



Original Article

Medication adherence and its influencing factors in community-dwelling older adults with chronic illnesses in a rural area

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ABSTRACT

Background & Aim: Older adults with chronic diseases are usually required to manage multiple medications and complex medication regimens. Medication adherence is crucial in older adults which is increasingly being recognized due to its potential to impact healthcare utilization and treatment efficacy. The current study aimed to assess medication adherence and its influencing factors in community-dwelling older adults with chronic illnesses in rural areas.

Methods & Materials: A cross-sectional study design was used to achieve the study aim. The study sample was composed of 310 older patients from a rural area in Sharkia Governorate, Egypt. Medication adherence was assessed by the Arabic version of the General Medication Adherence Scale. Association between medication adherence and older patients' characteristics was identified through the Chi-square test, Pearson's correlation coefficient, and Logistic regression.

Results: Among 310 older patients, 84.8% of them were non-adherent to their medications. Significant relationships were found between medication adherence and age, gender, educational level, marital status, and monthly income. Aging less than 70 years, female gender, sufficient income, fewer illnesses, and medication number were significant predictors for medication adherence.

Conclusion: The current study findings revealed that most rural older adults with chronic illnesses were non-adherent to their medications, with many influencing factors such as age, gender, educational level, monthly income, and illnesses and medication number. So, the study recommends the importance of developing strategies to improve medication adherence in community-dwelling older adults in rural areas.

Introduction

The demographic transformation of the global population is reshaping the health landscape as the number and proportion of older adults surge worldwide. The year 2020 saw about 727 million older adults, which is anticipated to double to an unprecedented 1.5 billion by 2050, according to the United Nations Department of Economic and Social Affairs (1). With this demographic shift, age-related health problems are poised to become more prevalent. The rapid aging of the global population underscores the

urgent need to focus on the health challenges faced by older adults, particularly those with multimorbidity, which refers to the co-occurrence of multiple chronic health conditions in a single individual and is an increasingly prevalent issue in aging populations worldwide, leading to an economic burden, reduced functional status, poor quality of life, increased treatment difficulties, and pharmaceutical consumption (2). Older adults with multimorbidity are more likely to have

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polypharmacy, making them particularly susceptible to non-adherence and its adverse consequences (3).

Adherence could be defined as the degree to which an individual's medicine-taking behavior, dietary habits and/or lifestyle changes implementation relate to established recommendations from his healthcare provider (4). According to a recent study, up to half of chronically ill patients fail to take their medication as prescribed, with older adults experiencing the highest rates. Medication non-adherence is considered a major problem with a negative effect on treatment goals and is thought to be a contributing factor in 10% to 75% of geriatric hospitalizations (5). Moreover, poor drug adherence is a prevalent issue with significant socioeconomic and health ramifications; estimates suggest that medication non-adherence is a primary driver of hospitalizations, accounting for up to 10% of all hospital admissions and is a significant contributor to healthcare costs, with annual expenses ranging from \$100 to \$300 billion due to medication waste (6).

Medication adherence is a global challenge; in the Middle East, non-adherence rates among patients with chronic diseases range from 1.4% to 88% (7). A large-scale study conducted in Riyadh reported poor adherence to oral antidiabetic medications in 42.8% of patients (8). The significance of medication adherence cannot be overstated, as it plays a pivotal role in improving chronic disease outcomes and reducing healthcare expenses. However, successfully promoting adherence and achieving long-term health outcomes necessitates a comprehensive understanding of the root causes of non-adherence (9). Medication non-adherence in older adults with chronic illnesses considers a serious problem as it challenges the efforts to reduce morbidity and mortality associated with underlying chronic illnesses (10).

Medication non-adherence is a multifaceted and intricate phenomenon that arises from a complex interplay of various

factors. It stems from the intricate interplay of five distinct dimensions of factors, including socioeconomic, patient-related, therapy-related, condition-related, healthcare team-related, and system-related factors, as reported by Smaje et al. (11). Older adults people are particularly vulnerable to non-adherence, due to multimorbidity-related polypharmacy and specific constraints such as physical, cognitive, or sensory impairments (12). Identifying the factors that might negatively influence medication adherence in rural older adults is important as this can support the identification of older adults at high risk for non-adherence and can help develop interventions to improve medication adherence.

