interviews using the Short Form Health Survey (SF-36) to assess QoL and a checklist to ascertain multimorbidity status. Statistical analyses including correlation and regression analyses were performed to explore the relationship between multimorbidity and QoL, adjusting for potential variables. **Results:** The findings reveal that there is no statistically significant association between multi-morbidity and the perceived changes in current health compared to one year ago ($X^2 = 4.814$, $p = 0.307$), with 11.76% of those with multi-morbidity reporting better health, and 11.14% of non-multi-morbid individuals reporting the same. Similarly, role function, general health, and energy and fatigue did not demonstrate statistically significant associations with multi-morbidity. However, the emotional problem variable approached significance ($X^2 = 9.299$, $p = 0.054^*$), with 35.29% of individuals with multi-morbidity experiencing emotional issues compared to 25.90% among non-multi-morbid individuals. Notably, health change exhibited a significant association ($X^2 =$

4.812, $p = 0.028$), indicating that 73.53% of those with multi-morbidity reported a worsening health change, compared to 59.34% of non-multi-morbid individuals. **Conclusion:** This study sheds light on the nuanced relationship between multi-morbidity and various dimensions of perceived health. While no significant associations were found between multi-morbidity and certain aspects such as role function, general health perception, and energy/fatigue levels, notable findings emerged regarding emotional well-being and health changes over time.

Subject Areas

Public Health, Women's Health

Keywords

Multimorbidity, Quality of Life, Outpatient Clinics, Ashanti Region, Ghana, SF-36, Cross-Sectional Study

1. Introduction

The evolving demographics and social dynamics accompanying aging populations are driving swift epidemiological shifts, notably marked by the surge of chronic non-communicable diseases (NCDs) and multimorbidity [1]. Multimorbidity denotes the coexistence of two or more long-term conditions, whether related or unrelated, within an individual [2]. Despite methodological variations in defining and assessing multimorbidity [3], its global burden is demonstrably increasing [4] [5], extending to low- and middle-income countries (LMICs) [6] [7], and specifically, Ghana [8] [9]. By 2035, multimorbidity prevalence is anticipated to double, with a forecast that the majority of individuals aged over 65 will contend with four or more chronic ailments [10] [11]. These people may either be within the outpatients' category or may be on admission in a health care facility. This study therefore seeks to assess the association between multimorbidity and quality of life among adults attending outpatient clinics in the Ashanti Region in Ghana.

The emergence of multimorbidity within the population has multiple contributors. Several factors, including advanced age [4] [12] [13] [14] [15], socioeconomic disparities [15], obesity [16], gender (female) [17] [18], sedentary lifestyle [19], tobacco and alcohol use [20] [21], and psychosocial elements like limited social networks and external locus of control [22] [23], are commonly associated with multimorbidity in global literature. Multimorbidity profoundly impacts various facets of patients' lives, manifesting in diminished quality of life (QoL), heightened disability, functional deterioration, and escalated healthcare expenditures [19] [24] [24]. Its adverse effect on QoL is particularly pronounced among middle-aged and elderly populations, females, and those with comorbid mental health conditions [17].

The experience of multimorbidity transcends the sum of individual chronic conditions [26], with specific disease clusters exerting distinct effects on physical and psychological well-being [27]. Consequently, individuals with multimorbidity consistently report lower health-related QoL compared to those without [28]. The enduring presence of multimorbidity poses substantial challenges for healthcare systems [29], given that individuals with diverse NCD combinations harbor varying needs and priorities [30]. Regrettably, insufficient attention is accorded to the preferences of individuals managing multiple health issues, especially among outpatients whose state of health conditions are not usually deemed critical [31] [32]. Furthermore, prevailing care models and guidelines, predominantly rooted in single disease paradigms, often overlook the holistic needs and circumstances of complex care patients [33] [34]. Consequently, individuals grappling with multiple conditions frequently interact with disparate healthcare professionals, resulting in fragmented, uncoordinated, and compartmentalized patient management [2] [35]. The advent of infections such as COVID-19 exacerbates this complexity, exacerbating the burden on healthcare systems and worsening outcomes for those with pre-existing chronic diseases and multimorbidity [36] [37].

