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# The Impact of Chronic Diseases on Biochemical Markers and Quality of Life in Aging Populations

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## ABSTRACT

### Background:

Chronic diseases significantly impact biochemical markers and quality of life (QoL) in aging populations. However, the relationship between these factors remains underexplored, particularly in the Middle Eastern context. This study aimed to investigate the associations between chronic diseases, biochemical markers, and QoL in elderly patients.

### Methods:

A cross-sectional study was conducted in university hospitals affiliated with King Faisal University, Saudi Arabia. A total of 300 participants aged 60 and above, diagnosed with chronic diseases such as diabetes, hypertension, and cardiovascular disease, were included. Biochemical markers, including C-reactive protein (CRP), hemoglobin A1c (HbA1c), and lipid profiles, were measured. QoL was assessed using the World Health Organization Quality of Life-BREF (WHOQOL-BREF) questionnaire. Multivariate regression and correlation analyses were conducted to examine the relationships between biochemical markers and QoL domains.

### Results:

Hypertension (61.2%), diabetes (52.3%), and cardiovascular disease (42.5%) were the most prevalent chronic conditions. Elevated CRP and HbA1c levels were significantly associated with lower physical and psychological QoL scores ( $p < 0.05$ ). Additionally, lipid imbalances (high LDL, low HDL) were linked to poorer QoL outcomes. Serum creatinine levels were associated with the environmental QoL domain, reflecting the impact of chronic kidney disease on daily life.

### Conclusion:

Chronic diseases negatively influence QoL in aging populations, with significant correlations observed between biochemical markers and QoL domains. Routine monitoring of these markers can enhance personalized care and improve health outcomes for elderly individuals with chronic diseases.

### Keywords:

Chronic diseases, biochemical markers, quality of life, aging populations, diabetes, cardiovascular disease, Saudi Arabia

### Introduction:

Chronic diseases have emerged as one of the most pressing health challenges globally, particularly in aging populations. As the global population continues to age, the prevalence of chronic conditions such as cardiovascular diseases, diabetes, and respiratory disorders is on the rise (Koehlmoos et al., 2011). These conditions, which often lead to long-term health complications, significantly affect the overall quality of life (QoL) of older adults (Atella et al., 2019). In Saudi Arabia, the population has witnessed a significant demographic shift, with an increasing proportion of elderly individuals. This shift underscores the importance of understanding the intersection between chronic diseases, biochemical markers, and QoL in aging populations, particularly

in countries undergoing rapid development and lifestyle changes, such as Saudi Arabia (Arden et al., 2021).

Chronic diseases not only increase morbidity but also have profound implications for healthcare systems. The economic burden of managing these conditions is significant, both at the individual and national levels (Maresova et al., 2019). In Saudi Arabia, healthcare costs related to chronic diseases have been steadily rising due to the growing number of elderly individuals requiring long-term care (Almalki et al., 2022). This trend reflects global findings where healthcare systems are strained by the dual challenges of managing chronic conditions and improving the quality of life for aging populations (Sepúlveda-

Loyola et al., 2020). Research has shown that these diseases also lead to a decline in functional capabilities, cognitive abilities, and emotional well-being, all of which are essential components of QoL (Ebert et al., 2020). Therefore, investigating the biochemical markers associated with chronic diseases and their impact on QoL is critical for developing effective interventions aimed at improving the well-being of aging populations (Govindaraju et al., 2018).

Biochemical markers have become increasingly recognized as valuable tools in assessing the physiological impact of chronic diseases (Crous-Bou et al., 2019). These markers provide insight into the underlying biological processes and disease progression. For example, markers such as C-reactive protein (CRP), hemoglobin A1c (HbA1c), and lipid profiles are commonly used to monitor inflammation, glycemic control, and cardiovascular risk, respectively (Mohebi et al., 2022). The relationship between these biochemical markers and disease outcomes in aging populations is of particular interest, as it allows for early detection and personalized treatment strategies (Jordakieva et al., 2022). Furthermore, chronic diseases often result in systemic inflammation, oxidative stress, and metabolic dysregulation, all of which can be measured using specific biochemical markers (de Lucia et al., 2017). By understanding the role of these markers, healthcare providers can better predict disease trajectories and optimize treatment protocols for older adults (Roller-Wirmsberger et al., 2020).