Nurses have a pivotal role in promoting medication adherence among older adults in community settings (13). With their multifaceted expertise, nurses are essential in ensuring that patients take their medications safely and effectively. They perform diverse functions, including medication history assessment, drug-drug interaction screening, medication regimen monitoring, patient education, and care coordination across disciplines, as detailed by Yang et al. (14).

The prevalence of medication adherence among older adults varies considerably depending on the setting, with adherence rates ranging from 40 to 75%, as evidenced by Angadi et al. (15). In a cross-sectional survey conducted in Egypt by Abd Allah et al. (16), identified a high prevalence of non-adherence among older adults living in rural areas with chronic health conditions. The study found that 58.3% of the population adhered poorly to their medication regimens. Compared to previous studies, 64.9% of geriatric patients with chronic diseases displayed remarkably high levels of medication adherence according to a cross-sectional study conducted in King Saud University Medical City, Saudi Arabia, which assessed medication adherence and associated factors in chronically ill geriatric patients (5).

Medication adherence is crucial among older adults with chronic diseases, which is

increasingly being recognized due to its potential to impact healthcare resource utilization and treatment efficacy. Consequently, the issue of medication adherence in older adults has become a mounting concern for healthcare systems due to its high prevalence and association with adverse health outcomes and increased healthcare costs (17). Little has been documented on medication adherence and its influencing factors in older patients residing in rural areas in Egypt. Also, identifying the influencing factors can help healthcare professionals identify older people at risk of medication non-adherence and help develop interventions to improve medication adherence in this population. Hence, this study was conducted to assess medication adherence and its influencing factors in community-dwelling older adults with chronic illnesses in a rural area in Sharkia Governorate, Egypt.

Methods

A cross-sectional design was used to assess medication adherence and its influencing factors in community-dwelling older adults with chronic illnesses in a rural area in Fakous district, Sharkia Governorate, Egypt.

A sample consisted of 310 older patients from the above-mentioned setting provided that the subjects were: (a) 60 years and older; (b) free from communication problems (speech and hearing problems); (c) diagnosed with any chronic illness for at least one year ago and taking prescribed medications.

The sample size was calculated using the OpenEpi free software program based on assuming that the total population of older adults in the selected setting was 1800 and the proportion of older patients who had poor medication adherence in a similar previous study was 58.3% (16), at confidence level 95%, so the sample size was 310.

A multistage sampling method was used as follows: 1) one district from Sharkia Governorate was chosen randomly (Fakous district). 2) one rural area was chosen randomly from the Fakous district (Aldaidamon Village).

3) The selected village was divided into ten areas, and four areas were picked randomly. 4) All eligible older patients in the randomly chosen areas who met inclusion criteria and agreed to participate in the study were included in the study sample till reaching the calculated sample size (n=310).

The study was conducted after approval from The Scientific Research Ethical Committee at the Faculty of Nursing, Zagazig University. After ethical approval, researchers visited the study setting, explained the purpose of the study to the older patients, and answered all their questions. The researchers also read the "Informed Consent Form" for participation in the study. Older adults who agreed the participation provided verbal consent. It was emphasized that participation in the study was voluntary, the information would be kept confidential and would not be used anywhere else, with the right to withdraw at any time.

"*Personal characteristics and disease questionnaire*" was developed by the researchers based on the literature review and included two parts. The first part included questions about older adults' demographic characteristics such as age, gender, marital status, education, current occupation, living condition, crowding index, and income. The second part included questions about older adults' medical history and medication use. The number, type, and duration of chronic illnesses such as hypertension, diabetes, renal disease, and cardiovascular disease. The number and type of daily medications, along with reasons for missing the medications, as reported by the participants. Reasons like forgetfulness, polypharmacy, complexity of regime, lack of time, side effects/adverse events, financial constraints, non-availability of medications, and negligence).