While numerous studies have explored the nexus between QoL and multimorbidity [38] [39], the majority have been conducted in high-income countries, employing disparate QoL measurement tools [40]. Notably, the Short Form Health Survey (SF-12) emerges as an efficient algorithm for reproducing the SF-36 tool to gauge health-related QoL [41].

However, methodological disparities persist, extending to data analysis techniques [42]. Ordinal regression models emerge as a more sensitive and comprehensive approach, superior to conventional methods in analyzing ordered outcomes like QoL [43] [44].

Yet, challenges remain, as data often fail to meet the assumptions of proportional odds models [43]. In such instances, a more pragmatic approach, such as the partial proportional odds (PPO) model, proves effective, offering insights into unobserved heterogeneity and identifying correlates of negative health outcomes, including impaired QoL [42] [44] [45].

Addressing the QoL concerns of individuals with multimorbidity represents a pivotal challenge for contemporary healthcare and social systems [25]. Consequently, there's a growing call to tailor multimorbidity management to account for its impact on individuals' QoL and their unique priorities [46] [47]. However, understanding the impact of multimorbidity on health-related QoL in Ghana remains scant, necessitating comprehensive assessments to inform targeted interventions.

2. Methodology

2.1. Study Design

This cross-sectional study design employed a quantitative research approach to

investigate the association between multimorbidity and QoL among outpatient adults.

2.2. Study Setting and Participants

The study was conducted at Komfo Anokye Teaching Hospital (the second largest hospital in Ghana) from April 2023 to July 2023 involving outpatient adults attending outpatient clinics. The facility serves as a referral centre notably in southern and northern Ghana.

2.3. Sample Size Calculation

The sample size was calculated using the formula for estimating a single proportion, with a 95% confidence level and a margin of error of 5%. Considering an anticipated prevalence of multimorbidity of 50% and assuming a non-response rate of 10%, the estimated sample size was $n = 400$.

2.4. Data Collection

Data was collected with a structured questionnaire by trained research assistants. The Short Form Health Survey (SF-36) was also used to assess QoL, while the questionnaire contained a checklist that was used to ascertain the presence of multimorbidity. Information on sociodemographic characteristics, medical history, and healthcare utilization were also solicited.

The SF-36 is a multipurpose, 36-item survey that measures eight domains of health [48] [49] [50] [51].

- Physical functioning
- Role limitations due to physical health
- Bodily pain
- General health perceptions
- Vitality
- Social functioning
- Role limitations due to emotional problems
- Mental health

2.5. Data Analysis

Descriptive statistics was used to summarize the characteristics of the study population. The association between multimorbidity and QoL was examined using correlation and regression analyses, adjusting for potential variables such as age, sex, socioeconomic status, and comorbidity burden.

2.6. Ethical Considerations

Ethical approval was obtained from the Komfo Anokye Teaching Hospital Institutional Review Board or ethics committees. Written informed consents were obtained from all study participants, and measures were taken to ensure confidentiality and privacy throughout the study.

3. Results

Table 1 shows the sociodemographic characteristics of respondents is presented in **Table 1**. With a median age of 43 years, the respondents span a wide age range, from below 20 years to those aged 60 years and above. Notably, individuals aged 60 years and above constitute the largest group, making up 27.50% of the sample. The study maintains a balanced gender representation, with females comprising 52.00% and males 48.00% of the respondents. Occupationally, the unemployed form the largest group at 37.75%, followed by traders, students, and farmers. Educational diversity is evident, with categories ranging from no formal education to tertiary education, allowing for a nuanced exploration of multi-morbidity across educational strata. The residence type exhibits a mix of urban and rural settings, with 43.00% per urban, 14.25% urban, and 42.75% rural.