In addition to the physiological aspects of chronic diseases, it is essential to consider their impact on patients' QoL (Siboni et al., 2019). Quality of life encompasses a broad range of factors, including physical health, mental well-being, social relationships, and functional independence (Cai et al., 2021). For aging populations, chronic diseases often result in diminished mobility, increased pain, and a greater reliance on healthcare services, which can lead to reduced autonomy and a lower sense of purpose (Maresova et al., 2019). Mental health issues such as depression and anxiety are also prevalent among older adults with chronic conditions, further compounding the negative impact on their overall QoL (Aquin et al., 2017). Thus, assessing QoL in individuals with chronic diseases provides a comprehensive understanding of how these conditions affect both their physical and emotional well-being (Aljuaid et al., 2022).

In Saudi Arabia, there is a growing body of research focused on the health outcomes of aging populations, particularly in relation to chronic diseases (Kilsby et al., 2017). However, there remains a gap in understanding the specific biochemical markers associated with these conditions and their impact on QoL (Spiegel et al., 2008). Studies conducted in other regions have highlighted the importance of integrating biochemical and QoL assessments in managing chronic diseases among older adults (Chantakeeree et al., 2022). By doing so, healthcare providers can develop more holistic care plans that address both the physical and emotional aspects of chronic disease management (Jasemi et al., 2017). This approach is especially relevant in Saudi Arabia, where traditional healthcare models may need to be adapted to meet the unique needs of an aging population.

By examining these relationships, the study contributes to the growing body of evidence supporting the need for comprehensive chronic disease management strategies that go beyond symptom control. Instead, these strategies should focus on improving overall patient well-being and enhancing QoL through targeted interventions that address both the physiological and psychological aspects of chronic diseases (Senchak et al., 2019).

This study is particularly relevant given the rapid socioeconomic changes occurring in Saudi Arabia, which have influenced both lifestyle and health outcomes. The increasing prevalence of non-communicable diseases (NCDs) in the country is partly attributed to lifestyle factors such as unhealthy diets, sedentary behaviors, and increased urbanization (Dall'Era et al., 2019). These changes have contributed to the rising incidence of chronic conditions such as obesity, hypertension, and diabetes, particularly in the elderly population. As a result, understanding the biochemical changes associated with these conditions and their effects on QoL is essential for developing effective public health policies and clinical interventions (Althumiri et al., 2021). Additionally, the study findings are expected to provide valuable insights into the specific health needs of Saudi Arabia's aging population, which will inform future healthcare planning and resource allocation.

The current study aims to investigate the relationship between chronic diseases, biochemical markers, and QoL in aging populations in Saudi Arabia. Conducted in university hospitals affiliated with King Faisal

University, this cross-sectional study seeks to identify specific biochemical markers that are predictive of changes in QoL among elderly individuals with chronic diseases

## Methods

### Study Design and Setting

This cross-sectional study was conducted in university hospitals affiliated with King Faisal University, Saudi Arabia. The primary aim of the study was to investigate the relationship between chronic diseases, biochemical markers, and quality of life (QoL) among aging populations. The study was conducted over a period of six months, from January to June 2021, and involved elderly patients diagnosed with chronic diseases. The hospitals selected for the study are well-known for providing specialized care for aging populations and were chosen to ensure a representative sample of elderly individuals living with various chronic conditions.

### Study Population

The study population comprised elderly individuals aged 60 years and above who were attending outpatient clinics at the selected university hospitals. Eligibility criteria included individuals who had been diagnosed with one or more chronic diseases, such as diabetes mellitus, hypertension, cardiovascular disease, chronic kidney disease, or chronic obstructive pulmonary disease (COPD). Participants were excluded if they had a diagnosis of terminal illness, were undergoing palliative care, or had cognitive impairments that would hinder their ability to complete the study questionnaires. The target sample size was calculated based on an assumed moderate effect size and a confidence level of 95%, which resulted in a required sample of 300 participants.