"*The General Medication Adherence Scale (GMAS)*" was originally developed and validated in Urdu and English languages in Pakistan by Naqvi et al. (18). The GMAS is an 11-item self-reporting adherence measure. Each item has 4 outcomes and awards an adherence

score. The scale was developed to assess adherence in the general population and is not limited to any disease state. Scoring: The GMAS included 11 items on a four-point scale; "always," "mostly," "sometimes," and "never." Items answered with always were scored as 0, mostly scored as 1, sometimes scored as 2, and never scored as 3. The total score of the GMAS was between 0 and 33, with higher scores indicating higher medication adherence. The adherence is categorized as adherent (≥ 27) or non-adherent (≤ 26). The Arabic version of the General Medication Adherence Scale (GMAS) was validated in Saudi patients with chronic diseases (19). Cronbach's alpha for the GMAS in our study was 0.72.

The data collection was completed between July 2022 and October 2022. The data of the study were collected from the participants in their homes through face-to-face interviews by the researchers who read and explained each question to older patients and recorded their answers.

All data were collected, tabulated, and statistically analyzed using IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp. Quantitative data were expressed as mean and standard deviation and qualitative data were

expressed as absolute numbers and percentages. Categorical variables were compared using the Chi-square test or Fisher's exact test when appropriate. Pearson's correlation coefficient was used to assess the association between the study variables. Logistic regression was used to predict the relationship between medication adherence as a dependent variable and independent variables. Cronbach alpha coefficient was calculated to assess the reliability of the scale through its internal consistency. Statistical significance was considered at $p < .05$.

Results

A total of 310 participants were included in the study. In terms of demographic characteristics of the older patients, Table 1 indicates that their mean age was 69.7 ($SD= 6.5$) years, and 55.8% of them their age ranged between sixty to less than seventy years. 52.6% of the studied older patients were females and married. Regarding education and current working status, 27.7% of the older patients were illiterate, 30% had secondary education, and 67.4% were no longer working. Regarding living conditions and income, 54.8% of the older patients lived with family, 58.1% had insufficient income, and the main source of income was pension (68.1%).

Table 1. Characteristics of the studied older patients and their relation to their medication adherence (N= 310)

Items	Total		Medication adherence				χ^2	P-value
			Adherent (n= 47)		Non-adherent (n= 263)			
	N	%	N	%	N	%		
Age group								
60-<70 years	173	55.8	44	25.4	129	74.6	32.1	0.0001*
≥ 70 years	137	44.2	3	2.2	134	97.8		
Mean (SD)	69.7	(6.5)						
Gender								
Male	147	47.4	6	4.1	141	95.9	26.7	0.0001*
Female	163	52.6	41	25.2	122	74.8		
Marital status								
Married	163	52.6	33	20.2	130	79.8	9.7	0.008*
Divorced	6	1.9	2	33.3	4	66.7		
Widowed	141	45.5	12	8.5	129	91.5		
Educational level								
Illiterate	86	27.7	0	.0	86	100.0	58.5	0.0001*
Read & write	39	12.6	0	.0	39	100.0		
Basic	31	10.0	0	.0	31	100.0		
Secondary	93	30.0	25	26.9	68	73.1		
University	61	19.7	22	36.1	39	63.9		

Current working								
Working	101	32.6	9	8.9	92	91.1	4.6	0.03*
Not working	209	67.4	38	18.2	171	81.8		
Living condition								
With family	170	54.8	34	20.0	136	80.0		
With one of sons	116	37.4	10	8.6	106	91.4	7.8	0.049*
With one of relatives	5	1.6	0	.0	5	100.0		
Alone	19	6.1	3	15.8	16	84.2		
Source of income								
Pension	211	68.1	41	19.4	170	80.6		
Property	50	16.1	6	12.0	44	88.0	12.4	0.007*
Social assistance	38	12.3	0	.0	38	100.0		
Relatives' assistance	11	3.5	0	.0	11	100.0		
Monthly income								
Insufficient	180	58.1	18	10.0	162	90.0	8.9	0.003*
Sufficient	130	41.9	29	22.3	101	77.7		

