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The Validation of Pharmaceutical Pictograms Among Turkish Individuals Aged 50 and Over

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Abstract

Objective: Aging is associated with physiological changes that impact medication use and adherence, particularly among older adults. This study evaluates the validity and comprehensibility of pharmaceutical pictograms developed by the International Pharmaceutical Federation for individuals aged 50-79 in Türkiye.

Materials and Methods: A cross-sectional survey was conducted with 150 participants visiting a community pharmacy in Ankara. Data were collected through a structured questionnaire assessing socio-demographic characteristics, health literacy, and understanding of 15 selected pictograms.

Results: Indicated that 46.6% of the pictograms were valid, with an average prediction performance of 61.01%. Factors such as health literacy and familiarity with medication instructions significantly influenced participants' understanding.

Conclusion: The findings suggest a need for culturally appropriate pictograms and enhanced health literacy initiatives to improve medication adherence among older adults in Türkiye.

Keywords: Pharmacautical pictograms, older adults, validation, health literacy

Introduction

Aging is an inevitable and natural process that primarily results in differences in an individual's anatomical structure and physiological functions, as well as in mental capabilities, social relationships, and psychology. With the increasing life expectancy and declining fertility rates across countries worldwide, the proportion of individuals aged 65 and older is rising more rapidly compared to other age groups (1). The United Nations defines countries where the population of older adults exceeds 10% of the total population as "Aged" nations, and it is projected that by 2030, the share of older adults in Türkiye will reach 12.9% (2). The prevalence of chronic diseases also increases with aging (3). One of the natural consequences of this phenomenon is the dramatic increase in medication usage among older adults compared to other age groups (4). In addition to having multiple chronic conditions, older adults constitute a unique group in medication use due to physiological changes, alterations in the absorption, distribution, metabolism, and excretion of drugs, as well as difficulties in adhering to dosage and administration guidelines (5).

The success of pharmacological treatment depends directly on the adherence of older adults to the prescribed regimen. Adherence to medical treatment is defined as the extent to which a patient's or caregivers' behaviours regarding medication use align with medical recommendations. The increasing incidence of medication non-adherence among older adults leads to various adverse outcomes, including the deterioration of medical conditions, decreased quality of life, increased morbidity and mortality, higher rates of hospital readmission, prolonged hospital stays, and escalating healthcare costs (6). Therefore, it is crucial to optimally present the medications

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to improve patient adherence and achieve the best possible treatment outcomes.

Older adults should always be informed by their doctors and pharmacists about the correct procedures for medication use. However, studies have shown that only 20-60% of verbal medication instructions provided by healthcare professionals are typically remembered (7-9). Therefore, written instructions that patients can easily access and refer to are a critical tool for providing more lasting medication information (10). This is particularly important for older individuals who are more likely to encounter difficulties in recalling instructions. Insufficient understanding or misinterpretation of medication instructions can lead to non-adherence to treatment, less effective therapies, poorer health outcomes, and medication errors (4,11). Older adults, especially those with lower education levels, may lack the necessary reading or language skills to comprehend much or all the written medication information. Furthermore, their ability to read and understand medication information may also be affected by declining visual capabilities. Due to poor visual acuity (e.g., contrast sensitivity) and low literacy, some older adults may need to ask family members or friends to read medication information for them (9).

One way to facilitate patients' understanding of prescribed pharmacotherapy is to support labels and instructions with visual tools such as pharmaceutical pictograms (12,13). Pictograms graphically represent actions (e.g., instilling drops in the eye) in a manner that can be understood regardless of the patient's literacy skills (14). A pictogram is defined as a figurative or metaphorical two-dimensional drawing intended to attract attention and convey information about an object or express an idea (15). Research has demonstrated that pictograms enhance patients' understanding of the proper use of medications, thereby improving adherence (4,13,16-20).

The use of pictograms has garnered increasing attention in recent years, likely due to heightened awareness among healthcare professionals regarding the necessity of providing adequate information to patients, such as older adults, children, and individuals with low literacy levels, who struggle to understand their treatments (21-24). There are two widely used, validated, and comprehensive sets of pharmaceutical pictograms: the United States Pharmacopeia (USP) pictograms and the set of pictograms developed by the International Pharmaceutical Federation (FIP). The FIP pictogram set was developed as downloadable software available on the FIP website. Pictogram projects were initiated in 2004 with the aim of creating a common language between professionals (pharmacists) and patients, resulting in approximately 100 pictograms that were categorized according to various purposes. Furthermore, these pictograms have been tested and validated across different cultures, age groups, and educational levels (15,24,25) and were last updated in February 2017 to address comprehension issues (26). While FIP's pharmaceutical pictograms are available for use, there has been no study in the literature designed to assess the comprehensibility of these pictograms among older individuals in Türkiye. This study aims to test the validity of the pictograms developed by FIP among individuals aged 50 and over who are likely to benefit the most from their use.

