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Original Article

Association Between Medication Regimen Complexity and Quality of Life: A Cross-Sectional Study in Older Adults in Iran

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Abstract

Objective: To examine the association between medication regimen complexity and quality of life in older adults, with a focus on age, functional status, and comorbidity burden.

Design: A cross-sectional, descriptive–analytical investigation.

Setting: Outpatient clinic at Asadabadi Polyclinic, Tabriz, Northwest Iran.

Participants: A total of 110 community-dwelling older adults aged 60 or above, recruited through convenience sampling. Inclusion criteria were being at least 60 years old, using at least one prescribed medication, being able to communicate and complete questionnaires, and willing to participate. Exclusion criteria comprised diagnosed dementia, severe hearing or speech impairments, inability to manage medications independently, medication administration by caregivers, and not using any medication.

Outcome Measures: The primary outcome was quality of life, assessed using the Older People's Quality of Life questionnaire (OPQOL-35). The primary exposure, medication regimen complexity, was evaluated with the Medication Regimen Complexity Index (MRCI). Additionally, comorbidity burden was measured by the Charlson Comorbidity Index (CCI), and functional status was assessed with the Activities of Daily Living (ADL) index.

Results: Of the participants, 53 were women and 57 were men. Most reported good or average quality of life. A significant inverse association was observed between medication regimen complexity and quality of life. In the adjusted linear regression model, each one-unit increase in the MRCI score was associated with a 0.80-unit decrease in the quality-of-life score ($p < 0.001$). Increasing age was also independently associated with lower quality of life, with a 0.57-unit reduction per additional year of age ($p = 0.002$). Other variables, including gender, comorbidity burden, functional status, educational level, employment status, and marital status, were not significant predictors. The model explained 54.2% of the variance in quality-of-life scores.

Conclusion: Medication regimen complexity and age were independently associated with quality of life in older adults. These findings emphasize the importance of patient-centered medication management strategies that simplify regimens to improve quality of life in this population.

Keywords: Aging, Medication regimen complexity, Older adults, OPQOL, Quality of life

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Introduction

Aging is an inevitable biological process that is commonly defined by chronological age, and individuals aged 60 years or older are generally classified as older adults.[1] Advances in medical science, public health, and education have increased life expectancy, leading to rapid growth in the older population worldwide.[2] According to the estimates of the United Nations, the global population of older adults is expected to reach approximately 2 billion by 2050.[3] In Iran, population aging is accelerating as well; in 2016, more than 8% of the population was aged 60 years or older, and this proportion is projected to increase substantially in the coming decades.[4]

Older adults experience a high prevalence of chronic

conditions, including cardiovascular diseases, diabetes, malignancies, chronic respiratory disorders, and musculoskeletal diseases.[5] These conditions frequently require long-term, complex pharmacologic treatments, making the preservation of quality of life (QOL) a major public health priority.[6] Polypharmacy, defined as the concurrent use of five or more medications, is highly prevalent among older adults due to multimorbidity and age-related physiological changes.[7] It is associated with adverse drug reactions, decreased medication adherence, higher healthcare costs, and increased hospitalization rates.[8]

Beyond the number of medications, the complexity of medication regimens (i.e., dosing frequency, dosage forms, and administration instructions) plays a critical role in treatment outcomes.[9] The medication regimen complexity index (MRCI) provides a comprehensive measure of regimen complexity that extends beyond simple medication counts. Increased MRC has been linked to medication errors, nonadherence, and drug-related problems, which may all negatively affect QOL in older adults.[10]

Moreover, age-related changes in pharmacokinetics and pharmacodynamics increase susceptibility to adverse drug events and drug–drug interactions.[11] Consequently, healthcare systems emphasize healthy aging, active living, and medication use optimization to maintain the highest possible QOL among older adults.[12] Although polypharmacy and medication complexity have been associated with adverse clinical outcomes, evidence of their impact on QOL remains limited and inconsistent, particularly in Middle Eastern populations.[13]

This study aims to explore the relationship between MRC and QOL among Iran's aging population, considering the increasing number of older adults and chronic diseases. It also seeks to identify key demographic and clinical factors that predict QOL.

