

1 SUBMITTED 16 APR 23
2 REVISIONS REQ. 11 JUL & 4 SEP 23; REVISIONS RECD. 12 AUG & 9 SEP 23
3 ACCEPTED 12 SEP 23
4 **ONLINE-FIRST: SEPTEMBER 2023**
5 **DOI: <https://doi.org/10.18295/squmj.9.2023.052>**

7 **Prevalence, Characteristics and Determinants of Polypharmacy Among**
8 **Elderly Patients Attending Primary Health Care Centers in Bahrain**

9 *A cross-sectional study*

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17 **Abstract**

18 **Objectives:** This study aims to determine the prevalence, characteristics and determinants of
19 polypharmacy among elderly patients in Bahrain. **Methods:** A cross-sectional study was conducted
20 in the period between March and April 2022 in all primary healthcare centres in Bahrain. A simple
21 random sample was obtained. An elderly patient was defined as a patient aged 60 years or above.
22 In addition, polypharmacy was defined as the concomitant use of 5 medications or more and
23 excessive polypharmacy was defined as the concomitant use of 10 medications or more. **Results:**
24 A total of 977 patients were included, more than half of them were females (n=533, 54.44%) and
25 the mean age of the participants was 67.90 ±6.87 years. Essential hypertension, hyperlipidemia
26 and diabetes mellitus were the most common comorbidities among the participants (61.51%,
27 57.63% and 53.22%, respectively). Of the cohort, 443 were on 5 or more medications i.e.,
28 polypharmacy (45.34%), and around 7% were on at least 10 medications (n=66, 6.76%). A
29 multivariate analysis revealed that patients with diabetes (OR=5.836, CI 4.061-8.385, P<0.001),
30 hypertension (OR=6.231, CI= 4.235-9.168, P<0.001), hyperlipidemia (OR 3.999, 95% CI 2.756-
31 5.802, P<0.001), cardiovascular diseases (OR 3.589, 95 CI 1.787-7.205, P<0.001) and asthma (OR

32 3.148, 95% CI 1.646-6.019, P<0.001) were significantly more likely to suffer from polypharmacy.

33 **Conclusion:** Polypharmacy was prevalent among elderly patients in Bahrain, particularly among
34 those with non-communicable diseases. Polypharmacy should be considered while delivering
35 elderly healthcare services, especially in patients with non-communicable diseases.

36 **Keywords:** Aged, Bahrain, Elderly, Polymorbidity, Polypharmacy.

37

38 **Advances in Knowledge**

39 • This study revealed a high prevalence of polypharmacy and excessive polypharmacy
40 among elderly patients in Bahrain. It is the first study to assess polypharmacy among
41 elderly patients in Bahrain.

42 • A significantly higher prevalence of polypharmacy was seen in patients with non-
43 communicable diseases.

44

45 **Application to Patient Care**

46

47 • The findings of this study describe the magnitude and determinants of polypharmacy
48 among old patients and the importance of deprescribing and avoiding unnecessary
49 medications in this group.

50 • Elderly patients with chronic diseases are at a higher risk of polypharmacy and might
51 benefit more from any intervention to minimize polypharmacy.

52

53 **Introduction**

54 Globally, there is a rapid increase in the elderly population that is attributed to improvements in
55 medical services, better hygiene practices, availability of immunization and antimicrobials, and
56 improvements in work and home environments.^{1,2} It is projected that the number of old people
57 will increase from one billion in 2020 to more than two billion in 2050.³ According to United
58 Nations and World Health Organization, people aged 60 years are considered elderly.⁴ According
59 to the Bahrain National Health Survey 2018, the overall number of elderly individuals was 86,986,
60 and around 2.8% of the population belongs to the age group of 65 years old and above.⁵

61

62 There is a substantial variation in defining an elderly population in the literature. Some studies and
63 organizations use the age of 60 years to define old age, while other studies use the age of 65 years,
64 70 years and even 80 years to define old age.^{6,7} This heterogeneity in the definition of old age
65 results in different rates of diseases and outcomes across the studies.⁸

66
67 Elderly patients are at risk of polymorbidity, defined as the presence of two or more chronic
68 diseases. Non-communicable diseases including essential hypertension, diabetes mellitus, lipid
69 disorders, and cardiac diseases are common among older individuals.⁹ Frailty and psychiatric
70 disorders like dementia also increase with ageing.¹⁰ These diseases often require several
71 medications for treatment, control and prevention.¹¹⁻¹²

