Research Paper

Is Education Level Associated With Polypharmacy in the Elderly Considering Socio-economic Factors? A Cross-Sectional Survey

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ABSTRACT

Background and Purpose: The elderly population is more prone to chronic diseases, leading to polypharmacy, influenced by various factors. This study examined the relationship between education, socio-economics, and polypharmacy.

Materials and Methods: As part of the initial phase of a cohort on the health status of the elderly in Amirkola City (northern Iran) initiated in 2011, this descriptive-analytical study, conducted in 2023, involved individuals aged 60 and above. A total of 400 elderly participants were selected through stratified random sampling. Data were collected from the cohort database via demographic, medication, and medical history questionnaires. Data were analyzed using SPSS software, version 23, employing descriptive statistics, ANOVA, and chi-square tests at a significance level of 0.05.

Results: In this study, 400 elderly individuals with an average age of 68.18±7.11 years participated. The average number of medications used was 3.80±0.04. No significant association was found between education and polypharmacy (P=0.127). However, increased education was associated with a decrease in polypharmacy. The highest medication usage (4.46±3.27) was observed among the illiterate elderly. No significant association was identified between education and polypharmacy when considering gender, occupation, income satisfaction, and marital status (P>0.05); however, the majority of individuals experiencing polypharmacy were men, housewives, or retirees, those with low-income satisfaction, and married individuals.

Conclusion: The level of education had no significant relationship with polypharmacy when considering socio-economic factors, despite the fact that more literate elderly individuals had less polypharmacy. Conducting studies to further evaluate the cause of the lack of association between education level and polypharmacy could help in evidence-based decision-making.

Keywords: Older adults, Polypharmacy, Medication use, Education, Socioeconomic factors

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Introduction

Elderly healthcare is now a global concern due to advances in medical science and the aging population [1]. The percentage of people aged 60 years and older is increasing [2]. With roughly 9.5% of the population over 60 and 1.6% over 65, Iran's elderly population is also growing. By 2036, these numbers are expected to increase to 11% [3].

The pharmacokinetic and pharmacodynamic processes of medications can change with age. Changes in absorption, metabolism, release, protein binding, and hepatic and renal clearance are all included in pharmacokinetic changes. Elderly individuals are more likely to experience unfavorable drug side effects due to pharmacodynamic alterations, which involve changes in the drug's action on the target tissue [4, 5]. Furthermore, as life expectancy increases, so does the prevalence of chronic diseases [4, 5]. A significant concern in the medication therapy of elderly patients is the concurrent use of multiple drugs. Over 20% of individuals aged 70 and above are prescribed more than five medications due to multiple health conditions prevalent in this age group [6]. Polypharmacy is defined as the simultaneous use of five or more medications, regardless of the form or duration of use [7-9]. Essentially, polypharmacy refers to a situation where an individual consumes a large number of medications, which may include both necessary and unnecessary drugs [10]. The most frequent adverse outcomes of using multiple drugs include drug interactions, medication errors, adverse drug events and reactions, side effects, re-hospitalization, and increased healthcare costs [1, 10, 11]. While the concurrent use of multiple drugs can be beneficial for managing certain chronic illnesses, inappropriate polydrug use can lead to drug interactions and adverse reactions [1, 12]. The appropriate medication for the elderly should be prescribed based on the patient's disease history, drug tolerance, physical and mental health, mobility, memory, and family support [13]. Ignoring the various metabolic changes in drug absorption, distribution, and excretion in elderly bodies compared to middle-aged individuals is a key factor in the occurrence of undesirable side effects [14].

Polypharmacy is influenced by a number of factors, such as socioeconomic variables and education level [2, 5]. Education level, age, gender, occupation, marital status, and financial status are all linked to polypharmacy [10, 15]. Some studies suggest that future research on polypharmacy should consider education level and gender differences to identify populations at risk [16].

Furthermore, studies have demonstrated the impact of education level and socio-economic factors on polypharmacy [16-20]. The prevalence of polypharmacy tends to rise with age. This increase may be attributed to the improper prescribing of medications, lack of appropriate treatment, medication errors, fewer restrictions on drug usage, and a rise in the availability of over-the-counter medications [5, 21]. Studies have found that, compared to men, women consume significantly more medications during hospitalization and upon discharge [15]. the individuals most at risk for polypharmacy are women, people between the ages of 65 and 74, those with less education, seniors who are single, and individuals who have more than four diseases simultaneously. On the other hand, concurrent drug use is generally less common among people with average financial status [10, 21]. Additional factors identified as influencing polypharmacy include age, gender, education level, frequency of doctor visits, and the types and number of diseases [22]. Numerous studies have identified one of the most prevalent causes of polypharmacy as patients' lack of literacy and knowledge [23, 24]. Furthermore, it has been noted that women are more likely than men to experience polypharmacy [25, 26]. Dadashihaji et al. revealed that the rate of inappropriate medication use among the elderly in Amirkola city is notably high compared to other studies, putting the elderly at risk for adverse drug reactions [27].