Materials and Methods

This study is designed as a quantitative descriptive cross-sectional field research, based on the methods of similar pictogram validity studies (4,15,16,25) and the recommendations of Dowse (27), who has conducted research on pharmaceutical pictograms for over 20 years. This study was carried out in accordance with the principles of the Declaration of Helsinki. It has been approved by the Medical and Health Sciences Research Board and the Ethics Committee of Başkent University (approval number: 23/15, date: 18.01.2023) and supported by the Başkent University Research Fund. Informed consent was obtained from all participants.

Participants

The population of the study consists of individuals aged 50-79 who visited a community pharmacy in the Mamak district of Ankara in April 2023. The sample size was computed as 110 by accepting α=0.05, $Z_{\alpha/2}$=1.96, p=0.67 [based on the International Organization for Standardization (ISO) criterion, proportion of citizens who understand the meaning of symbolic images correctly], and margin of error =0.1. The target sample was reached through a convenience sampling method among individuals visiting the community pharmacy in Mamak, Ankara, to obtain prescription or over-the-counter medications. Inclusion criteria for the study were: being between the ages of 50 and 79, being a Turkish citizen, having purchased prescription or over-the-counter medication in the last month, scoring 24 or higher on the Standardized Mini-Mental Test, not being deaf (self-reported), not having more than 3 diopters of myopia, not having more than 2 diopters of hyperopia, and being willing to participate in the study.

Data Collection

Data for the study were collected using a questionnaire consisting of three sections. Before administering the questionnaire, the Standardized Mini-Mental Test, which has been validated and tested for reliability in Turkish by Güngen et al. (28), was conducted. Participants who scored 24 or above were eligible to complete the questionnaire.

The first section of the questionnaire includes questions regarding the socio-demographic information of the adults (such as age, gender, education level, income level, and occupation). Additionally, to assess the individuals' health literacy levels, the Turkish version of the Single-Item Health Literacy Screening

developed by Morris et al. (29) was employed using a 5-point Likert Scale (30). Questions regarding perceived health status were included through a single-item "perceived health status" measure on a 5-point Likert Scale, as well as questions on the presence of chronic diseases and medication use. Lastly, to evaluate medication adherence, the Morisky Medication Adherence Scale, developed by Morisky et al. (31) in 1986, was used. This scale consists of four yes/no questions and has been validated and tested for reliability in Turkish by Yilmaz and Buzlu (32).

The second section of the questionnaire includes 15 pharmaceutical pictograms selected from the 103 pictograms developed by FIP (Appendix 1). The decision to limit the study to 15 pictograms was based on the consideration that including all pictograms would lengthen the interview duration and increase participant fatigue. This choice aligns with Dowse's (27,33) recommendations for validity studies, which suggest using 15-30 pictograms, as well as the frequent use of 15 pictograms in other validity research. Based on a review of the literature on pictogram validity among older adults in other countries (4,25,34,35), the 15 most evaluated pictograms in other studies were chosen for their potential relevance among commonly used medications for older adults. To assess the predictability and comprehensibility of the pictograms, a survey was developed based on ISO 9186 standards. The purpose of ISO 9186 is to ensure that graphic symbols are understandable to all users. In this test, participants were asked to respond to the question, "What do you think this pictogram means?" for each pictogram.

In the third section of the questionnaire, the pictograms were presented along with their meanings, and participants were asked to evaluate the extent to which the pictograms met their intended meanings. Evaluations were conducted on a 7-point Likert scale, ranging from weak to strong relationships.

Pilot Study: A pilot application of the questionnaire forms was conducted to test the comprehensibility of the forms. As a general rule of thumb, that the sample size for a pilot study should be 10 percent of the anticipated sample for the main study (36), a different set of 10 individuals who met the inclusion criteria completed the questionnaire form. Based on the results of the pilot study, the questionnaire forms were revised.