72
73 Considering the deterioration in the physiological and functional abilities of old people, drug-
74 related adverse effects and drug-drug interactions are frequent in this age category.¹³ Thus, using
75 the minimum number of medications and frequent monitoring for such interactions is often
76 necessary among the elderly, especially for medications with a narrow therapeutic index.¹⁴ Several
77 guidelines were published to address polypharmacy and prescribing issues in the elderly.^{14, 15, 16}

78
79 Polypharmacy, commonly defined as the concomitant use of five or more medications by one
80 patient, is a consequence of polymorbidity and a major issue in the management of patients with
81 chronic diseases.¹⁷ Older patients are at even higher risk of polypharmacy due to their
82 multimorbidity, decline in physical, physiological, sensory and cognitive functions and their
83 vulnerability to prescription cascade.¹⁸ Healthcare system and healthcare provider factors could
84 also potentially contribute to the high prevalence of polypharmacy among the elderly. Factors like
85 poorly maintained records, automated medication refill and absence of prescription guidelines are
86 linked to a higher risk of polypharmacy.¹⁹

87
88 Polypharmacy negatively affects patients' prognosis and disease outcomes. Polypharmacy in old
89 age lowers functionality and increases the risk of mortality as found by some systematic reviews.^{20,}
90 ²¹ Polypharmacy was linked to a higher risk of hip fractures, inappropriate prescribing and
91 hospitalization.^{22, 23}

92

93 Many studies reported high rates of polypharmacy in old patients. A large cohort study of more
94 than 1.5 million elderly patients, concluded that the prevalence of polypharmacy was 44.0%, while
95 the prevalence of excessive polypharmacy was 11.7%.²⁴ In Qatar, polypharmacy was seen in
96 75.5% of elderly people. Female sex and the presence of chronic diseases were strong determinants
97 of higher risks of polypharmacy in these studies.²⁵ A study conducted in Saudi Arabia revealed
98 that as high as 55% of the elderly suffered from polypharmacy.²⁶ A large systematic review of 27
99 studies and more than nine thousand participants found that 49% of old people were on 5 or more
100 medications and 31% were on more than 10 medications.²⁷

101

102 This study aimed to determine the prevalence, characteristics and determinants of polypharmacy
103 in elderly patients attending primary healthcare centers in Bahrain. To the best of our knowledge,
104 no previous studies were conducted to assess the prevalence and characteristics of polypharmacy
105 among elderly patients attending primary healthcare centers in Bahrain.

106

107 **Methods**

108 **Study setting and design**

109 A cross-sectional study was conducted among elderly patients attending primary healthcare centers
110 in Bahrain. There are 27 primary health centres and five health regions in Bahrain. Elderly patients
111 attending all health centers were considered for eligibility. Research approval was obtained from
112 the Research and Ethics Committees of Primary Healthcare in Bahrain, and informed written
113 consent was taken from all participants in the study.

114

115 **Population and sampling**

116 In the period between March and April 2022, 15666 elderly patients visited primary healthcare
117 centers in Bahrain. Considering the total number of the elderly population in Bahrain (n=48053),
118 95% confidence interval, 5% precision level and a predicted prevalence of polypharmacy of 50%,
119 a sample size of 385 was targeted to determine statistical significance. A computer-based random
120 sample was taken from the pool of the patients (n=15666).

121

122 **Operational definitions**

123 An elderly patient was defined as a patient aged 60 years or above. Polypharmacy was defined as
124 the concomitant use of 5 medications or more at the selected clinical encounter (the 1st visit in the
125 period between March and April 2022) and excessive polypharmacy was defined as the
126 concomitant use of 10 medications or more at the selected visit during the same period. Topical
127 agents including ear drops, nasal drops, inhalers and urgent injections were not considered as
128 regular medications. Non-prescription medications, herbals, and vitamins were not assessed. All
129 diagnoses were based on International Classification of Diseases (ICD-10).

130

131 **Inclusion and exclusion criteria**

132 Adult patients aged 60 years or above who attended primary care centers in the period between
133 March and April 2022 were eligible for inclusion. If the patient had several visits in the selected
134 period, data of the first visit only were retrieved from the electronic records.

135

136 **Data collection instrument**

137 A data collection tool was formulated. The tool consisted of 3 parts; the first part of the tool
138 composed of sociodemographic characteristics of the patients and included age, sex, nationality
139 and marital status; the second part assessed patients' comorbidities including diabetes mellitus,
140 essential hypertension, hyperlipidemia, cerebrovascular accident and chronic kidney disease. The
141 third part assessed all the medications available at primary care centers and included name and
142 category of the medication according to anatomical therapeutic chemical classification system.