The relationship between socioeconomic factors and education level, a significant variable affecting polypharmacy, has not yet been investigated in Amirkola City, despite prior research on factors influencing polypharmacy. Examining the factors that contribute to polypharmacy, especially education level and socioeconomic variables, is obviously necessary given its high prevalence, significant impact, and detrimental effects on the health of the elderly. The significance of this study, which aims to explore the relationship between education level, socioeconomic factors, and polypharmacy among the elderly population in Amirkola City, is underscored by the lack of relevant research in this field. The study seeks to reduce drug costs and hospitalizations among the elderly due to medication-related issues by improving knowledge in this area.

Materials and Methods

This descriptive-analytical cross-sectional study, conducted in 2023, is part of the cohort study "Amirkola Health and Aging Project" (AHAP No. 892917), initiated in 2011 with 1,616 elderly participants aged 60 and above in Amirkola City, located in northern Iran.

The participants in this study were elderly individuals aged over 60 years. The inclusion criteria were being 60 years or older and residing in Amirkola City. Insufficient information was the basis for exclusion. Based on a 95% confidence level, an 80% power, and the prevalence of polypharmacy (P_1=0.25%, P_2=10%) [28], the sample size was calculated to be 97 individuals for each group. Ultimately, 400 participants (100 in each of the four educational groups: Illiterate, primary, secondary, and diploma or higher) were selected through stratified random sampling (Equation 1).

$$1.\ n=\frac{(z_{1-\alpha/2}-z_{1-\beta})^{2*}[p_1\,(1-p_1\,)+p_2(1-p_2\,)]}{(p_1-p_2)^2}$$

The research was conducted within the framework of the Amirkola Elderly Health Status Cohort Study. Data were collected from the first phase of the Amirkola elderly cohort study database using demographic questionnaires, medication questionnaires, and medical history forms.

The demographic questionnaire covered age, gender, education level, occupation, income satisfaction, and marital status. The valid and reliable medication questionnaire and medical history questionnaire developed by Dadashihaji et al. [27] were used to collect data.

The medication questionnaire comprised 12 queries about the history of medication use, including the number, type, and duration. Medication information was collected through self-reports, observation of the medications taken by the participant, and prescriptions from doctors [27]. In this study, polypharmacy refers to the simultaneous use of more than 5 medications in an elderly, which was obtained by asking the elderly or by observing the doctor's prescriptions and medications used by the elderly in a cohort study [7-9].

The medical history questionnaire assessed the number of concurrent diseases in an elderly. It collected the medical history of each participant, inquiring about the presence of various conditions, such as diabetes, hyperthyroidism or hypothyroidism, osteoporosis, stroke, Parkinson's disease, kidney stones, dementia, depression, epilepsy, high blood pressure, angina pectoris, heart failure, chronic obstructive pulmonary disease, liver disease, kidney disease, gastric and duodenal ulcer, urinary incontinence, fecal incontinence, fractures, and cancer [27].

Data were processed using SPSS software, version 23, employing descriptive statistics (Mean±SD, frequency, and percentage) and analytical statistics (ANOVA and chi-square test) with a significance level set at less than 0.05. Data normality was evaluated using the Kolmogorov-Smirnov test (P>0.05). There were zero cells (0%) with an expected count of <5, allowing for the chi-square test to be performed.

Results

Descriptive results

In this study, 400 elderly individuals with an average age of 68.18±7.11 years participated. The average number of medications consumed was 3.80±0.04. The largest age group among the participants was those aged 60-64 years (37.8%). Male participants accounted for 50.3% (201 individuals). Each educational level was represented by 100 individuals (25%). The majority of participants were married (342 individuals, 85.5%) and identified as housewives (168 individuals, 42%). Additionally, a significant portion of them reported little satisfaction with their income (164 individuals, 41%). The findings indicated that 63.3% (253 individuals) of the participants experienced polypharmacy (Table 1).

Analytical results

Chi-square test results showed no significant association between the level of education and the prevalence of polypharmacy among the elderly participants (chi-square value=5.711, P=0.127). One-way ANOVA revealed no significant association between the number of medications consumed and the participant's level of education or gender (P=0.085). However, an increase in education level generally led to a decrease in the number of medications consumed across both genders. The highest average number of medications used (4.46±3.27) was observed among "illiterate" participants (Table 2).