Regarding the medical history of older patients, the number of chronic conditions ranged from 1 to 6 diseases with a mean of 3.2 ($SD= 1.1$). Additionally, the chronic conditions duration ranged from 1 to 21 years with a mean of 8.2 ($SD = 4.2$), and 59% of older patients did not follow up regularly with their doctors. The most frequently reported condition was high hypertension (75.2%), followed by diabetes (50%) and arthritis (43.5%). Regarding the participants' health insurance type, Table 2 indicated that 43.9% of older patients had governmental health insurance, while 41.3% of them had not any type of health insurance. Table 2 also demonstrates that the number of medications

used by older patients per day ranged from 2 to 12 medications with a mean of 7.3 ($SD= 2.3$), the duration of medication use ranged from 1 to 21 years with a mean of 8.1 ($SD= 4.2$), and only 10% of older patients reported Taking Over-the-Counter (OTC) drugs. Regarding participants' self-reported medication adherence and reasons for non-adherence, Table 2 shows that 50.6% of older patients were adherent to their medications, and 49.4% of them were non-adherent. The most frequently reported reason for non-adherence to medications was polypharmacy (69%), followed by forgetfulness (56.5%), negligence (54.2%), and financial constraints (46.1%).

Table 2. Medical history and medication use as reported by the studied older patients (N= 310)

Number of Chronic Illnesses		
Mean (SD)	3.2 (1.1)	
Median (Range)	3 (1-6)	
Chronic Illnesses duration in years		
Mean (SD)	8.2 (4.2)	
Median (Range)	7(1-21)	
Follow up regularly	N	%
Yes	127	41
No	183	59
Health insurance		
Governmental	136	43.9
Special	46	14.8
Without	128	41.3
Types of chronic illnesses		
Hypertension	233	75.2
Cardiac disease	69	22.3
Renal disease	52	16.8
Arthritis	135	43.5
Diabetes	155	50.0
Neurological	42	13.5
Hepatic	49	15.8

Osteoporosis	41	13.2
Respiratory	37	11.9
Gastrointestinal	132	42.6
Thyroid	31	10.0
Duration of medication use in years.		
Mean (SD)	8.1 (4.2)	
Median (Range)	7 (1-21)	
Number of medications per day		
Mean (SD)	7.3 (2.3)	
Median (Range)	7 (2-12)	
Taking OTC drugs		
Yes	31	10.0
No	279	90.0
Self-reported medication adherence		
Yes (Adherence)	157	50.6
No (Non-adherence)	153	49.4
Self-reported reasons for non-adhering to medications		
Forgetfulness	175	56.5
Polypharmacy	214	69.0
Financial constraints	143	46.1
Fear from side effects	82	26.5
Complexity of regime	152	49.0
Negligence	168	54.2
Not believe in medications	90	29.0
Non-availability of medications	5	1.6
Busy in work/ lack of time	75	24.2

In terms of medication adherence based on GMAS, Table 3 reveals that 84.8% of older patients were non-adherent to their medications, and only 15.2% of them were adherent to their medications. Older patients' medication adherence scores ranged from 2 to 29, with a mean score of 18.2 ($SD=6.3$). Table 1 revealed that there were statistically significant relations between older patients' medication adherence and their age ($p<.001$), gender ($p<.001$), educational level ($p<.001$), marital status ($p=.008$), current working ($p=.03$), living condition ($p=.049$), monthly income ($p=.003$), and source of income ($p=.007$). Older patients who were non-adherent to medications aged 70 years and more were males, widowed, illiterate, working currently, living with sons or relatives, and had insufficient income.

Concerning the correlation between older patients' medication adherence score and

their characteristics, Table 3 indicates highly significant negative correlations between medication adherence scores and older patients' age ($r= -.418$), number of chronic diseases ($r=-0.28$), and number of medications ($r=-0.27$). This indicated that the lower scores of medication adherence, which reflects poor medication adherence, were associated with advancing age, increasing number of medications, and chronic conditions among participants.