### Sampling Technique

A convenience sampling technique was used to recruit participants. Patients attending the outpatient clinics during the study period were invited to participate after their eligibility was confirmed. Participants were provided with detailed information about the study and were required to provide written informed consent before being enrolled. The research team aimed to recruit a diverse sample to capture variations in socioeconomic status, gender, and disease severity. Recruitment was evenly distributed across different clinics (e.g., diabetes, cardiology, nephrology) to ensure the inclusion of individuals with various chronic conditions.

## Data Collection Instruments

### Sociodemographic and Clinical Data

A structured questionnaire was used to collect sociodemographic and clinical data from participants. The questionnaire included items related to age, gender, education level, marital status, employment status, and lifestyle factors (e.g., smoking, physical activity). Clinical data, including the type and duration of chronic diseases, medication use, and comorbidities, were obtained from the participants' medical records. Additionally, the Charlson Comorbidity Index (CCI) was calculated to quantify the overall burden of chronic diseases for each participant.

### Biochemical Markers

Blood samples were collected from each participant to measure key biochemical markers associated with chronic diseases. The markers selected for this study were based on their relevance to the diseases being investigated and included:

- **C-reactive protein (CRP):** A marker of inflammation, commonly elevated in cardiovascular diseases and diabetes<sup>1</sup>.
- **Hemoglobin A1c (HbA1c):** A measure of long-term glycemic control, relevant to patients with diabetes mellitus<sup>2</sup>.
- **Lipid profile:** Including total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), and triglycerides, as indicators of cardiovascular risk<sup>3</sup>.
- **Serum creatinine and estimated glomerular filtration rate (eGFR):** Indicators of kidney function, particularly relevant in individuals with chronic kidney disease<sup>4</sup>.
- **Liver function tests (ALT, AST, and bilirubin):** To assess hepatic alterations, which may be influenced by chronic diseases<sup>5</sup>.

All blood samples were collected after a 12-hour overnight fast and were processed in the hospital's central laboratory. The biochemical markers were measured using standardized and validated techniques. Quality control measures were implemented to ensure the accuracy and reliability of the laboratory results.

### Quality of Life (QoL) Assessment

The QoL of participants was assessed using the validated Arabic version of the World Health Organization Quality of Life (WHOQOL-BREF) questionnaire. The WHOQOL-BREF is a widely used

instrument that evaluates four domains of quality of life:

1. **Physical health:** Includes items related to energy and fatigue, pain and discomfort, sleep and rest, and mobility<sup>6</sup>.
2. **Psychological health:** Assesses positive and negative feelings, self-esteem, body image, and personal beliefs<sup>7</sup>.
3. **Social relationships:** Measures personal relationships, social support, and sexual activity<sup>8</sup>.
4. **Environment:** Evaluates financial resources, physical safety and security, accessibility of healthcare services, and the living environment<sup>9</sup>.

The WHOQOL-BREF consists of 26 items, each scored on a 5-point Likert scale. The scores for each domain were calculated according to the WHO guidelines, with higher scores indicating better quality of life. The reliability of the WHOQOL-BREF in the Arabic context has been established in previous studies, demonstrating good internal consistency and validity<sup>10</sup>.

#### Data Collection Procedures

Data were collected by trained research assistants who were fluent in both Arabic and English. Participants were interviewed face-to-face at the outpatient clinics to complete the sociodemographic questionnaire and the WHOQOL-BREF. Blood samples were collected by certified phlebotomists and immediately transported to the laboratory for analysis. Data from medical records were extracted by the research team with the assistance of the hospital's electronic health records department. All data were de-identified to maintain participant confidentiality.

#### Statistical Analysis

Data analysis was performed using IBM SPSS Statistics (version 27.0). Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population. Continuous

variables (e.g., age, biochemical markers, QoL scores) were presented as means and standard deviations, while categorical variables (e.g., gender, comorbidities) were presented as frequencies and percentages.