Methods

Study Design

This cross-sectional, descriptive–analytical study was performed among older adults visiting Asadabadi Polyclinic in Tabriz, Iran. The target population included community-dwelling individuals aged 60 years or older who attended the clinic for outpatient healthcare services during the study period. As mentioned earlier, the study aimed to explore the relationship between MRC and QOL, as well as to predict QOL while considering relevant demographic and clinical variables, such as age, gender, occupation, education, sources of fixed income, MRCI, activities of daily living (ADL), and Charlson comorbidity index (CCI).

Sample Size and Sampling

Assuming a medium effect size ($f^2 = 0.15$), a type I error rate of 5% ($\alpha = 0.05$), and a statistical power of 80% ($1 - \beta = 0.80$), the minimum required sample size was calculated using G*Power software (version 3.1.9.4). Based on these parameters and considering QOL as the primary outcome variable, a total of 110 participants was deemed sufficient for this study. Using a convenience sampling method, participants were recruited from eligible older adult individuals attending the intended clinic. To reduce potential selection bias, enrollment was consecutive throughout the data collection period.

Inclusion and Exclusion Criteria

The inclusion criteria were age 60 years or older, use of at least one prescribed medication, ability to communicate and complete questionnaires, and willingness to participate. On the other hand, the exclusion criteria included diagnosed dementia, severe hearing or speech impairments, inability to manage medications independently, medication administration by caregivers, and lack of medication use.

Data Collection

After routine clinical care, eligible participants were informed about the study and asked to provide written informed consent. Then, data were collected using standardized questionnaires administered by trained research staff. To ensure data quality, all questionnaires were reviewed for completeness at the time of collection, and any ambiguities were clarified immediately.

Medication Regimen Complexity Index

MRC was evaluated using the MRCI, originally developed by George et al [14] and validated in some studies.[15,16] The MRCI assesses complexity based on dosage forms, dosing frequency, and additional administration instructions. The Persian version was created through a standardized forward–backward translation process.[17] In addition, its face and qualitative validity were confirmed by a panel of seven experts, including pharmacists and professionals in social and preventive medicine.

The MRCI comprises three domains. Domain A assesses medication dosage forms and routes of administration, assigning varying weights to oral, topical, inhalational, injectable, ophthalmic, otic, nasal, and other dosage forms based on their level of complexity. Moreover, domain B evaluates dosing frequency, assigning higher scores to more frequent or irregular schedules, including as-needed regimens and oxygen therapy. Additionally, domain C captures additional administration instructions, such as tablet splitting or crushing, variable dosing, timing in relation to meals, dose adjustments, and alternating doses.

For each participant, domain-specific scores (A, B, and C) were calculated and summed to obtain the total MRCI score, with higher scores indicating greater MRC. The MRCI has no predefined upper limit, as the total score depends on the number of medications and the complexity of their administration. Furthermore, the original version of the MRCI has demonstrated acceptable reliability and validity across diverse populations and has been widely used in clinical and epidemiological studies. In the present

study, the Persian MRCI checklist was completed based on participants' current medication regimens.

Older People's Quality of Life Questionnaire (OPQOL-35)

QOL was assessed using the OPQOL-35, which measures older adults' QOL across different domains, such as health, independence, social participation, psychological well-being, and environmental factors. The Persian version of the OPQOL-35 has shown satisfactory reliability and validity.[18]

Activities of Daily Living Index

Functional status was determined with the ADL index, which evaluates basic daily activities, such as personal hygiene, eating, dressing, mobility, bathing, and toileting. Scores range from 0 to 16, with higher scores indicating greater independence. It is noteworthy that the Persian version has displayed good validity and reliability among older Iranian adults.[19]

Charlson Comorbidity Index

Comorbidity burden was measured using the CCI,[20] a validated tool based on ICD diagnostic codes. Each condition is assigned a weighted score, and the total score indicates overall comorbidity severity. In this study, the CCI was considered a potential confounding variable in the relationship between MRC and QOL.