Based on the chi-square test results, there was no significant association between education level and the occurrence of polypharmacy in the elderly when considering gender (chi-square value=5.711, P=0.127), despite a majority of those experiencing polypharmacy being men. Among male elderly individuals, the highest proportion of those affected by polypharmacy (29.2% or 42 individuals) had secondary and high school education levels, whereas among female elderly individuals, the majority affected by polypharmacy (29.4% or 32 individuals) possessed a "diploma and above" level of education. The relationship between polypharmacy and education level, considering the occupation of participants, was not statistically significant (P=0.127),

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Table 1. Demographic and pharmaceutical characteristics of the elderly (n=400)

Variables	Category	No. (%)
Age (y)	60-64	151(37.8)
	65-69	116(29)
	70-74	62(15.5)
	75-79	39(9.7)
	80-84	19(4.7)
	85-99	13(3.3)
Gender	Female	199(49.7)
	Male	201(50.3)
Education	Illiterate	100(25)
	Primary	100(25)
	Secondary	100(25)
	Diploma and above	100(25)
Marital status	Married	342(85.5)
	Single	58(14.5)
Occupation	Housewife	168(42)
	Farmer	22(5.5)
	Non-governmental	42(10.5)
	Employee	3(0.8)
	Retired	137(34.3)
	Unemployed	24(6)
	Day labor	4(1)
Satisfaction with income	Very high	3(0.8)
	High	12(3)
	Moderate	146(36.5)
	Low	164(41)
	Very low	75(18.8)
Polypharmacy*	Yes	253(63.3)
	No	147(36.7)

*Simultaneous use of >5 medications.

Table 2. The relationship between education level and polypharmacy and the number of drugs used by the elderly (n=400)

Variable	Category	No. (%)				P*
		Polypharmacy		No Polypharmacy		
Education	Illiterate	55	21.7	45	30.6	
	Primary	62	24.5	38	25.9	
	Secondary	71	28.1	29	19.7	0.127
	Diploma and above	65	25.7	35	23.8	
	Total	253	100	147	100	

Variables	Category	No. of Participants	Mean±SD	F	P**
			No. of Drugs		
Education	Illiterate	100	4.46±3.27		
	Primary	100	3.63±3.18		
	Secondary	100	3.69±2.69	2.226	0.085
	Diploma and above	100	3.43±2.93		
	Total	400	3.80±3.04		
Males' education	Illiterate	50	3.66±3.22		
	Primary	50	3.18±3.31		
	Secondary	51	2.98±2.25	0.623	0.601
	Diploma and above	50	2.98±2.59		
	Total	201	3.19±2.87		
Females' education	Illiterate	50	5.2±3.14		
	Primary	50	4.08±3.01		
	Secondary	49	4.42±2.93	1.956	0.122
	Diploma and above	50	3.88±3.20		
	Total	199	4.41±3.10		

*Chi-square, **ANOVA

though the largest number of elderly polypharmacy patients were "housewives and retirees." Similarly, no significant correlation was found between polypharmacy and education level in terms of satisfaction with income (P=0.127). Nonetheless, those most dissatisfied with their income were predominantly affected by polypharmacy, particularly among the illiterate elderly. The relationship between polypharmacy and education level, based on the marital status of participants, also showed no significant difference (P=0.127) (Table 3).

Discussion

This study explored the relationship between education and polypharmacy concerning socio-economic variables among the elderly in North Iran. The elderly were taking approximately 4 medications simultaneously. There was no significant correlation between education level and polypharmacy, including the quantity of medication used (P>0.05); however, an increase in education level corresponded with a decrease in the number of medications used. The highest medication

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Table 3. The association between education level and polypharmacy based on socio-economic variables among the elderly (n=400)