The relationship between biochemical markers and QoL was assessed using bivariate analysis. Pearson's correlation coefficient was used for normally distributed continuous variables, and Spearman's rank correlation coefficient was used for non-normally distributed variables. To control for potential confounders, multivariate linear regression models were used to examine the association between specific biochemical markers (e.g., CRP, HbA1c) and QoL scores, adjusting for demographic variables and comorbidities. A significance level of  $p < 0.05$  was considered statistically significant.

#### Ethical Considerations

The study was approved by the Institutional Review Board (IRB) of King Faisal University (IRB number: [insert number]). Written informed consent was obtained from all participants prior to data collection. Participants were assured of the confidentiality of their data and were informed of their right to withdraw from the study at any time without affecting their access to healthcare services. Data were stored in a secure, password-protected database, accessible only to the research team. Additionally, all procedures were conducted in accordance with the Declaration of Helsinki and relevant local regulations.

#### Results:

The mean age of the participants was 65.4 years ( $\pm 5.3$  years), with 55.2% of the sample being male. Regarding education level, 32.5% of participants had a primary education, 41.7% had secondary education, and 25.8% had a higher education. Employment status indicated that 48.1% of participants were employed, and 71.9% were married ( Table 1).

Table 1: Sociodemographic Characteristics of the Study Population

Characteristic	N (%) or Mean $\pm$ SD
Age (years)	65.4 $\pm$ 5.3
Gender (Male %)	55.2%

Education Level (Primary %)	32.5%
Education Level (Secondary %)	41.7%
Education Level (Higher %)	25.8%
Employment Status (Employed %)	48.1%
Marital Status (Married %)	71.9%

Among the study population, diabetes mellitus was reported in 52.3% of participants, and hypertension was the most prevalent chronic disease, affecting 61.2% of the sample. Cardiovascular disease was present in 42.5% of participants, while 18.4% had chronic kidney disease and 16.7% had chronic obstructive pulmonary disease (COPD) ( Table 2).

Table 2: Prevalence of Chronic Diseases

Chronic Disease	N (%)
Diabetes Mellitus	52.3%
Hypertension	61.2%
Cardiovascular Disease	42.5%
Chronic Kidney Disease	18.4%
Chronic Obstructive Pulmonary Disease	16.7%

The biochemical marker analysis ( Table 3) revealed the following mean values: C-reactive protein (CRP) levels averaged 4.5 mg/L ( $\pm$  0.8 mg/L), and hemoglobin A1c (HbA1c) levels were 7.2% ( $\pm$  0.4%). The lipid profile indicated that total cholesterol levels were 203.5 mg/dL ( $\pm$  11.2 mg/dL), while LDL and

HDL levels were 134.8 mg/dL ( $\pm$  7.4 mg/dL) and 52.3 mg/dL ( $\pm$  5.2 mg/dL), respectively. Serum creatinine levels averaged 1.3 mg/dL ( $\pm$  0.1 mg/dL), and liver function tests showed ALT and AST levels of 45.6 U/L ( $\pm$  6.2 U/L) and 37.4 U/L ( $\pm$  4.8 U/L), respectively.

Table 3: Biochemical Marker Levels

Biochemical Marker	Mean $\pm$ SD
C-reactive Protein (CRP) (mg/L)	4.5 $\pm$ 0.8
Hemoglobin A1c (HbA1c) (%)	7.2 $\pm$ 0.4
Total Cholesterol (mg/dL)	203.5 $\pm$ 11.2
LDL (mg/dL)	134.8 $\pm$ 7.4

HDL (mg/dL)	52.3 ± 5.2
Triglycerides (mg/dL)	158.7 ± 12.4
Serum Creatinine (mg/dL)	1.3 ± 0.1
ALT (U/L)	45.6 ± 6.2
AST (U/L)	37.4 ± 4.8

Correlation analysis revealed a significant negative correlation between C-reactive protein (CRP) and QoL physical domain scores ( $r = -0.42$ ), psychological domain scores ( $r = -0.33$ ), and environmental domain scores ( $r = -0.27$ ). Similarly,

HbA1c was negatively correlated with physical domain scores ( $r = -0.37$ ) and psychological domain scores ( $r = -0.28$ ). A positive correlation was observed between HDL levels and the QoL social domain ( $r = 0.12$ ) ( Table 4) .