Table 2 shows the exploration of the relationship between multi-morbidity and the quality of life (QOL) among adults attending outpatient clinics in the Ashanti Region involves a detailed analysis of a 400-respondent sample. The study considers variables such as current health compared to one year ago, role function, general health, energy and fatigue, emotional problems, health change, pain, and social activity. The findings reveal that there is no statistically significant association between multi-morbidity and the perceived changes in current health compared to one year ago ($X^2 = 4.814$, $p = 0.307$), with 11.76% of those with multi-morbidity reporting better health, and 11.14% of non-multi-morbidity individuals reporting the same. Similarly, role function, general health, and energy and fatigue did not demonstrate statistically significant associations with multi-morbidity. However, the emotional problem variable approached significance ($X^2 = 9.299$, $p = 0.054^*$), with 35.29% of individuals with multi-morbidity experiencing emotional issues compared to 25.90% among non-multi-morbid individuals. Notably, health change exhibited a significant association ($X^2 = 4.812$, $p = 0.028$), indicating that 73.53% of those with multi-morbidity reported a worsening health change, compared to 59.34% of non-multi-morbid individuals. The variables of pain and social activity affected did not show significant associations with multi-morbidity. This in-depth analysis of the relationship between multi-morbidity and various dimensions of QOL emphasizes the need to address both physical health and emotional well-being in managing individuals with multiple health conditions.

4. Discussion

The exploration of the relationship between multi-morbidity and the quality of life (QOL) among adults attending outpatient clinics in the Ashanti Region provides valuable insights into the complex interplay between health conditions and overall well-being. The detailed analysis of a 400-respondent sample offers nuanced findings across multiple dimensions of QOL, shedding light on both similarities and disparities between individuals with multi-morbidity and those without.

Table 1. Distribution of respondents' sociodemographic information.

Variable	Frequency (n = 400)	Percentage (%)
Age		
median age = 43 years		
25% quartile = 25 years		
75% quartile = 61 years		
Age groups		
Below 20 years	54	13.50
20 - 29 years	74	18.50
30 - 39 years	60	15.00
40 - 49 years	44	11.00
50 - 59 years	58	14.50
60 years and above	110	27.50
Gender		
Female	206	52.00
Male	192	48.00
Occupation		
Unemployed	151	37.75
Farmer	40	10.00
Trader	87	21.75
Student	43	10.75
Artisan	19	4.75
Civil Servant	32	8.00
Retired	28	7.00
Educational level		
No formal education	106	26.50
Primary/JSS	127	31.75
Secondary	89	22.25
Tertiary	78	19.50
Residence type		
Per Urban	172	43.00
Urban	57	14.25
Rural	171	42.75
Ethnicity		
Akan	364	91.00
Ga	4	1.00
Northerner	25	6.25
Voltarian	7	1.75

Table 2. Association between multi-morbidity and quality of life among adults attending the outpatient clinic.

Variable	Frequency (n = 400) (%)		X ²	P-value
	Morbidity			
	Multi-morbidity	Non-multi morbidity		
Current health compared to 1 year				
Better	8 (11.76)	37 (11.14)	4.814	0.307
Good	10 (14.71)	80 (24.10)		
Equal	17 (25.00)	85 (25.60)		
Worse	12 (17.65)	61 (18.60)		
Much worse	21 (30.88)	69 (20.78)		
Role function				
Limited	34 (50.00)	158 (47.59)	0.131	0.717
Not limited	34 (50.00)	174 (52.41)		
General Health				
Poor health	23 (33.82)	129 (38.86)	0.606	0.436
Good Health	45 (66.18)	203 (61.14)		
Energy and Fatigue				
Have challenges during work	33 (48.53)	151 (45.48)	0.211	0.646
Have no challenge during work	35 (51.47)	181 (54.52)		
Emotional Problem				
Moderately severe	12 (34.00)	86 (37.90)	9.299	0.054*
Not at all slightly	24 (52.00)	86 (37.90)		
Very severe	7 (14.00)	62 (24.20)		
Health Change				
Get worse	50 (73.53)	197 (59.34)	4.812	0.028
Excellent	18 (26.47)	135 (40.66)		
Pain				
Pain affects work	43 (63.24)	195 (58.73)	0.474	0.491
Pain does not affect work	25 (36.76)	137 (41.27)		
Social activity affected				
Always	27 (39.71)	126 (37.95)	0.255	0.968
Most of the time	4 (5.88)	16 (4.82)		
Sometime	3 (4.41)	16 (4.82)		
None of the time	34 (50.00)	174 (52.41)		