Statistical Analysis

Descriptive statistics were presented as means ± standard deviations (SD) for continuous variables, as well as frequencies and percentages for categorical variables. Pearson correlation coefficients assessed relationships among MRC (MRCI), QOL (OPQOL-35), CCI, and ADL. An independent t-test and a one-way analysis of variance were used to compare mean QOL scores across two or more groups, and the chi-square test was employed to evaluate associations between categorical variables. Moreover, linear regression analysis was performed to identify independent predictors of QOL, with a significance level set at $P < 0.05$. Ultimately, analyses were conducted using SPSS (version 26), Microsoft Excel 2019, and GraphPad Prism for graphical presentation.

Results

Association Between Age, Gender, Employment Status, Educational Status, and Marital Status With the Quality of Life

In this study, 110 older adults were examined, including 53 women (48.2%) and 57 men (51.8%). In terms of marital status, 71.8% were married, 0.9% were divorced, and 27.3% were widowed. Regarding employment, 14.5% were employed, while 85.5% were unemployed. Additionally, 45.5% of the participants were illiterate, while 21.9%, 9.1%, 15.4%, and 8.1% had elementary school, guidance school, high school, and university education, respectively. The highest age frequency was observed in the 60–65 years group (31%).

Additionally, participants' QOL was classified as very good (6.4%), good (61.8%), average (31.8%), and poor (0%). The proportion of very good QOL was higher in women (9.4%) than in men (3.5%), whereas men more frequently reported good QOL (65% vs. 58.5% in women). QOL tended to decrease with increasing age, with the highest proportions of average and poor QOL observed in participants aged > 75 years, although the differences between age groups were not statistically significant.

As regards employment, employed older adults reported very good QOL more often than unemployed participants (18.7% vs. 4.2%), but the difference was not statistically significant overall. As educational level increased, the percentage of participants with good or very good QOL also increased, with the highest percentage of good QOL observed among high school (88.4%) and guidance school (90%) graduates. However, these differences were not statistically significant. Married participants had higher QOL, with 6.1% reporting very good and 64.6% reporting good QOL, compared with widowed and divorced participants.

Finally, gender and marital status were strongly associated with the QOL of the older adult, whereas age group, education level, and employment demonstrated no statistically significant differences. Nonetheless, the results revealed trends of decreasing QOL with increasing age

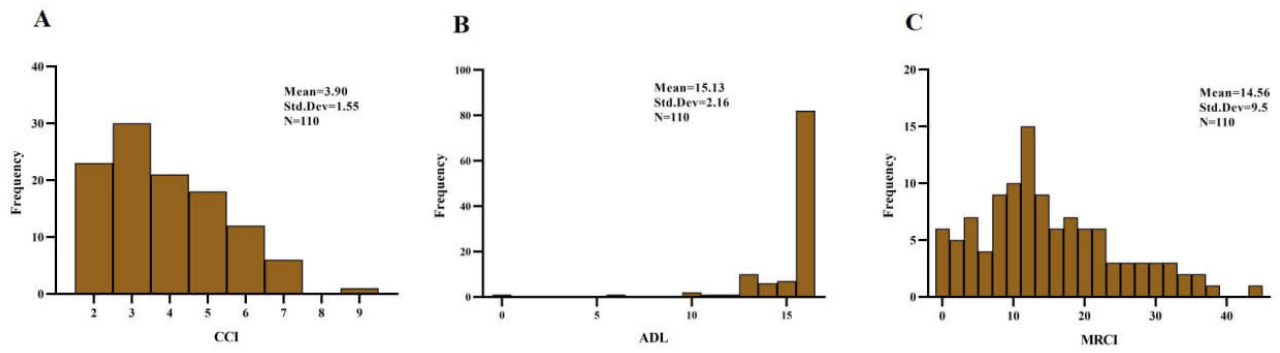

Figure 1. Histograms of CCI, ADL, and MRCI: **(A)** Distribution of CCI, **(B)** Distribution of ADL, and **(C)** Distribution of MRCI
Note. ADL: Activities of daily living; CCI: Charlson comorbidity index; MRCI: Medication regimen complexity index

Table 1. Association Between Age, Gender, Employment Status, Educational Status, and Marital Status With Quality of Life