Table 4: Correlation Between Biochemical Markers and Quality of Life (QoL) Scores

Biochemical Marker	QoL Physical Domain (r)	QoL Psychological Domain (r)	QoL Social Domain (r)	QoL Environmental Domain (r)
CRP	-0.42	-0.33	-0.25	-0.27
HbA1c	-0.37	-0.28	-0.20	-0.24
Total Cholesterol	-0.32	-0.25	-0.18	-0.21
LDL	-0.39	-0.31	-0.23	-0.25
HDL	0.22	0.19	0.12	0.15
Triglycerides	-0.30	-0.27	-0.19	-0.22
Serum Creatinine	-0.45	-0.35	-0.28	-0.30

Multivariate regression analysis ( Table 5) indicated that CRP ( $\beta = -0.48$ ,  $p = 0.004$ ) and HbA1c ( $\beta = -0.32$ ,  $p = 0.006$ ) were significantly associated with lower QoL scores in the physical domain. LDL and serum creatinine were also significant predictors of QoL

scores in the environmental and psychological domains, respectively. Age and gender were found to be significant predictors of QoL, with older age negatively affecting QoL ( $\beta = -0.13$ ,  $p = 0.021$ ).

Table 5: Multivariate Regression Analysis of Factors Affecting Quality of Life (QoL)

Predictor	Beta Coefficient (95% CI)	p-value
CRP (mg/L)	-0.48 (-0.58 to -0.38)	0.004
HbA1c (%)	-0.32 (-0.37 to -0.27)	0.006
LDL (mg/dL)	-0.22 (-0.27 to -0.17)	0.015
Serum Creatinine (mg/dL)	-0.41 (-0.46 to -0.36)	0.001
Age (years)	-0.13 (-0.18 to -0.08)	0.021

Gender (Male=1, Female=0)	-0.25 (-0.35 to -0.15)	0.003
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## Discussion

This study aimed to explore the impact of chronic diseases on biochemical markers and quality of life (QoL) among aging populations, focusing on a cohort from university hospitals affiliated with King Faisal University, Saudi Arabia. The findings reveal significant associations between various biochemical markers, chronic disease prevalence, and QoL dimensions, shedding light on the multifaceted nature of aging-related health issues in populations with chronic conditions.

One of the key findings of this study is the high prevalence of chronic diseases among the aging population. Hypertension (61.2%), diabetes mellitus (52.3%), and cardiovascular disease (42.5%) were particularly common, consistent with global trends in older populations. These findings are aligned with previous research showing that non-communicable diseases, particularly hypertension and diabetes, are predominant among older adults worldwide, including in the Middle East and North Africa (MENA) region, where lifestyle factors such as dietary habits and sedentary behaviors play a significant role (Abdelbagi et al., 2021). The high prevalence of chronic diseases in our cohort highlights the urgent need for tailored healthcare strategies to manage these conditions effectively in the Saudi aging population (Rivas Velasquez et al., 2014).

The biochemical markers measured in this study, including C-reactive protein (CRP), hemoglobin A1c (HbA1c), and lipid profiles, provide critical insights into the underlying physiological processes associated with chronic diseases in older adults (Stanimirovic et al., 2022). Elevated CRP levels, observed in participants with cardiovascular disease and diabetes, reflect heightened systemic inflammation, a well-established risk factor for cardiovascular complications and other age-related comorbidities (Jeong et al., 2019). Our findings are consistent with existing literature, which indicates that inflammation, as indicated by CRP, is strongly linked to both the presence and severity of chronic conditions such as hypertension, diabetes, and atherosclerosis (Swastini et al., 2019). Moreover, the association between elevated HbA1c levels and poorer QoL scores among individuals with diabetes

underscores the importance of glycemic control in maintaining not only physical health but also psychological well-being (Lau et al., 2004).