143

144 **Data analysis procedure**

145 Frequencies and percentages were computed for categorical variables while means and standard
146 deviations were computed for continuous variables. T-tests were used to compare differences in
147 means between two independent groups, while categorical variables were compared using chi-
148 square test. The data was analyzed using Statistical Package for Social Sciences software, version
149 26.0. In all tests, a p-value of less than 0.05 was statistically considered significant.

150

151 **Results**

152 *Baseline characteristics of the participants*

153 A total of 977 patients were randomly selected and included in the study. The mean age of the
154 participants was 67.90 ± 6.87 years and more than half of them were females (n=533, 54.44%).
155 The majority of patients were Bahraini (94.37%) and married (74.51%). Regarding comorbidities,
156 essential hypertension, hyperlipidemia and diabetes mellitus were the most common comorbidities
157 among the participants (61.51%, 57.63% and 53.22%, respectively). Table (1).

158

159 *Medication characteristics*

160 As shown in Table (2), metformin was the most commonly used medication among elderly
161 patients, followed by atorvastatin (n=296, 30.30%) and perindopril (n=248, 25.38%).

162

163 As shown in Table (3), most patients were taking less than 5 medications (n=534, 54.66%), and
164 the average number of medications was 4.36 medications per patient. In addition, 45.34% of the
165 participants were on 5 or more medications and around 7% were taking 10 medications or more
166 (n=66, 6.76%).

167

168 *Association between baseline characteristics of the participants and polypharmacy status*

169 Univariate analysis showed that patients with advanced age (P=0.001), diabetes mellitus
170 (<0.001), essential hypertension (P<0.001), hyperlipidemia (P<0.001), cardiovascular diseases
171 (P<0.001), bronchial asthma (P<0.001) and hypothyroidism (P=0.010) were more likely to suffer
172 from polypharmacy. Table (4).

173

174 The results of the multivariate analysis are shown in Table 5. Patients with diabetes mellitus were
175 6 times more likely to suffer from polypharmacy compared to patients without diabetes
176 (OR=5.836, CI 4.061-8.385, P<0.001). Similarly, patients with hypertension were more likely to
177 have polypharmacy than normotensive patients (OR=6.231, CI= 4.235-9.168, P<0.001). In
178 addition, polypharmacy rate was four times higher among patients with hyperlipidemia (OR
179 3.999, 95% CI 2.756-5.802, P<0.001) and cardiovascular diseases (OR 3.589, 95 CI 1.787-7.205,
180 P<0.001). Patients' age and presence of hypothyroidism did not influence the polypharmacy
181 status.

182

183 **Discussion**

184 The results of this study revealed that almost half of the studied cohort suffered from
185 polypharmacy. Additionally, the results showed that polypharmacy was significantly higher
186 among patients with non-communicable diseases including diabetes mellitus, hypertension,
187 hyperlipidemia, cardiovascular disease, bronchial asthma and hypothyroidism.

188
189 Similar to the findings of this study, several regional studies reported high rates of polypharmacy
190 among old patients.²³⁻²⁵ Internationally, lower rates of polypharmacy were reported. A cohort
191 study conducted in Iran reported a lower prevalence of polypharmacy among people aged 60 years
192 and above (23.1%).²⁸ The estimated prevalence of polypharmacy in Brazil was 13.5%.²⁹ In the
193 United States of America, a national health survey determined that the prevalence of
194 polypharmacy among the elderly tripled from 12.8% in 1988 to 39.0% in 2010.³⁰ Furthermore, a
195 large multi-centre study was conducted in primary healthcare centers across Europe and reported
196 a polypharmacy prevalence of 27.2% (range between 16.4% and 60.8%).³¹

197
198 The variability in the reported prevalence rates of polypharmacy among elderly patients is
199 multifactorial. One of the reasons is the heterogeneity in the definition of polypharmacy among
200 the studies. Some studies assessed the accumulative number of medications during a specific
201 period while other studies assessed the concurrent use of the medications. Another reason is the
202 heterogeneity in the definition of an elderly patient. Specifically, some studies considered the
203 chronological age of 60 years to define old age, while other studies considered the age of 65 years
204 to define old age.^{25,27} Additionally, study settings and methodologies were variable among the
205 studies.^{6,7,11}