	Number (110)	Quality of life			
		Very Good	Good	Average	Poor
Age					
60-65	34 (31)	3 (8.8)	24 (70.5)	7 (20.6)	0
66-70	26 (23.5)	3 (11.5)	21 (80.7)	2 (7.7)	0
71-75	26 (23.5)	0	15 (57.7)	11 (42.3)	0
>75	24 (22)	1 (4.2)	8 (33.3)	15 (62.5)	0
Total	110 (100)	7 (6.4)	68 (61.8)	35 (31.8)	0
Gender					
Female	53 (48.2)	5 (9.4)	31 (58.5)	17 (32)	0
Male	57 (51.8)	2 (3.5)	37 (65)	18 (31.5)	0
Employment status					
Employed	16 (14.5)	3 (18.7)	12 (75)	1 (6.3)	0
Unemployed	94 (85.5)	4 (4.2)	56 (59.5)	34 (36.3)	0
Educational status					
Illiterate	50 (45.5)	5 (10)	25 (50)	20 (40)	0
Elementary school	24 (21.9)	1 (4.1)	14 (58.3)	9 (37.6)	0
Guidance school	10 (9.1)	0	9 (90)	1 (10)	0
High school	17 (15.4)	1 (5.8)	15 (88.4)	1 (5.8)	0
University	9 (8.1)	0	6 (66.4)	3 (33.6)	0
Marital status					
Married	82 (71.8)	5 (6.1)	53 (64.6)	24 (29.3)	0
Divorced	1 (0.9)	0	0	1 (100)	0
Widowed	27 (27.3)	2 (7.4)	16 (59.3)	9 (33.3)	0

Note. Values are reported as numbers and percentages of the row total.

and increasing QOL with higher education level (Table 1).

Distribution of Charlson Comorbidity Index, Activities of Daily Living, and Medication Regimen Complexity Index

Figure 1 shows the distributions of CCI, ADL, and MRCI. The average CCI was 3.90 (SD = 1.55), with a minimum of 2 and a maximum of 9. In addition, the average ADL was 15.13 (SD = 2.16), with a minimum and maximum of 0 and 16 (Figure 1).

Correlation Between Drug Complexity Index and Activities of Daily Living

The average drug complexity index was 14.56 (SD = 9.5). The lowest score was 0, while the highest score was 43.50. The distribution of complexity index scores is displayed in Figure 1A. Pearson's test examined the relationship between QOL and the drug complexity index (Figures 2A-C). A strong negative relationship was observed between these two variables, indicating that QOL among older adults decreased with an increase in the drug complexity index. This decrease was statistically significant regardless of gender (n = 110, r = -0.23, $P = 0.01$). Notably, the correlation between the drug complexity index and QOL was stronger in women (r = -0.29, $P = 0.30$) than in men (r = 0.07, $P = 0.55$) (Figures 2A-C).

Correlation Between Drug Complexity Index and Older People's Quality of Life Questionnaire

The correlation between the drug complexity index and OPQOL was also evaluated, and the results (Figures 2D-F) demonstrated a strong, statistically significant relationship (r = -0.62, $P < 0.0001$). Furthermore, drug complexity was related to OPQOL. This correlation was also analyzed separately in women (r = -0.55, $P < 0.0001$) and men (r = -0.70, $P < 0.0001$).

Correlation Between Drug Complexity Index and Charlson Comorbidity Index

The correlation between the drug complexity index and CCI was assessed (Figures 2 G-F), revealing a statistically significant relationship (r = 0.50, $P < 0.0001$). Moreover, drug complexity was related to CCI. This correlation was separately analyzed in women (r = 0.34, $P = 0.01$) and men (r = 0.67, $P < 0.0001$).

Contour Plot of Medication Regimen Complexity Index, Charlson Comorbidity Index, Activities of Daily Living, and Older People's Quality of Life Questionnaire

The interactive relationships between MRCI, ADL, and CCI (Figures 3A-C) and between MRCI and ADL OPQOL are shown as counterplots, overall and separately for males and females, in Figures 3D-F.