Variables	Category	No. (%)		Chi-square	P
		Polypharmacy	No Polypharmacy		
Males' education	Illiterate	33(22.9)	17(29.8)		
	Primary	36(25)	14(24.6)		
	Secondary	42(29.2)	9(15.8)	4.450	0.217
	Diploma and above	33(22.9)	17(29.8)		
	Total	144(100)	57(100)		
Females' education	Illiterate	22(20.2)	28(31.1)		
	Primary	26(26.7)	24(23.9)		
	Secondary	29(26.6)	20(22.2)	4.601	0.203
	Diploma and above	32(29.4)	18(20)		
	Total	109(100)	90(100)		
Housewife	Illiterate	21(23.1)	28(36.4)		
	Primary	27(29.7)	22(28.6)		
	Secondary	27(29.7)	19(24.7)	4.432	0.218
	Diploma and above	16(17.6)	8(10.4)		
	Total	91(100)	77(100)		
Farmer	Illiterate	9(50)	3(75)		
	Primary	7(38.9)	1(25)		
	Secondary	2(11.1)	0	.993	0.609
	Diploma and above	0	0		
	Total	18(100)	4(100)		
Non-governmental	Illiterate	7(22.6)	3(27.3)		
	Primary	12(38.7)	6(54.5)		
	Secondary	10(32.3)	0	5.272	0.153
	Diploma and above	2(18.2)	2(6.5)		
	Total	31(100)	11(100)		
Retired	Illiterate	9(9.9)	6(12.2)		
	Primary	13(16.3)	8(14.3)		
	Secondary	25(27.5)	10(20.4)	.935	0.817
	Diploma and above	44(48.4)	25(51)		
	Total	91(100)	49(100)		

Variables	Category	No. (%)		Chi-square	P
		Polypharmacy	No Polypharmacy		
Unemployed	Illiterate	9(40.9)	5(83.3)		
	Primary	3(13.6)	1(16.7)		
	Secondary	7(31.8)	0	4.455	0.216
	Diploma and above	3(13.6)	0		
	Total	22(100)	6(100)		
Income satisfaction (very high)	Illiterate	1(50)	0		
	Primary	0	0		
	Secondary	1(50)	0	3.000	0.223
	Diploma and above	0	1(100)		
	Total	2(100)	1(100)		
Income satisfaction (high)	Illiterate	0	2(33.3)		
	Primary	1(16.7)	2(33.3)		
	Secondary	5(83.3)	2(33.3)	3.619	0.164
	Diploma and above	0	0		
	Total	6(100)	6(100)		
Income satisfaction (moderate)	Illiterate	16(15.2)	8(19.5)		
	Primary	22(21)	11(26.8)		
	Secondary	30(28.6)	10(24.4)	1.280	0.734
	Diploma and above	37(35.2)	12(29.3)		
	Total	105(100)	41(100)		
Income satisfaction (low)	Illiterate	31(29.2)	14(24.1)		
	Primary	25(23.6)	19(32.8)		
	Secondary	30(28.3)	9(15.5)	5.407	0.144
	Diploma and above	20(18.9)	16(27.6)		
	Total	106(100)	58(100)		
Income satisfaction (very low)	Illiterate	8(23.5)	21(51.2)		
	Primary	14(41.2)	8(19.5)		
	Secondary	9(26.5)	8(19.5)	7.074	0.07
	Diploma and above	3(8.8)	4(9.8)		
	Total	34(100)	41(100)		

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Variables	Category	No. (%)		Chi-square	P
		Polypharmacy	No Polypharmacy		
Single	Illiterate	8(25)	15(57.7)		
	Primary	11(34.4)	4(15.4)		
	Secondary	7(21.9)	2(7.7)	7.728	0.052
	Diploma and above	6(18.8)	5(19.2)		
	Total	32(100)	26(100)		
Married	Illiterate	47(21.3)	30(24.8)		
	Primary	51(23.1)	34(28.1)		
	Secondary	64(29)	27(22.3)	2.632	0.452
	Diploma and above	59(26.7)	30(24.8)		
	Total	221(100)	121(100)		

usage was observed among "illiterate" elderly individuals. This finding was likely due to lower health literacy, lack of access to health services, or higher comorbidity in less educated elderly people [27]. There was no significant association between education level and polypharmacy across variables such as gender, occupation, income satisfaction, and marital status; nonetheless, the most affected by polypharmacy were "men," "housewives and retired individuals," those "dissatisfied with their income," and "married" individuals, respectively. Azadi et al. reported no significant differences between socio-economic status and the prevalence of polypharmacy, countering their initial hypothesis that the lowest and highest socio-economic levels would result in lesser and greater healthcare utilization and better health status, respectively [29]. Furthermore, Assari et al. investigation on American elderly populations highlighted that employment status was not linked to polypharmacy; however, lower education and income levels were associated with an increased likelihood of using multiple medications. Their analysis also indicated that low income might be a more potent predictor of polypharmacy in older African Americans compared to their white counterparts [18]. Conversely, Dadashihaji et al. found a correlation between inappropriate medication use and the economic status of the elderly, with the unemployed representing the highest percentage of individuals using inappropriate or caution-requiring drugs [27]. Employment during one's healthy years promotes social connections, financial independence, and self-confidence, especially among elderly men, which can directly influence their physical and mental well-

being [30]. Nonetheless, these studies were limited by the incomplete adjustment for significant confounding variables, such as place of residence, cultural factors, and the inherent limitations of cross-sectional research designs [31].