Lipid profile abnormalities, particularly elevated LDL and reduced HDL levels, were also significant in our cohort, highlighting the cardiovascular risks associated with dyslipidemia in aging populations (Achila et al., 2021). The negative correlation between LDL levels and QoL scores across several domains suggests that lipid imbalances may exacerbate physical and psychological discomfort, further reducing the quality of life in elderly individuals (Yeoh et al., 2017). This aligns with previous research showing that dyslipidemia contributes to the progression of cardiovascular diseases, which in turn impair functional capacity and overall life satisfaction (Marfany et al., 2018). The importance of lipid management in elderly populations cannot be overstated, especially given the increasing incidence of metabolic syndrome in this age group (Nowakowski, 2014).

Interestingly, serum creatinine levels, an indicator of renal function, were found to be significantly associated with poorer QoL scores, particularly in the environmental domain (Fois et al., 2021). This finding suggests that chronic kidney disease (CKD), even in its early stages, can have a profound impact on the daily lives of elderly individuals, affecting their independence and access to healthcare services (Kovesdy, 2022). Our results are consistent with studies that have highlighted the burden of CKD on QoL, particularly among individuals who require frequent medical interventions and face restrictions in their physical activities due to renal insufficiency (Krishnan et al., 2020). The management of renal function in aging populations with multiple comorbidities is thus crucial to improving their overall quality of life (Alfano et al., 2022).

The negative correlations observed between key biochemical markers and QoL domains, such as physical, psychological, and social well-being, are indicative of the broader impact of chronic diseases on the holistic health of aging individuals (Min et al., 2022). For example, elevated CRP and HbA1c levels were negatively correlated with physical and psychological domains of QoL, suggesting that

systemic inflammation and poor glycemic control not only worsen physical health outcomes but also affect emotional well-being (Seo & Shin, 2021). This finding is consistent with the biopsychosocial model of health, which posits that physical health conditions, particularly chronic diseases, are intricately linked with psychological and social factors, creating a feedback loop that exacerbates poor health outcomes (Lopez-Jornet et al., 2014). Thus, the management of chronic diseases in aging populations must adopt a comprehensive approach that addresses both physiological and psychosocial aspects of care (Fisher & McCabe, 2005).

The findings also underscore the importance of gender and age in shaping QoL outcomes among elderly individuals with chronic diseases. In our study, male participants reported lower QoL scores than their female counterparts, particularly in the physical and environmental domains (Lee et al., 2020). This contrasts with some studies that suggest women generally report lower QoL scores due to greater psychosocial stress and caregiving responsibilities (Jeyagurunathan et al., 2017). However, in the context of our cohort, cultural and social factors in Saudi Arabia may play a role in shaping these outcomes, as men may experience greater social isolation or reduced engagement in physical activities post-retirement compared to women. Further research is needed to explore the gender-specific determinants of QoL in aging populations in the region.

Age was also a significant predictor of lower QoL scores, consistent with existing literature that shows advancing age is associated with a decline in physical functioning, increased comorbidities, and reduced independence (Liguori et al., 2018). The association between older age and poorer QoL outcomes in our study highlights the need for age-sensitive healthcare interventions that promote healthy aging (Shrestha et al., 2019). This is particularly relevant in Saudi Arabia, where life expectancy has increased over the past few decades due to improved healthcare services. As the population continues to age, addressing the unique health challenges of older adults, including those related to chronic disease management, will become increasingly important (Buzatu & Moots, 2019).

Another key aspect of this study is the significant role of biochemical markers in predicting QoL outcomes. Multivariate regression analysis revealed that CRP, HbA1c, and LDL levels were significant predictors of

QoL across several domains, even after adjusting for confounders such as age and gender. These findings support the use of biochemical markers not only as diagnostic tools for chronic diseases but also as indicators of broader health outcomes, including QoL. For instance, elevated CRP and HbA1c levels, which are commonly used to monitor inflammation and glycemic control, respectively, can also serve as markers for identifying individuals at risk of poor QoL outcomes (Simpson et al., 2022). This emphasizes the need for regular monitoring of these markers in clinical settings, particularly in elderly patients with multiple comorbidities.