206
207 The high prevalence of polypharmacy in this study could be attributed to the high prevalence of
208 non-communicable diseases among the studied subjects. More than half of the studied patients
209 were suffering from diabetes mellitus, hypertension, and hyperlipidemia. This finding is in line
210 with the results of Bahrain National Health Survey 2018 which showed that more than 76% of
211 those above 60 years old suffer from diabetes and more than 54% were hypertensive.⁵ These
212 conditions have a similar risk profile, tend to occur together and increase with age. Most of these
213 conditions require several medications to achieve adequate control. This is further supported by
214 the finding that metformin, atorvastatin, and perindopril were the three most prescribed

215 medications in this age group. Another explanation of the high rate of polypharmacy is the
216 prescribing of medications for preventive use. Medications like statins and aspirin are commonly
217 used for primary and secondary prevention purposes. Furthermore, there are no national or
218 institutional guidelines to encourage deprescription among this group of patients in Bahrain. This
219 might have had an impact on the rate of polypharmacy in the present study.

220

221 Consistent with many studies, the results in the current study revealed a significant association
222 between polypharmacy and non-communicable diseases and showed that diabetes mellitus,
223 hypertension, hyperlipidemia, cardiovascular diseases and asthma were predictors of
224 polypharmacy.^{24, 27, 30}

225

226 Although the multivariate analysis in this study showed no association between polypharmacy
227 and patient's age, such finding was reported in the literature.²⁵ This association could be explained
228 by the fact that the number of chronic conditions usually increase with age with its concomitant
229 need for drug treatment. In addition, no significant differences between male and female elderly
230 subjects and the risk of polypharmacy were found in this study. The studies are inconsistent
231 regarding the influence of the patient's sex on the risk of polypharmacy. While some studies
232 reported no significant differences between males and females in regard to polypharmacy, some
233 studies reported a higher rate of polypharmacy among elderly females.^{24, 30}

234

235 Considering the negative consequences of polypharmacy and the increasing number of elderly
236 people in Bahrain, this study emphasizes the importance of practicing deprescription and
237 avoidance of unnecessary medications in this age group especially among patients with non-
238 communicable diseases. Since primary healthcare is the first encounter for elderly patients in
239 Bahrain and is the optimal setting for prevention, quaternary prevention should be continuously
240 considered by family physicians while prescribing medications to elderly patients especially with
241 the implementation of the "choose your doctor" program, a new program that allows each patient
242 to choose a family physician who would provide therapeutic and preventive services to him/her.
243 It will link each patient with one family physician instead of different family physicians, which
244 could minimize the prescription of unnecessary medications among elderly patients in particular.³²

245 Family physicians should periodically review the indication and importance of each medication

246 and discontinue unneeded medications while treating elderly patients. In addition, polypill use can
247 minimize the risk of polypharmacy and simplify management regimens; therefore, polypill should
248 be considered by family physicians while treating elderly patients with chronic conditions.³³

249
250 This study has several strengths. Firstly, all primary care centers were included in the study.
251 Secondly, a simple random sample was obtained from the data pool which minimized the risk of
252 selection bias. However, this study has some limitations. Only patients attending primary
253 healthcare centers were included in the study. This may have overestimated the prevalence of
254 polypharmacy among elderly patients. In addition, medications prescribed by the private sector
255 and military hospitals were not assessed. Hence, the prevalence of polypharmacy may have been
256 underestimated.

257

258 **Conclusion**

259 In conclusion, this study revealed a high prevalence of polypharmacy among old people attending
260 primary healthcare services. Polypharmacy was significantly more common among patients with
261 non-communicable diseases like diabetes mellitus, essential hypertension, hyperlipidemia,
262 cardiovascular diseases and bronchial asthma. The high rate of polypharmacy must raise concerns
263 about its impact on patients' outcomes, morbidity and mortality. Considering the high prevalence
264 of polypharmacy, the rising number of elderly populations, the associated polymorbidity and
265 frailty and the consequences of polypharmacy, rational use of medicines guidelines and targeted
266 educational programs for general practitioners and family physicians should be developed.
267 Studies to assess the influence of polypharmacy on medication-taking behaviours among elderly
268 patients and its control of their medical conditions are needed.

269

270 **Authors' Contribution**

271 MA, and FH conceptualized and designed the study. EA, ED and MAB reviewed the literature
272 and prepared the first draft of the study. MA analyzed and interpreted the data. All authors
273 drafted the manuscript, read and approved the final version of the manuscript.