Firstly, the study reveals that there is no statistically significant association between multi-morbidity and perceived changes in current health compared to one year ago suggests that having multiple health conditions does not necessarily dictate a decline in self-reported health over time. This finding challenges assumptions about the inevitability of health deterioration in the context of multi-morbidity and underscores the importance of individual variations in health outcomes. However, earlier research has highlighted the difficulties associated with managing multimorbidity [8]. Evidence suggests that prevalent risk factors driving the escalating burden of multimorbidity include advanced age, obesity, sedentary lifestyle, socioeconomic disadvantage, and the consumption of tobacco and alcohol [21]. These findings imply that a significant proportion of the risk factors for multimorbidity are amenable to modification [6].

Similarly, the absence of significant associations between multi-morbidity and variables such as role function, general health, and energy and fatigue implies that the impact of multiple health conditions on these aspects of QOL may be more nuanced or influenced by other factors beyond the presence of co-morbidities. Numerous studies have indicated that multimorbidity significantly diminishes quality of life (QoL) [38] [39] [43]. While direct comparisons with prior research may be challenging due to methodological differences, the authors note a consistent finding: individuals grappling with multimorbidity exhibit markedly lower QoL compared to those managing a single chronic condition. These results highlight the complexity of assessing QOL in individuals with multi-morbidity and the need for comprehensive approaches that consider diverse factors contributing to well-being.

However, the study's identification of a near-significant association between multi-morbidity and emotional problems suggests that individuals with multiple health conditions may be more vulnerable to experiencing psychological distress compared to their counterparts with fewer health issues. This finding underscores the importance of addressing mental health concerns alongside physical health management in the care of individuals with multi-morbidity.

Furthermore, the significant association between multi-morbidity and reported worsening health change underscores the substantial impact that co-morbidities can have on individuals' perceived health trajectories. This finding underscores the urgency of proactive interventions aimed at mitigating the progression of health decline in individuals with multi-morbidity and promoting strategies for maintaining or improving overall well-being.

Although variables such as pain and social activity affected did not demonstrate significant associations with multi-morbidity in this study, their inclusion in the analysis provides valuable insights into additional dimensions of QOL that may be influenced by the presence of multiple health conditions.

5. Conclusion

The study highlights the complexity of the relationship between multi-morbidity

and QOL, emphasizing the need for tailored interventions that address both physical and psychological aspects of health in individuals with multiple health conditions. Having multiple health conditions does not inevitably lead to a decline in self-reported health over time, highlighting the importance of individual variations in health outcomes. The impact of multi-morbidity on different aspects of QOL may vary, emphasizing the need for comprehensive approaches to well-being assessment. This highlights the importance of addressing mental health concerns alongside physical health management in the care of individuals with multi-morbidity.

6. Recommendation

This study's inclusive analysis of the relationship between multi-morbidity and various dimensions of QOL highlights the need for holistic approaches to healthcare that address both physical and emotional aspects of well-being in individuals with multiple health conditions. By recognizing the diverse factors contributing to QOL outcomes in this population, healthcare providers can tailor interventions to meet the complex needs of individuals with multi-morbidity and improve their overall quality of life.

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Availability of Data and Materials

The data supporting this study's findings are available from the corresponding author upon request.

Authors' Contributions

JA led the background development, fieldwork, and analysis of the paper. **JKB** was involved in analyses and report writing. All authors were involved in editing and proofreading the manuscript. **IBK** was the local collaborator at the study site. **EBK** final editing and typesetting.

Ethics Approval and Consent to Participate

The study was approved by the Research and Development Unit of Komfo Anokye Teaching Hospital, Kumasi-Ghana. Respondents were selected based on their consent. Again, all participants were provided with written informed consent to participate. The study followed all the ethical considerations about respon-

dents' selection, interview process, confidentiality, and data analysis protocols.

Consent for Publication

All Authors' have fully consented for this paper to be published.

Conflicts of Interest

The authors declare that they have no conflict of interest.