According to Table 4, Logistic regression for predicting medication adherence among older patients revealed that age less than 70 years, female gender, sufficient income, decreased disease number, and decreased medication number were significant predictors for medication adherence among older patients ($P<0.05$).

Table 3. Older patients' adherence to medications and its correlation with their characteristics (N= 310)

Items	N	%
Older patients' adherence to medications		
Adherent (Based on GMAS)	47	15.2
Non-adherent (Based on GMAS)	263	84.8
Medication Adherence total mean score (33) #		
Mean (SD)		18.2 (6.3)
Median (range)		19 (2-29)

Correlation between older adults' medication adherence score and their characteristics

Items	Medication adherence total mean score	
	(r)	p
Age per years	-0.418**	0.0001
Number of chronic diseases	-0.28**	0.0001
Number of medications	-0.27**	0.0001

(#) maximum score (r) Correlation coefficient *Significant at p< 0.05 **Highly Significant at p< 0.01

Table 4. Logistic regression for predicting medication adherence in older patients

Predictors	Exp (B)	Sig.
Age (less than 70 years)	8.4	0.002
Gender (Female)	25.1	0.0001
Monthly income (Sufficient)	3.04	0.013
Number of diseases	0.413	0.001
Number of medications	0.785	0.034

Exp (B): odds ratio *p < 0.05 significant predictors

Discussion

Our study revealed that most rural older adults with chronic illnesses were non-adherent to their medications. In the same vein, a study conducted in Iran by Kharameh et al. (17) noticed that medication adherence was found to be poor in more than two-thirds of older adults with chronic diseases. Similarly, the results of a study conducted by Abd Allah et al. (16) in Egypt showed that about two-thirds of older adults with chronic health conditions living in rural areas had poor adherence to their medication regimens. These findings also agreed with Chew et al. (10) study, which found that two-thirds of the studied participants were not adhering to their medication regime.

These findings are inconsistent with a study conducted in Riyadh, Saudi Arabia, by Alhabib et al. (5) that assessed medication adherence in geriatric patients with chronic diseases and reported that studied seniors with chronic diseases had a high medication

adherence rate. Additionally, the findings of a previous study by Menditto et al. (20), conducted in three European countries (the Republic of Ireland, Italy [Campania Region], and Spain [Aragon Region]) revealed that older populations receiving chronic therapies had sub-optimal medication adherence, with Ireland having a lower proportion of non-adherent older people than Italy and Spain.

The results of the current study show that older adults had 3.2 chronic conditions on average, with hypertension being the most common. This result is consistent with Jeon (21), who stated that 3.21 was the average number of chronic illnesses, and the most prevalent illness was hypertension among the studied sample. Also, less than half of the study participants had governmental health insurance. This finding quarrels with that of Liu et al. (22), who revealed in a recent study that most older patients had health insurance. The current study revealed that males were more likely to be non-adherent to medications than females, contradicting Salama et al. (23), who found that

male patients constituted a higher percentage of the adherent group than female patients.

According to this study, older adults consumed an average of 7.3 medications per day, ranging from 2 to 12. This finding somewhat matched that of Bosch-Lenders et al. (24), who investigated "factors associated with appropriate knowledge of the indications for prescribed drugs among community-dwelling older patients with polypharmacy and found that less than half of studied participants reported daily intake of more than ten prescribed drugs, with an average mean number of nine prescribed drugs per patient.

Considering the current study findings, most participants claimed that polypharmacy was the cause of non-adherence to medication. This finding is consistent with Tan et al. (25) study on Singaporean elderly people, which discovered that polypharmacy is associated with medication non-adherence. Likewise, these results agree with Menditto et al. (20) findings that polypharmacy, which is more common in older populations, has been shown to reduce adherence. These findings are controversial with those of Lau et al. (26), who claimed that individuals requiring more medication categories were more likely to demonstrate better medication adherence.