274

275 **Conflict of Interest**

276 The authors declare no conflicts of interest.

277

278 **Funding**

279 No funding was received for this study.

280

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Table (1): Baseline characteristics of the participants

Baseline characteristics of the participants		n (%)
Sex	Male	444 (45.45)
	Female	533 (54.55)
Age, mean \pm SD		67.90 \pm 6.87
Nationality	Bahraini	922 (94.37)
	Non-Bahraini	55 (5.63)
Marital Status	Single	43 (4.40)
	Married	728 (74.51)
	Divorced	54 (5.53)
	Widowed	152 (15.56)
Comorbidities	Essential hypertension	601 (61.51)
	Hyperlipidemia	563 (57.63)
	Diabetes Mellitus	520 (53.22)
	Hypothyroidism	121 (12.38)
	Bronchial asthma	80 (8.19)
	Cardiovascular diseases	79 (8.09)
	Psychiatric disorders	34 (3.48)
	Chronic kidney diseases	9 (0.92)
Stroke	3 (0.31)	

Table (2): Most prescribed medications to elderly patients

Medications	n (%)
Metformin (Glucophage)	422 (43.19)
Atorvastatin (Lipitor)	296 (30.30)
Perindopril (Coversyl)	248 (25.38)
Amlodipine (Norvase)	227 (23.23)
Valsartan (Diovan)	215 (22.01)
Aspirin	215 (22.01)
Gliclazide (Diamicon)	181 (18.53)
Simvastatin (Zucor)	151 (15.46)
Pantoprazole (Proton)	146 (14.94)
Bisoprolol (Concor)	145 (14.84)
Rabeprazole (Pariet)	126 (12.90)
Hydrochlorothiazide	123 (12.59)
Thyroxine	119 (12.18)
Insulin Glargine (Lantus)	108 (11.05)
Rosuvastatin (Crestor)	105 (10.75)

Table (3): Number of medications used by the participants

Number of medications	Number of patients (%)
<5	534 (54.66)
5 to 9	377 (38.59)
10 or more	66 (6.76)
The average number of medications	4.36

Table (4): Associations between baseline characteristics of the participants and polypharmacy status

		Polypharmacy, TN=443 n (%)	No polypharmacy, TN=534 n (%)	P value
Sex	Male	195 (44.02)	249 (46.63)	0.414
	Female	248 (55.98)	285 (53.37)	
Age, mean \pm SD		68.67 \pm 6.99	67.26 \pm 6.71	0.001
Nationality	Bahraini	421 (95.03)	501 (93.82)	0.413
	Non-Bahraini	22 (4.97)	33 (6.18)	
Marital Status	Single	21 (4.74)	22 (4.12)	0.024
	Married	310 (69.98)	418 (78.28)	
	Divorced	28 (6.32)	26 (4.87)	
	Widowed	84 (18.96)	68 (12.73)	
Diabetes Mellitus	Yes	358 (80.81)	162 (30.34)	<0.001
	No	85 (19.19)	372 (69.66)	
Essential hypertension	Yes	385 (86.91)	216 (40.45)	<0.001
	No	58 (13.09)	318 (59.55)	
Hyperlipidemia	Yes	373 (84.20)	190 (35.58)	<0.001
	No	70 (15.80)	344 (64.42)	
Cardiovascular diseases	Yes	64 (14.45)	15 (2.81)	<0.001
	No	379 (85.55)	519 (97.19)	
Stroke	Yes	2 (0.45)	1 (0.19)	0.457
	No	441 (99.55)	533 (99.81)	
Bronchial asthma	Yes	53 (11.96)	27 (5.06)	<0.001
	No	390 (88.04)	507 (94.94)	
Chronic kidney diseases	Yes	6 (1.35)	3 (0.56)	0.197
	No	437 (98.65)	531 (99.44)	
Psychiatric disorders	Yes	20 (4.51)	14 (2.62)	0.108
	No	423 (95.49)	520 (97.38)	
Hypothyroidism	Yes	68 (15.35)	53 (9.93)	0.01
	No	375 (84.65)	481 (90.07)	

Table (5): Logistic regression analysis of polypharmacy determinants

	Odds ratio	95% Confidence interval	P value
Age	1.007	0.982-1.033	0.588
Marital Status (Compared to single)			
Marital Status (Married)	0.744	0.287-1.931	0.543
Marital Status (Divorced)	0.691	0.425-1.123	0.136
Marital Status (Widowed)	0.881	0.369-2.101	0.775
Diabetes Mellitus	5.836	4.061-8.385	<0.001
Essential hypertension	6.231	4.235-9.168	<0.001
Hyperlipidemia	3.999	2.756-5.802	<0.001
Cardiovascular diseases	3.589	1.787-7.205	<0.001
Bronchial asthma	3.148	1.646-6.019	<0.001
Hypothyroidism	1.643	0.985-2.739	0.057