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References

- [1] WHO (2016) World Health Statistics 2016: Monitoring Health for the SDGs, Sustainable Development Goals.
- [2] Mercer, S., Salisbury, C. and Fortin, M. (2014) ABC of Multimorbidity. John Wiley & Sons, Ltd., London.
- [3] Ho, I.S.-S., Azcoaga-Lorenzo, A., Akbari, A., Black, C., Davies, J., Hodgins, P., *et al.* (2021) Examining Variation in the Measurement of Multimorbidity in Research: A Systematic Review of 566 Studies. *The Lancet Public Health*, **6**, E587-E597. [https://doi.org/10.1016/S2468-2667\(21\)00107-9](https://doi.org/10.1016/S2468-2667(21)00107-9)
- [4] Xu, X., Mishra, G.D. and Jones, M. (2017) Mapping the Global Research Landscape and Knowledge Gaps on Multimorbidity: A Bibliometric Study. *Journal of Global Health*, **7**, Article 010414. <https://www.icmje.org/disclosure-of-interest/> <https://doi.org/10.7189/jogh.07.010414>
- [5] Zemedikun, D.T., Gray, L.J., Khunti, K., Davies, M.J. and Dhalwani, N.N. (2018) Patterns of Multimorbidity in Middle-Aged and Older Adults: An Analysis of the UK Biobank Data. *Mayo Clinic Proceedings*, **93**, 857-866. <https://doi.org/10.1016/j.mayocp.2018.02.012>
- [6] Abebe, F., Schneider, M., Asrat, B. and Ambaw, F. (2020) Multimorbidity of Chronic Non-Communicable Diseases in Low- and Middle-Income Countries: A Scoping Review. *Journal of Comorbidity*, **10**, 1-13. <https://doi.org/10.1177/2235042X20961919>
- [7] Asogwa, O.A., Boateng, D., Marzà-Florensa, A., Peters, S., Levitt, N., van Olmen, J., *et al.* (2022) Multimorbidity of Non-Communicable Diseases in Low-Income and Middleincome Countries: A Systematic Review and Meta-Analysis. *BMJ Open*, **12**, e049133. <https://doi.org/10.1136/bmjopen-2021-049133>
- [8] Bhagavathula, A.S., Gebreyohannes, E.A., Seid, M.A., Adane, A., Brkic, J. and Fialová, D. (2021) Prevalence and Determinants of Multimorbidity, Polypharmacy, and Potentially Inappropriate Medication Use in the Older Outpatients: Findings from EuroAgeism H2020 ESR7 Project in Ethiopia. *Pharmaceuticals*, **14**, Article 844. <https://doi.org/10.3390/ph14090844>
- [9] Eyowas, F.A., Schneider, M., Alemu, S., Pati, S. and Getahun, F.A. (2022) Magnitude, Pattern and Correlates of Multimorbidity among Patients Attending Chronic Outpatient Medical Care in Bahir Dar, Northwest Ethiopia: The Application of Latent Class Analysis Model. *PLOS ONE*, **17**, e0267208. <https://doi.org/10.1371/journal.pone.0267208>