Data Collection: Data for the study were collected through face-to-face interviews at a community pharmacy located in the Mamak district of Ankara. The administration of the questionnaire took approximately 25-30 minutes.

Statistics

The data were analysed using IBM SPSS 27 software, employing validity analysis, descriptive statistics, and hypothesis testing.

Validity of Pictograms: Validation studies for pictograms have utilized the parameters of transparency and translucency, either independently or in combination, to establish pictogram validity (4,25,34). Transparency refers to the understanding of a pictogram without any accompanying text, while translucency refers to the degree of perceived representativeness between a pictogram and its intended meaning (4,25,34). In this study, pictogram validity was similarly established based on transparency and translucency. The transparency parameter was evaluated with the prediction score, and the translucency was evaluated with the semantic proximity assessment.

Prediction Score: Open-ended comments from participants regarding their understanding of the pictograms were reviewed by researchers. Each comment was independently assessed for alignment with the intended meanings of the pictograms. Inter-rater reliability was assessed using Fleiss's kappa coefficient and was calculated as 0.876 (95% confidence interval: 0.721-0.987) for 15 pictograms. In the classification made by Fleiss, a kappa value of 0.75 and above was considered to be perfect agreement. Then, the researchers discussed the answers with different ratings. Consensus was sought for inconsistent ratings, and if a consensus could not be reached, the majority rating was accepted as valid. Correct responses were assigned a score of "1", partially correct responses received a score of "0.5", and incorrect responses received a score of "0". The prediction score was calculated as the percentage of correct (both fully and partially) responses obtained for each pictogram (e.g., the "I" pictogram was correctly understood by "x%" of participants). Each pictogram's prediction score was evaluated against the ISO standard comprehension criterion of 67%. Both counts and percentages were computed for prediction scores.

Semantic Proximity Assessment: A minimum acceptable level of ≥5 points were established for evaluating the semantic proximity of the pictograms. Pictograms for which at least 85% of participants rated 5 points or above were considered to align with the intended meanings. Pictograms that met both the 67% prediction score criterion and had a semantic proximity score above 5 were classified as "valid". Pictograms that met only the prediction score criterion were classified as "partially valid", while those that did not meet either condition were classified as "invalid".

Independent Variables: The independent variables of the study included socio-demographic characteristics, health literacy levels, characteristics related to health status, medication use characteristics, and medication adherence. For the independent variables, counts and percentages were calculated for categorical variables, and means and standard deviations were calculated for continuous quantitative variables.

Hypothesis Testing: The accuracy percentage of a participant's task in predicting the meaning of the pictograms was considered as the prediction performance (e.g., participant "y" successfully

understood an average of "z%" of the pictograms). The mean and standard deviation were computed for prediction performance, and the normality of the distribution was assessed using the Kolmogorov-Smirnov test. To identify factors associated with prediction performance, an Independent Samples t-test was conducted for two-group categorical variables, and One-Way Analysis of Variance was performed for categorical variables with more than two groups.

Results

The distribution of participants' socio-demographic characteristics is presented in Table 1. Of the participants, 55.4% are male and 44.6% are female. The average age of participants is calculated to be 57.74±8.23 years. Among the participants, 75% are married, while 25% are divorced, separated, widowed, or single. In terms of education, 53.6% of participants have a high school education or lower, while 46.4% have at least an associate's or bachelor's degree. Regarding occupational status, 26.8% are employed in professional occupations, while 29.5% work in unskilled jobs. Additionally, 43.8% of the participants are retirees, homemakers, or unemployed. Notably, 54.5% of participants have an income below the poverty line (Table 1).

The characteristics related to participants' health status and medication use are presented in Table 2. A total of 60.7% of participants rated their overall health status as good. Among the participants, 54.5% reported having a chronic illness, while 45.5% did not have any chronic conditions. Regarding medication reports, 45.5% of participants possess a medication report, while 54.5% do not. Additionally, 65.2% of participants are aware of the side effects of medications, whereas 34.8% lack such knowledge. When it comes to purchasing over-the-counter medications, 31.3% of participants do so, while 68.8% do not purchase over-the-counter medications. Furthermore, 52.7% of participants frequently or always read the usage instructions, 73.2% understand them, while 26.8% do not (Table 2).