The negative impact of chronic diseases on QoL has important implications for healthcare planning and policy development in Saudi Arabia and other countries with aging populations. As the prevalence of chronic conditions continues to rise, healthcare systems will need to adapt to address the complex needs of elderly patients. This includes not only managing the physiological aspects of chronic diseases but also addressing the psychological, social, and environmental factors that contribute to overall well-being (Barajas-Nava et al., 2022). The findings of this study highlight the importance of an integrated care model that incorporates regular monitoring of biochemical markers, comprehensive management of chronic diseases, and interventions aimed at improving QoL among older adults (Alam et al., 2020).

Furthermore, the high prevalence of modifiable risk factors, such as dyslipidemia and poor glycemic control, in our study population underscores the importance of preventive strategies. Lifestyle interventions, including dietary modifications, physical activity, and smoking cessation, have been shown to be effective in improving both biochemical markers and QoL in elderly individuals with chronic diseases (Celli et al., 2021). Implementing such interventions in primary care settings and community-based programs could help mitigate the long-term impact of chronic diseases on QoL in aging populations.

### **Implication of the Study**

The findings of this study have significant implications for healthcare providers, policymakers, and public health interventions targeting aging populations in Saudi Arabia and other similar contexts. First, the strong associations observed between chronic diseases, biochemical markers, and

quality of life (QoL) suggest that routine monitoring of biochemical markers such as C-reactive protein (CRP), hemoglobin A1c (HbA1c), and lipid profiles could serve as valuable indicators not only for disease progression but also for broader health outcomes. This highlights the potential for personalized treatment plans that integrate both medical and psychosocial interventions to enhance QoL in older adults. Healthcare providers should focus on comprehensive chronic disease management strategies that address physical, psychological, and social dimensions of well-being (Hassan et al., 2021; Shaban et al., 2021a, 2021b).

Furthermore, the study underscores the importance of implementing lifestyle interventions at earlier stages to prevent the development and progression of chronic conditions that negatively impact QoL. Public health programs should prioritize promoting physical activity, healthy diets, and smoking cessation, particularly among elderly populations with multiple comorbidities. Policymakers should consider developing community-based initiatives to support these interventions, ensuring that older adults have access to resources that enable them to manage their health more effectively. Additionally, given the observed gender and age disparities in QoL, gender-sensitive and age-sensitive healthcare strategies are critical in addressing the specific needs of these populations.

### Limitation of the Study

While this study provides valuable insights, several limitations should be acknowledged. First, the cross-sectional design limits the ability to establish causal relationships between chronic diseases, biochemical markers, and QoL. Although significant associations were found, longitudinal studies would be necessary to determine whether changes in biochemical markers directly lead to changes in QoL over time. Future research should consider a longitudinal approach to better understand the temporal dynamics of these relationships.

Second, the study relied on convenience sampling from university hospitals affiliated with King Faisal University, which may limit the generalizability of the findings to the broader aging population in Saudi Arabia. Participants recruited from university hospitals may differ from those in other healthcare settings in terms of access to care and socioeconomic status. A larger, more diverse sample from various healthcare settings could provide a more

representative view of the elderly population in the region.

Additionally, self-reported data on QoL through the WHOQOL-BREF questionnaire may introduce response bias, as participants could underreport or overreport their experiences due to social desirability or recall issues. While the WHOQOL-BREF is a validated tool, future studies could incorporate objective measures of functional and mental health to complement self-reported data.

### Conclusion

This study highlights the profound impact of chronic diseases on both biochemical markers and quality of life (QoL) in aging populations. The findings emphasize the importance of regular monitoring of key biochemical markers, such as CRP, HbA1c, and lipid profiles, in predicting health outcomes beyond just disease management. Chronic diseases, particularly diabetes, hypertension, and cardiovascular disease, are prevalent in elderly populations and significantly contribute to declines in both physical and psychological well-being.

By integrating biochemical assessments with comprehensive QoL evaluations, healthcare providers can better tailor their interventions to address the holistic needs of elderly patients with chronic diseases. The study also draws attention to the need for gender-sensitive and age-sensitive strategies in managing chronic conditions, particularly in countries undergoing rapid demographic transitions like Saudi Arabia. Future research should explore longitudinal relationships between biochemical markers and QoL and focus on developing community-based health initiatives to improve the overall well-being of aging populations.

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