- [10] Calderon-Larranaga, A., Vetrano, D.L., Ferrucci, L., Mercer, S.W., Marengoni, A., Onder, G., *et al.* (2018) Multimorbidity and Functional Impairment: Bidirectional Interplay, Synergistic Effects and Common Pathways. *Journal of Internal Medicine*, **285**, 255-271. <https://doi.org/10.1111/joim.12843>
- [11] Kingston, A., Robinson, L., Booth, H., Knapp, M. and Jagger, C. (2018) Projections of Multi-Morbidity in the Older Population in England to 2035: Estimates from the Population Ageing and Care Simulation (PACSim) Model. *Age and Ageing*, **47**, 374-380. <https://doi.org/10.1093/ageing/afx201>
- [12] Mounce, L.T.A., Campbell, J.L., Henley, W.E., Tejerina Arreal, M.C., Porter, I. and Valderas, J.M. (2018) Predicting Incident Multimorbidity. *Annals of Family Medicine*, **16**, 322-329. <https://doi.org/10.1370/afm.2271>
- [13] Ornstein, S.M., Nietert, P.J., Jenkins, R.G. and Litvin, C.B. (2013) The Prevalence of Chronic Diseases and Multimorbidity in Primary Care Practice: A PPRNet Report. *Journal of the American Board of Family Medicine*, **26**, 518-524. <https://doi.org/10.3122/jabfm.2013.05.130012>
- [14] Willadsen, T., Jarbøl, D., Reventlow, S., Mercer, S., *et al.* (2018) Multimorbidity and Mortality: A 15-Year Longitudinal Registry-Based Nationwide Danish Population Study. *Journal of Comorbidity*, **8**, 1-9. <https://doi.org/10.1177/2235042X18804063>
- [15] Barnett, K., Mercer, S.W., Norbury, M., Watt, G., Wyke, S. and Guthrie, B. (2012) Epidemiology of Multimorbidity and Implications for Health Care, Research, and Medical Education: A Cross-Sectional Study. *The Lancet*, **380**, 37-43. [https://doi.org/10.1016/S0140-6736\(12\)60240-2](https://doi.org/10.1016/S0140-6736(12)60240-2)
- [16] Romano, E., Ma, R., Vancampfort, D., Firth, J., Felez-Nobrega, M., Haro, J.M., *et al.* (2021) Multimorbidity and Obesity in Older Adults from Six Low- and Middle-Income Countries. *Preventive Medicine*, **153**, Article 106816. <https://doi.org/10.1016/j.ypmed.2021.106816>
- [17] Violan, C., Foguet-Boreu, Q., Flores-Mateo, G., Salisbury, C., Blom, J., Freitag, M., *et al.* (2014) Prevalence, Determinants and Patterns of Multimorbidity in Primary Care: A Systematic Review of Observational Studies. *PLOS ONE*, **9**, e102149. <https://doi.org/10.1371/journal.pone.0102149>
- [18] Alimohammadian, M., Majidi, A., Yaseri, M., Ahmadi, B., Islami, F., Derakhshan, M., *et al.* (2017) Multimorbidity as an Important Issue among Women: Results of a Gender Difference Investigation in a Large Population-Based Cross-Sectional Study in West Asia. *BMJ Open*, **7**, e013548. <https://doi.org/10.1136/bmjopen-2016-013548>
- [19] Skou, S.T., Mair, F.S., Fortin, M., Guthrie, B., Nunes, B.P., Miranda, J.J., *et al.* (2022) Multimorbidity. *Nature Reviews Disease Primers*, **8**, Article No. 48. <https://doi.org/10.1038/s41572-022-00376-4>
- [20] AMS (2018) Multimorbidity: A Priority for Global Health Research.
- [21] Freisling, H., Viallon, V., Lennon, H., Bagnardi, V., Ricci, C., Butterworth, A.S., *et al.* (2020) Lifestyle Factors and Risk of Multimorbidity of Cancer and Cardiometabolic Diseases: A multinational Cohort Study. *BMC Medicine*, **18**, Article No. 5. <https://doi.org/10.1186/s12916-019-1474-7>
- [22] van den Akker, M., Buntinx, F., Metsemakers, J.F.M., Roos, S. and Knottnerus, J.A. (1998) Multimorbidity in General Practice: Prevalence, Incidence, and Determinants of Co-Occurring Chronic and Recurrent Diseases. *Journal of Clinical Epidemiology*, **51**, 367-375. [https://doi.org/10.1016/S0895-4356\(97\)00306-5](https://doi.org/10.1016/S0895-4356(97)00306-5)
- [23] France, E.F., Wyke, S., Gunn, J.M., Mair, F.S., McLean, G. and Mercer, S.W. (2012) Multimorbidity in Primary Care: A Systematic Review of Prospective Cohort Studies. *The British Journal of General Practice*, **62**, e297-e307. <https://doi.org/10.3399/bjgp12X636146>