Prediction of Quality of Life Using Linear Regression Analysis

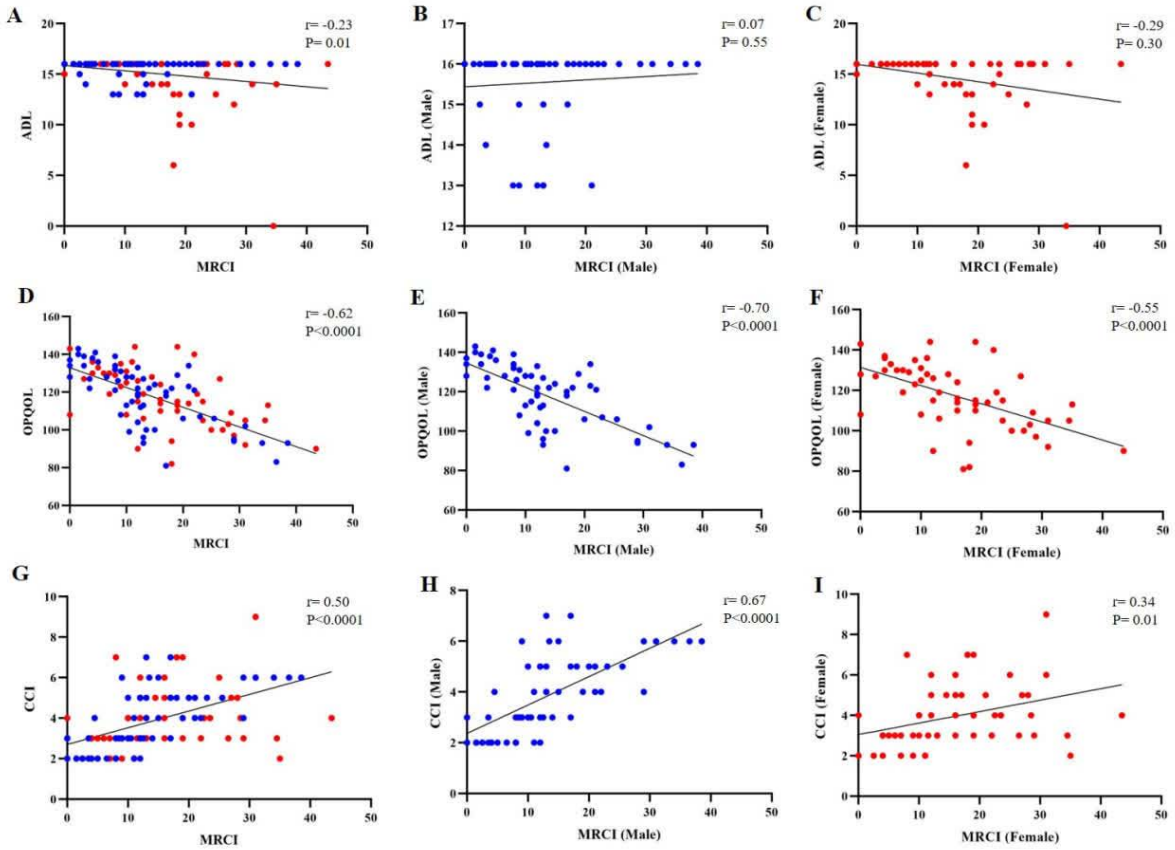

Figure 2. Correlation Between MRCI and ADL, OPQOL, and CCI: **(A)** Correlation Between MRCI and ADL for **(B)** Males and **(C)** Females, **(D)** Correlation Between MRCI and OPQOL for **(E)** Males and **(F)** Females, and **(G)** Correlation Between MRCI and CCI for **(H)** Males and **(I)** Females

Note. ADL: Activities of daily living; CCI: Charlson comorbidity index; MRCI: Medication regimen complexity index; OPQOL: Older People's Quality of Life Questionnaire