The percentage of participants' understanding of the pictograms (prediction performance) averaged 61.01±16.94%. Upon examining the prediction performances of the participants, those who used over-the-counter medications, those who found medication instructions easily, and with high health literacy levels exhibited significantly higher prediction performances ($p<0.05$) (Table 2).

Table 3 presents the levels of comprehensibility (prediction scores) and semantic proximity assessments for the pictograms. The pictograms with the highest correct responses were P8 ("Do not drink alcohol") at 95.5% and P12 ("Do not crush") at 92.9%. Conversely, the pictograms with the lowest comprehensibility were P3 ("Inject under the skin") at 15.2%, P4 ("Two tablets") at 26.8%, and P6 ("Inhale") at 36.6%. According to Table 3, four pictograms (18.2%) did not meet the ISO' standard of 67%: P3

Table 1. Distribution of participants according to their socio-demographic characteristics and average prediction performances

	n	%	Mean ± SD	p
Gender				
Female	50	44.6	61.86±16.64	0.634
Male	62	55.4	60.32±17.28	
Occupation				
Blue collar	33	29.5	61.01±14.90	0.795
White collar	29	25.9	63.33±17.62	
Retired	30	26.8	60.67±15.16	
Not-working	20	17.9	58.85±19.91	
Having a partner				
Yes	28	75.0	57.5±15.46	0.207
No	84	25.0	62.18±17.33	
Age				
50-64	90	80.4	61.77±16.94	0.336
65-79	22	19.6	57.87±16.95	
Income				
Below poverty line	61	54.5	59.72±17.54	0.382
Above poverty line	51	45.5	62.54±16.22	
Education				
High school or lower	60	53.6	59.27±16.58	0.246
At least associate/bachelor's degree	52	46.4	63.01±17.29	

SD: Standard deviation

("Inject under the skin"), P4 ("Two tablets"), P6 ("Inhale"), and P13 ("Take with food"). In the semantic proximity assessment, the average scores for P4 ("Two tablets") and P13 ("Take with food") fell below 5. Of the 15 pictograms evaluated for meaning prediction and visual semantic relationships, 46.6% (n=7) were found to be valid, 26.6% (n=4) were partially valid, and 26.6% (n=4) were deemed invalid.

Discussion

The comprehensibility of medication instructions is crucial for improving adherence to medication therapies among older adults. This study utilized a cross-sectional field approach in Ankara to evaluate the validity of pictograms developed by the FIP among individuals aged 50 and older in Türkiye. The findings of the study indicate two significant conclusions.

First, it was determined that 46.6% of the pictograms were valid, 26.6% were not sufficiently understood, and 26.6% required revision. Studies conducted among older adults in Canada (25) and Poland (34) reported higher validity rates, while lower validity rates were observed in studies in Singapore (4) and the Philippines (35). The notably low validity of the pictograms developed by FIP among Turkish individuals aged 50 and over may stem from several factors. These include generally low educational levels among older adults in Türkiye (with only 7.9% being university graduates according to 2021 TSI statistics), specifically low

Table 2. Distribution of participants according to their health status and medication use and average prediction performances

	n	%	Mean ± SD	p
Chronic disease				
Yes	61	54.5	60.54±16.51	0.752
No	51	45.5	61.56±17.59	
General health status				
Good	68	60.7	62.50±18.85	0.250
Not-good	44	39.3	58.71±13.35	
Medication report				
Yes	51	45.5	60.39±17.21	0.725
No	61	54.5	61.53±16.83	
Knowledge of side effects				
Yes	73	65.2	62.28±16.98	0.279
No	39	34.8	58.63±16.81	
Person administering medication				
Self	109	98.2	61.24±16.97	0.288
Others	2	1.8	48.33±11.78	
Purchasing over-the-counter medication				
Yes	35	31.3	66.66±15.75	0.017*
No	77	68.8	58.44±16.93	
Reading medication instructions				
Rarely or never	59	52.7	59.77±15.41	0.417
Frequently or always	53	47.3	62.38±18.55	
Understanding instructions				
Yes	82	73.2	63.25±16.76	0.020*
No	30	26.8	54.88±16.15	
Health literacy				
Low	70	62.5	55.79±18.46	0.011*
High	42	37.5	64.14±15.25	
Medication adherence				
High	34	30.4	58.67±16.08	0.063
Medium	50	44.6	59.12±16.19	
Low	28	25.0	67.50±18.23	