- [24] Marengoni, A., Angleman, S., Melis, R., Mangialasche, F., Karp, A., Garmen, A., *et al.* (2011) Aging with Multimorbidity: A Systematic Review of the Literature. *Ageing Research Reviews*, **10**, 430-439. <https://doi.org/10.1016/j.arr.2011.03.003>
- [25] Aiden, H. (2018) Multimorbidity: Understanding the Challenge. Report, the Richmond Group of Charities.
- [26] Harrison, C., Henderson, J., Miller, G. and Britt, H. (2017) The Prevalence of Diagnosed Chronic Conditions and Multimorbidity in Australia: A Method for Estimating Population Prevalence from General Practice Patient Encounter Data. *PLOS ONE*, **12**, e0172935. <https://doi.org/10.1371/journal.pone.0172935>
- [27] Hunter, M.L., Knuiman, M.W., Musk, B.A.W., Hui, J., Murray, K., Beilby, J.P., *et al.* (2021) Prevalence and Patterns of Multimorbidity in Australian Baby Boomers: The Busselton Healthy Ageing Study. *BMC Public Health*, **21**, Article No. 1539. <https://doi.org/10.1186/s12889-021-11578-y>
- [28] Hunger, M., Thorand, B., Schunk, M., Doring, A., Menn, P., Peters, A., *et al.* (2011) Multimorbidity and Health-Related Quality of Life in the Older Population: Results from the German KORA-Age Study. *Health and Quality of Life Outcomes*, **9**, Article No. 53. <https://doi.org/10.1186/1477-7525-9-53>
- [29] NICE (2016) Multimorbidity: Clinical Assessment and Management: Multimorbidity: Assessment, Prioritisation and Management of Care for People with Commonly Occurring Multimorbidity. NICE Guideline NG56, National Institute for Health and Care Excellence.
- [30] Leijten, F.R.M., Struckmann, V., van Ginneken, E., Czypionka, T., Kraus, M., Reiss, M., *et al.* (2018) The SELFIE Framework for Integrated Care for Multi-Morbidity: Development and Description. *Health Policy*, **122**, 12-22. <https://doi.org/10.1016/j.healthpol.2017.06.002>
- [31] Riley, E. (2018) Just One Thing after Another' Living with Multiple Conditions. Report, Taskforce on Multiple Conditions.
- [32] Bayliss, E.A., Bonds, D.E., Boyd, C.M., Davis, M.M., Finke, B., Fox, M.H., *et al.* (2014) Understanding the Context of Health for Persons with Multiple Chronic Conditions: Moving from What Is the Matter to What Matters. *The Annals of Family Medicine*, **12**, 260-269. <https://doi.org/10.1370/afm.1643>
- [33] Guthrie, B., Payne, K., Alderson, P., McMurdo, M.E.T. and Mercer, S.W. (2012) Adapting Clinical Guidelines to Take Account of Multimorbidity. *BMJ*, **345**, e6341. <https://doi.org/10.1136/bmj.e6341>
- [34] Young, C.E., Boyle, F.M. and Mutch, A.J. (2016) Are Care Plans Suitable for the Management of Multiple Conditions? *Journal of Comorbidity*, **6**, 103-113. <https://doi.org/10.15256/joc.2016.6.79>
- [35] Salisbury, C., Man, M.S., Bower, P., Guthrie, B., Chaplin, K., Gaunt, D.M., *et al.* (2018) Management of Multimorbidity Using a Patient-Centred Care Model: A Pragmatic Cluster-Randomised Trial of the 3D Approach. *The Lancet*, **392**, 41-50. [https://doi.org/10.1016/S0140-6736\(18\)31308-4](https://doi.org/10.1016/S0140-6736(18)31308-4)
- [36] Ailabouni, N.J., Hilmer, S.N., Kalisch, L., Braund, R. and Reeve, E. (2020) COVID-19 Pandemic: Considerations for Safe Medication Use in Older Adults with Multimorbidity and Polypharmacy. *Journals of Gerontology Series A*, **76**, 1068-1073. <https://doi.org/10.1093/gerona/glaa104>
- [37] Guan, W.-J., Liang, W.-H., Zhao, Y., Liang, H.-R., Chen, Z.-S., Li, Y.-M., *et al.* (2020) Cardiovascular Comorbidity and Its Impact on Patients with COVID-19. *European Respiratory Journal*, **55**, Article 2001227. <https://doi.org/10.1183/13993003.01227-2020>