Additionally, over half of older adults reported that forgetfulness was the reason for non-adherence. This result is in line with the findings of studies that were reviewed by Al Qasem et al. (8), who noticed that among Middle Eastern patients with chronic conditions, forgetfulness was one of the most frequently reported reasons for non-adherence to medication. Félix and Henrique (27) showed that lower adherence among participants resulted from some of them being careless about taking their medication. This result is consistent with our study's finding that negligence was most frequently cited as the underlying cause of medication non-adherence.

Concerning the influencing factors of medication adherence among study

participants, the present study revealed a statistically significant relationship between older patients' medication adherence and insufficient income among study participants. This finding is in accordance with Park et al. (28), who found that there was no direct association between low income and medication adherence; their justification is that low socioeconomic status can lead to unhealthy behaviors, limited access to healthcare, and lower adherence to treatment regimens. Regarding gender, Liquori et al. (29) mention that in chronic older patients, there was no significant relationship between gender and medication adherence. Contrary to our study's findings, where older patients' medication adherence was associated with their gender.

The current study findings indicate highly significant negative correlations between medication adherence and the number of chronic diseases. This could be due to the multiple morbidities among older adults, as more prescription drugs are frequently needed. This result is supported by Abd Allah et al. (16), who mentioned a statistically significant negative correlation between medication adherence and several diseases among older participants. Regarding the relationship between older adults adhering to medications and their monthly income, the current study indicated that older adults who were non-adherent to medications had insufficient income. These findings are noticed to be similar to that of a study conducted in Egypt by Abdul-Satta et al. (30), who found that lower socioeconomic status and lower educational level were associated with patients' adherence to medication and reported that these factors prevented these patients from adhering to their medication.

This study was a cross-sectional study, which does not provide a cause-and-effect relationship between variables. Moreover, the study was conducted in only one rural area, which might limit the generalizability of the findings. Furthermore, assessing medication

adherence was based on older patients' self-reported answers, which might lead to overestimating the non-adherence rate. Hence, it is recommended to replicate this study using a well-designed research design, and assessment tools, with a larger sample to provide a higher level of evidence of its findings.

Conclusion

The current study findings revealed that most rural older adults with chronic illnesses were non-adherent to their medications. The most frequently reported reason for non-adherence to medications was polypharmacy, followed by forgetfulness, negligence, and financial constraints. Significant relationships were found between medication adherence and age, gender, educational level, marital status, and monthly income. Furthermore, aging less than 70 years, female gender, sufficient income, decreased illnesses, and medication number were significant predictors for medication adherence in older patients.

The study findings found a high prevalence of medication non-adherence among rural geriatric patients. Also, many influencing factors were identified. Hence, the importance of developing strategies and educational programs to improve medication adherence in rural older patients with special concern for influencing factors assessed in this study is recommended. Moreover, continued investigation is needed to identify reasons why older rural patients fail to adhere to taking their medications to improve health outcomes in this population.

Furthermore, assessing medication adherence must be an essential part of the management of rural older adults with chronic illnesses, and identifying factors underlying medication non-adherence can help healthcare providers to implement strategies tailored to older patients' needs. Further studies are needed to implement and evaluate the effectiveness of educational programs for improving

medication adherence in rural older patients and subsequently improving their general health.

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Conflict of Interests

The authors declare that there is no conflict of interest.