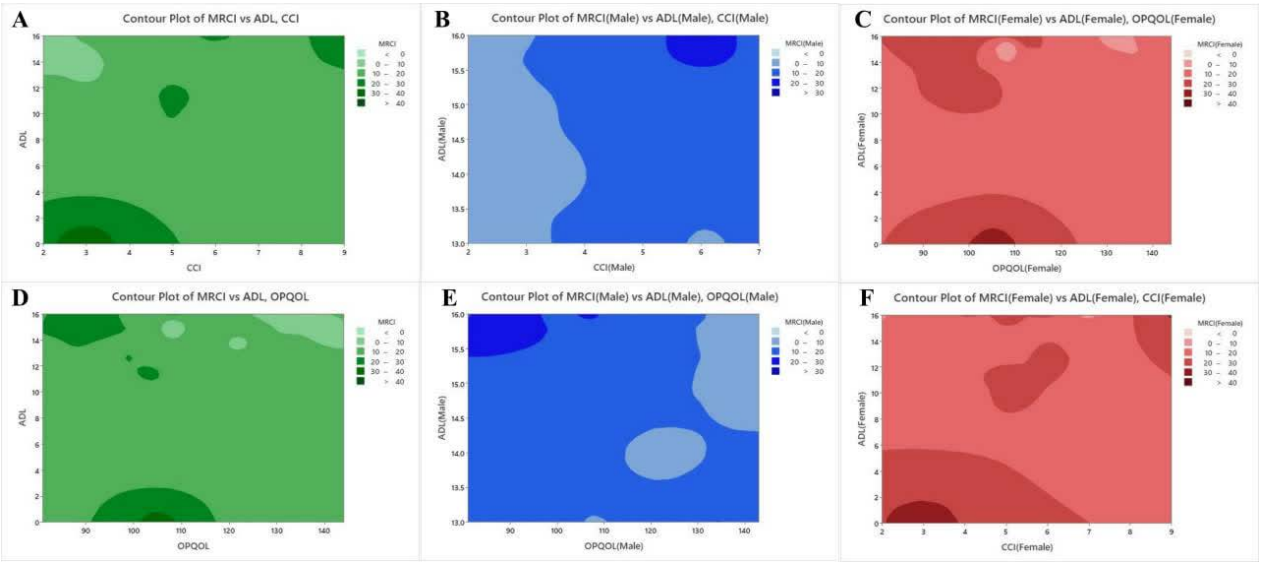

Figure 3. Changes in MRCI vs. OPQOL, ADL, and CCI: **(A)** Contour Plot of MRCI vs. ADL and CCI for **(B)** Males and **(C)** Females and **(D)** Contour Plot of MRCI vs. ADL and OPQOL for **(E)** Males and **(F)** Females

Note. ADL: Activities of daily living; CCI: Charlson comorbidity index; MRCI: Medication regimen complexity index; OPQOL: Older People's Quality of Life Questionnaire

QOL was predicted using a linear regression model (Table 2). The results indicated that among the variables included in the model, MRCI and age were significantly associated with QOL. The adjusted coefficient of determination (adjusted R^2) was 54.2%, indicating that approximately 54% of the variance in QOL scores was explained by the model.

After controlling for other variables, each one-unit increase in the MRCI was associated with a 0.80-unit decrease in the QOL score ($B = -0.80$, $P < 0.001$). In

Table 2. Prediction of Quality of Life Based on Linear Regression Modeling

	B	t	*P*-Value	95.0% Confidence Interval for B	
				Lower Bound	Upper Bound
MRCI	-0.80	-5.933	<0.001	-1.059	-0.532
CCI	-1.44	-1.358	0.177	-3.547	0.664
ADL	0.90	1.628	0.107	-0.196	1.988
Age	-0.57	-3.212	0.002	-0.922	-0.218
Gender	-4.48	-1.171	0.244	-7.119	-1.834
Having a job	1.38	0.426	0.671	-5.026	7.778
Having a spouse	-1.30	-1.063	0.290	-3.721	1.124
Education	-1.01	-1.350	0.180	-2.498	0.475

Note. ADL: Activities of daily living; CCI: Charlson comorbidity index; MRCI: Medication regimen complexity index; Adjusted $R^2 = 54.2\%$

addition, QOL decreased by 0.57 units for each one-year increase in age, which was statistically significant ($B = -0.57$, $P = 0.002$). Conversely, other variables, including CCI, ADL, gender, employment status, marital status (having a spouse), and educational level, were not significantly associated with QOL ($P > 0.05$).