- [38] Fortin, M., Dubois, M.F., Hudon, C., Soubhi, H. and Almirall, J. (2007) Multimorbidity and Quality of Life: A Closer Look. *Health and Quality of Life Outcomes*, **5**, Article No. 52. <https://doi.org/10.1186/1477-7525-5-52>
- [39] Fortin, M., Lapointe, L., Hudon, C., Vanasse, A., Ntetu, A.L. and Maltais, D. (2004) Multimorbidity and Quality of Life in Primary Care: A Systematic Review. *Health and Quality of Life Outcomes*, **2**, Article No. 51. <https://doi.org/10.1186/1477-7525-2-51>
- [40] Makovski, T.T., Schmitz, S., Zeegers, M.P., Stranges, S. and van den Akker, M. (2019) Multimorbidity and Quality of Life: Systematic Literature Review and Meta-Analysis. *Ageing Research Reviews*, **53**, Article 100903. <https://doi.org/10.1016/j.arr.2019.04.005>
- [41] Hagell, P., Westergren, A. and Årestedt, K. (2017) Beware of the Origin of Numbers: Standard Scoring of the SF-12 and SF-36 Summary Measures Distorts Measurement and Score Interpretations. *Research in Nursing & Health*, **40**, 378-386. <https://doi.org/10.1002/nur.21806>
- [42] Lall, R., Campbell, M.J., Walters, S.J. and Morgan, K. (2002) A Review of Ordinal Regression Models Applied on Health-Related Quality of Life Assessments. *Statistical Methods in Medical Research*, **11**, 49-67. <https://doi.org/10.1191/0962280202sm271ra>
- [43] Williams, R. (2016) Understanding and Interpreting Generalized Ordered Logit Models. *The Journal of Mathematical Sociology*, **40**, 7-20. <https://doi.org/10.1080/0022250X.2015.1112384>
- [44] Peterson, B., Frank, E. and Harrell, J. (1990) Partial Proportional Odds Models for Ordinal Response Variables. *Journal of the Royal Statistical Society Series C*, **39**, 205-217. <https://doi.org/10.2307/2347760>
- [45] Abreu, M.N.S., Siqueira, A.L., Cardoso, C.S. and Caiaffa, W.T. (2008) Ordinal Logistic Regression Models: Application in Quality of Life Studies. *Cadernos de Saúde Pública*, **24**, S581-S591. <https://doi.org/10.1590/S0102-311X2008001600010>
- [46] Austad, B., Hetlevik, I., Mjølstad, B.P. and Helvik, A.S. (2016) Applying Clinical Guidelines in General Practice: A Qualitative Study of Potential Complications. *BMC Family Practice*, **17**, Article No. 92. <https://doi.org/10.1186/s12875-016-0490-3>
- [47] Turner, A., Mulla, A., Booth, A., Aldridge, S., Stevens, S., Begum, M., et al. (2018) The International Knowledge Base for New Care Models Relevant to Primary Care-Led Integrated Models: A Realist Synthesis. *Health Services and Delivery Research*, **6**. <https://doi.org/10.3310/hsdr06250>
- [48] Ware, J.E., Kosinski, M. and Keller, S.D. (1996) A 12-Item Short-Form Health Survey. *Medical Care*, **34**, 220-233. <https://doi.org/10.1097/00005650-199603000-00003>
- [49] The SF-36v2® Health Survey. Quality Metric. <https://www.qualitymetric.com/health-surveys/the-sf-36v2-health-survey/>
- [50] National Center for Interprofessional Practice and Education (2016) The Short-Form (SF-36) Health Survey. <https://nexusipe.org/advancing/assessment-evaluation/short-form-sf-36-health-survey>
- [51] FORWARD (2021) What Are the SF-36, PCS, and MCS? <https://www.forwarddatabank.org/knowledge-base/what-are-the-sf-36-pcs-and-mcs/>

List of Abbreviation

QoL	Quality of Life
LMICs	Low- and Middle-Income Countries
SF	Short Form
PPO	Partial Proportional Odds