References

1. United Nations, Department of Economic and Social Affairs. World population ageing 2020: highlights. Available at: https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/files/documents/2020/Sep/un_pop_2020_pf_ageing_10_key_messages.pdf Accessed July 22, 2022.
2. Zhang C, Xiao S, Shi L, Xue Y, Zheng X, Dong F, Zhang J, Xue B, Lin H, Ouyang P. Urban–Rural Differences in Patterns and Associated Factors of Multimorbidity Among Older Adults in China: A Cross-Sectional Study Based on Apriori Algorithm and Multinomial Logistic Regression. *Frontiers in Public Health*. 2021 Aug 30;9:707062.
3. González-Bueno J, Sevilla-Sánchez D, Puigoriol-Juventeny E, Molist-Brunet N, Codina-Jané C, Espauella-Panicot J. Factors associated with medication non-adherence among patients with multimorbidity and polypharmacy admitted to an intermediate care center. *International Journal of Environmental Research and Public Health*. 2021 Sep 12;18(18):9606.
4. World Health Organization (WHO). Adherence to long-term therapies: evidence for action. 2003. Available at: https://www.who.int/chp/knowledge/publications/adherence_Section1.pdf?ua=1 Accessed July 24, 2022.
5. Alhabib MY, Alhazmi TS, Alsaad SM, AlQahtani AS, Alnafisah AA. Medication adherence among geriatric patients with chronic diseases in Riyadh, Saudi Arabia. *Patient Preference and Adherence*. 2022 Jan 1:2021-30.
6. Baryakova TH, Pogostin BH, Langer R, McHugh KJ. Overcoming barriers to patient adherence: the case for developing innovative drug

delivery systems. *Nature Reviews Drug Discovery*. 2023 May;22(5):387-409.

7. Al Qasem A, Smith F, Clifford S. Adherence to medication among chronic patients in Middle Eastern countries: A review of studies. *EMHJ-Eastern Mediterranean Health Journal*. 2011;17(4):356-363.

8. Balkhi B, Alwhaibi M, Alqahtani N, Alhawassi T, Alshammari TM, Mahmoud M, Almetwazi M, Ata S, Kamal KM. Oral antidiabetic medication adherence and glycaemic control among patients with type 2 diabetes mellitus: a cross-sectional retrospective study in a tertiary hospital in Saudi Arabia. *BMJ Open*. 2019 Jul 1;9(7):e029280.

9. Neiman AB, Ruppert T, Ho M, Garber L, Weidle PJ, Hong Y, George MG, Thorpe PG. CDC grand rounds: Improving medication adherence for chronic disease management—innovations and opportunities. *Morbidity and Mortality Weekly Report*. 2017 Nov 11;66(45):1248.

10. Chew SM, Lee JH, Lim SF, Liew MJ, Xu Y, Towle RM. Prevalence and predictors of medication non-adherence among older community-dwelling people with chronic disease in Singapore. *Journal of Advanced Nursing*. 2021 Oct;77(10):4069-80.

11. Smaje A, Weston-Clark M, Raj R, Orlu M, Davis D, Rawle M. Factors associated with medication adherence in older patients: A systematic review. *Aging Medicine*. 2018 Dec;1(3):254-66.

12. Ulley J, Harrop D, Ali A, Alton S, Fowler Davis S. Deprescribing interventions and their impact on medication adherence in community-dwelling older adults with polypharmacy: A systematic review. *BMC Geriatrics*. 2019 Dec;19(1):1-3.

13. Bolina AF, Gomes NC, Marchiori GF, Pegorari MS, Tavares DM. Potentially inappropriate medication use and frailty phenotype among community-dwelling older adults: A population-based study. *Journal of Clinical Nursing*. 2019 Nov;28(21-22):3914-22.

14. Yang C, Lee DT, Wang X, Chair SY. Effects of a nurse-led medication self-management intervention on medication adherence and health outcomes in older people with multimorbidity: A randomised controlled trial. *International Journal of Nursing Studies*. 2022 Oct 1;134:104314.

15. Angadi NB, Kavi A, Torgal SS. Therapeutic Adherence among Elderly with

Chronic Diseases Residing in Urban Area of South India—A descriptive cross-sectional study. *Biomedical and Pharmacology Journal*. 2020 Dec 30;13(4):2109-16.

16. Abd Allah ES, Mahmoud SA, Serea MM. Factors Affecting Medication Adherence among Elderly in Rural Areas, Sharkia Governorate, Egypt. *Annals of the Romanian Society for Cell Biology*. 2021 Aug 5;25(6):18830-41.

17. Kharameh ZT, Khoshravesh S, Noori R, Abdolmalaki M, Bakhshi M. Determinants of medication adherence among Iranian elderly patients with chronic diseases. *Jundishapur Journal of Chronic Disease Care*. 2018 Jul 31;7(3):e68310. doi: 10.5812/jjcdc.68310.