Discussion

Given the rapid growth of the older population worldwide, identifying factors that influence QOL in older adults has become a public health priority [21]. Older adults are particularly vulnerable to chronic diseases and often require long-term treatment with multiple medications, increasing MRC.[22] This study investigated the association between MRC and QOL in older adults.

Our findings demonstrated that QOL was significantly and negatively associated with age. As age increased, QOL declined, which is consistent with the results of previous research, showing that aging is accompanied by functional decline, increased comorbidity burden, and reduced physical and psychological well-being.[23] In the linear regression model, after controlling for potential confounders, QOL decreased by 0.57 units for each additional year of age, indicating that age is an independent predictor of QOL in older adults. Similar findings were reported in several studies, highlighting the negative impact of aging on health-related QOL.[24,25] In descriptive analyses, men reported higher QOL scores than women, which is in line with the findings of some studies in Iran and other countries.[26,27] Cultural factors, gender roles, and differences in social support and economic independence may partly explain this observation. However, in the adjusted regression model, gender was not a significant independent predictor of QOL, suggesting that other demographic and clinical factors may mediate the observed differences.

One of the key findings of this study was a significant inverse association between MRC and QOL. Higher MRCI scores were related to lower QOL scores. After adjustment for demographic and clinical variables, each one-unit increase in MRC was associated with a 0.80-unit decrease in QOL. This finding reveals the importance of considering both the number of medications and the complexity of medication regimens when evaluating treatment outcomes in older adults. MRC may adversely affect QOL through several mechanisms,[10] including reduced medication adherence,[28] increased risk of drug–drug interactions,[29] higher likelihood of adverse drug reactions,[30] and greater difficulty managing daily medication schedules.[31] These challenges may be particularly pronounced in older adults with functional limitations.

In addition, a significant relationship was observed between MRC and ADL, implying that individuals with lower functional ability tend to have more complex medication regimens. This finding aligns with the findings of previous studies, demonstrating that complex medication regimens are associated with impaired functional status and difficulties with medication management among older adults.[32]

Overall, the results of this study underscore the critical role of MRC and age in determining QOL in older adults. Our findings emphasize the need for patient-centered medication management strategies that simplify treatment regimens and support functional independence in this population.

Nonetheless, several limitations of this study should be acknowledged to ensure appropriate interpretation of the results. First, because of the cross-sectional design, the observed associations between MRC, age, functional status, and QOL cannot be interpreted as causal. Moreover, participants were recruited via convenience sampling from a single outpatient polyclinic, which may limit the sample's representativeness and restrict the generalizability of the findings to other populations of older adults (e.g., those residing in rural areas, hospitalized patients, or individuals receiving long-term care services). Although consecutive recruitment was used to reduce selection bias, residual selection bias cannot be entirely excluded. In addition, the use of self-reported instruments to assess QOL and functional status may be subject to reporting bias. Therefore, our findings should be interpreted with caution, and future research using longitudinal designs with larger and more diverse samples is warranted.

Conclusions

QOL in older adults was strongly influenced by MRC

and age. A higher MRC was associated with a significant reduction in QOL, with each one-unit increase in the MRCI score leading to a 0.80-unit decrease in the QOL score. Furthermore, increasing age was identified as an independent predictor of poorer QOL, with a 0.57-unit reduction in the QOL score for each additional year of age.

Although descriptive analyses demonstrated differences in QOL between men and women, gender was not a significant predictor in the adjusted regression model. These findings indicate the importance of optimizing medication regimens and addressing age-related challenges to improve QOL in older adults. In general, interventions that simplify medication regimens and enhance functional ability may improve health outcomes in this growing population.

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Writing–review & editing: Hamid Soltani Zangbar, Solmaz Fallahi.

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Data availability statement

The data related to the study are available from the corresponding author upon reasonable request.

Ethical approval

This study was approved by the Regional Ethics Committee of Tabriz University of Medical Sciences (IR.TBZMED.REC.1398.864).

Consent for publication

Not applicable.

Conflict of interests

The authors declare no conflict of interests.

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