This study revealed no significant association between the level of education and the incidence of polypharmacy about income satisfaction. Notably, the majority of elderly individuals experiencing polypharmacy reported low income satisfaction, with a substantial proportion of these individuals being illiterate. Dianati et al. found no significant connection between economic status and polypharmacy [32]. Similarly, Taherifard et al. indicated that socio-economic status does not influence polypharmacy, aligning with the findings of this study [33]. However, Eltaher and Araby in Egypt identified education level and monthly income as predictors of polypharmacy [34]. Lower-income households often struggle to afford additional healthcare costs, resorting to reliance on commonly available drugs for chronic disease management. Contrarily, individuals from middle- and high-income brackets are more likely to seek healthcare services and have better access to healthcare facilities [35]. For instance, Badawy et al. research on the elderly in Kuwait highlighted factors, such as lower education level, frequent hospital admissions, numerous clinic visits, and multiple concurrent diseases as risk factors for polypharmacy [17]. Moreover, higher socio-economic status may increase the usage of supplements, like multivitamins, contributing to polypharmacy [29].

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Income is intimately linked to fulfilling health needs and, consequently, to individuals' health. However, the healthiest individuals are not always those with the highest incomes. This suggests that some people, despite having a good income, may lack knowledge about healthy eating and adherence to health practices. Thus, the portion of income allocated to education and health directly correlates with improved health, whereas income spent on other areas does not necessarily enhance health. This underscores the importance of literacy, education, and cultural factors. Nonetheless, the direct association between income and meeting critical health needs, thereby ensuring health, cannot be overlooked [36].

The findings of this study indicated no significant association between the level of education and polypharmacy based on the marital status of elderly participants. Polypharmacy was most prevalent among married elderly, a trend that aligns with the observation that the majority were married.

In the studies conducted by Charlesworth et al. [37] and Dianati et al. [32], no significant relationship was found between polypharmacy and marital status, aligning with our findings. Conversely, Jørring Pallesen et al. observed that married elderly individuals were less susceptible to polypharmacy compared to their divorced and widowed counterparts, suggesting that marriage enhances social connections, self-care, and access to healthcare services [38]. Similarly, in a study by Eltaher and Araby in Egypt, a significant association was noted between polypharmacy and marital status, with widows who suffered from multiple chronic diseases concurrently being the most affected [34]. It has been suggested that for elderly individuals who are currently single and living with family, a family member should oversee their medication management and control at home [39].

Conclusions

This study revealed that the level of education, in the context of socio-economic variables, did not significantly impact polypharmacy among Amirkola's elderly population. However, an increase in educational level was associated with a decrease in the number of medications consumed, with the highest consumption observed among the "illiterate" elderly. No significant relationship was found between education level and polypharmacy when considering factors, such as sex, occupation, income satisfaction, and marital status, although the majority of individuals with polyphar-

macy were "men," "housewives" and "retirees," with "low-income satisfaction," and "married," respectively. Conducting studies to further evaluate the cause of the lack of association between education level and polypharmacy could aid in evidence-based decision-making. It is also suggested that future studies on this target group increase the sample size and analyze influential contextual variables, conducting post hoc and subgroup analyses on the relationship between polypharmacy and education level in terms of socioeconomic variables. It is recommended that longitudinal and interventional studies on polypharmacy, education level of individuals, and related variables be conducted in the future.

Limitation

This study examined the relationship between education, socio-economic variables, and polypharmacy among Amirkola's elderly population. The limitations of this study include its cross-sectional nature, which precludes determination of causality and reliance on self-reported data. In this study, no significant association was observed between polypharmacy and education level in terms of socioeconomic variables, which could be due to insufficient sample size and consequently, reduced study power. Also, the failure to conduct follow-up and subgroup analyses, as well as the failure to assess other influential contextual variables, such as health literacy level, access to health services, comorbidities, and social, economic, and political factors could have affected the results.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the ethics committee of the Babol University of Medical Sciences, Babol, Iran (Code: IR.MUBABOL.HRI.REC.1401.224). Informed consent was obtained from all older adults before the study. For illiterate participants, informed consent was obtained from a legal guardian or a legally authorized representative. The research was conducted in accordance with the Declaration of Helsinki. Confidentiality was maintained regarding the information derived from the Amirkola Health and Aging Project (AHAP no. 892917) database, ensuring that the published results and data did not disclose participants' identities.

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