18. Naqvi AA, Hassali MA, Rizvi M, Zehra A, Iffat W, Haseeb A, Jamshed S. Development and validation of a novel General Medication Adherence Scale (GMAS) for chronic illness patients in Pakistan. *Frontiers in Pharmacology*. 2018 Oct 9;9:1124.

19. Naqvi AA, Mahmoud MA, AlShayban DM, Alharbi FA, Alolayan SO, Althagfan S, Iqbal MS, Farooqui M, Ishaqui AA, Elrggal ME, Haseeb A. Translation and validation of the Arabic version of the General Medication Adherence Scale (GMAS) in Saudi patients with chronic illnesses. *Saudi Pharmaceutical Journal*. 2020 Sep 1;28(9):1055-61.

20. Menditto E, Cahir C, Aza-Pascual-Salcedo M, Bruzzese D, Poblador-Plou B, Malo S, Costa E, González-Rubio F, Gimeno-Miguel A, Orlando V, Kardas P. Adherence to chronic medication in older populations: Application of a common protocol among three European cohorts. *Patient Preference and Adherence*. 2018 Oct 5:1975-87. doi: 10.2147/PPA.S164819.

21. Jeon HO. Correlation of physical, psychological, and functional factors with independent medication adherence in Korean older adults with chronic illness: Using the 2017 national survey of older Koreans. *Archives of Gerontology and Geriatrics*. 2020 Sep 1;90:104130.

22. Liu J, Yu Y, Yan S, Zeng Y, Su S, He T, Wang Z, Ding Q, Zhang R, Li W, Wang X. Risk factors for self-reported medication adherence in community-dwelling older patients with multimorbidity and polypharmacy: A multicenter cross-sectional study. *BMC Geriatrics*. 2023 Dec;23(1):1-0.

23. Salama AA, Yasin AE, Elbarbary W. Medication knowledge as a determinant of
24. Menoufia Medical Journal. 2017 Jan 1;30(1):63.
25. Bosch-Lenders D, Maessen DW, Stoffers HE, Knottnerus JA, Winkens B, van den Akker M. Factors associated with appropriate knowledge of the indications for prescribed drugs among community-dwelling older patients with polypharmacy. *Age and Ageing*. 2016 May 1;45(3):402-8.
26. Tan YW, Suppiah S, Bautista MA, Malhotra R. Polypharmacy among community-dwelling elderly in Singapore: Prevalence, risk factors and association with medication non-adherence. *Proceedings of Singapore Healthcare*. 2019 Dec;28(4):224-31.
27. Lau Y, Htun TP, Chan KS, Klainin-Yobas P. Multidimensional factors affecting medication adherence among community-dwelling older adults: a structural-equation-modeling approach. *Journal of Public Health*. 2017 Feb;25:113-22.
28. Félix IB, Henriques A. Medication adherence and related determinants in older people medication adherence in geriatric patients, Serse Elian City, Menoufia Governorate, Egypt. with multimorbidity: A cross-sectional study. *InNursing Forum* 2021. Oct 2021;56:834-43.
29. Park HY, Seo SA, Yoo H, Lee K. Medication adherence and beliefs about medication in elderly patients living alone with chronic diseases. *Patient Preference and Adherence*. 2018 Jan 24;175-81.
30. Liquori G, De Leo A, Di Simone E, Dionisi S, Giannetta N, Ganci E, Trainito SP, Orsi GB, Di Muzio M, Napoli C. Medication Adherence in Chronic Older Patients: An Italian Observational Study Using Medication Adherence Report Scale (MARS-5I). *International Journal of Environmental Research and Public Health*. 2022 Apr 25;19(9):5190.
31. Abdul-Sattar AB, Abou El Magd SA. Determinants of medication non-adherence in Egyptian patients with systemic lupus erythematosus: Sharkia Governorate. *Rheumatology International*. 2015 Jun;35:1045-51.