*p<0.05, SD: Standard deviation

Table 3. Prediction score and semantic closeness assessment of pictograms

	Prediction score				Semantic closeness		
	False (%)	Partially correct (%)	Correct (%)	Total correct (%)	≥5 score (%)	Mean ± SD	Validation
P1	14.3	78.6	7.1	85.7	63.4	5.12±1.90	Partially valid
P2	13.4	78.6	8	86.6	65.2	5.16±1.86	Partially valid
P3	84.8	10.7	4.5	15.2	61.6	5.01±2.09	Not-valid
P4	73.2	0	26.8	26.8	59	4.96±2.13	Not-valid
P5	12.5	14.3	73.2	87.5	86.6	6.08±1.30	Valid
P6	63.4	13.4	23.2	36.6	80.4	5.71±1.88	Not-valid
P7	25	2.7	69.6	72.3	83.1	5.95±1.88	Partially valid
P8	4.5	50	45.5	95.5	88.3	6.31±1.31	Valid
P9	29.5	4.5	66.1	70.6	90.2	6.50±1.32	Valid
P10	12.5	0	87.5	87.5	89.3	6.40±1.65	Valid
P11	10.7	1.8	87.5	89.3	91.2	6.46±1.36	Valid
P12	7.1	0.9	92	92.9	92.8	6.54±1.38	Valid
P13	52.7	18.8	28.6	47.4	57.2	4.63±2.50	Not-valid
P14	29.5	0	70.5	70.5	79.5	5.71±2.12	Partially valid
P15	8	8	83.9	91.9	92	6.39±1.42	Valid

SD: Standard deviation

health literacy (37,38), the lack of a standardized pictogram set leading to low familiarity, and the potential cultural inappropriateness of these pictograms.

For example, the two tablets pictogram, which might initially seem straightforward, was often misunderstood by participants. While most correctly interpreted that the tablets were to be taken "orally" and "swallowed", they also failed to grasp the instruction to take "two" tablets. This highlights a common limitation in visual design where numerical information is not explicitly emphasized. Incorporating clearer visual elements, such as prominently displaying two distinct tablets or using numerical symbols alongside the pictogram, could significantly enhance interpretive accuracy. Similar issues have been identified in previous studies, which underscore the importance of precise and unambiguous design in improving user comprehension of numerical instructions (16,39).

Similarly, the pictogram for "Take with food" was frequently misinterpreted by participants as meaning "Eating fish", "Healthy eating", or "Taking medication before/after meals". These misinterpretations could be attributed to the cultural disconnection between the imagery used and local dietary habits. For instance, replacing the fish symbol with a more culturally relevant food item, such as bread or rice, commonly consumed in Türkiye, might improve comprehension. This aligns with findings in the literature that emphasize the importance of integrating local cultural contexts into pictogram design to enhance clarity and effectiveness (4,40).

When examining other pictograms categorized as "invalid", the low prediction score for the "Inject under the skin" pictogram may reflect the physical and cognitive challenges older adults face with injection procedures. Research suggests that older adults may require additional visual or textual clarification to understand complex medical instructions, especially for less familiar procedures (41). Meanwhile, the pictogram for "Inhale" might suffer from a lack of familiarity among those without respiratory issues regarding the use of inhalers. These findings emphasize the critical need to design pictograms that are tailored to the target audience's level of experience and knowledge. Enhancing these pictograms with supplementary text or more recognizable symbols could improve their effectiveness, as studies have recommended, advocating for iterative and user-centered design processes (35,42).

Second, the average prediction performance was found to be relatively low at 61%. However, it was revealed that prediction performance was influenced more by modifiable factors related to medication use-such as health literacy, over-the-counter medication use, and ease of understanding instructions-rather than by socio-demographic characteristics. Numerous studies in the literature indicate that as medication use increases, so does awareness and familiarity with pictograms (4,42,43). Consistent with the findings of this study, a strong relationship between health literacy and pharmaceutical pictogram prediction performance has also been highlighted in other studies on pictogram validity (40,43-46). The emergence of health literacy as a more significant indicator than socio-

demographic characteristics can be considered valuable from the perspective of medication and health policies. This suggests that effective interventions to enhance health literacy may have a substantial impact on understanding medication regimens and adhering to treatment. Improving health literacy could ultimately lead to better health outcomes for older adults, emphasizing the need for targeted educational programs and resources.

Study Limitations

This study has several limitations. First, the data were collected solely from older adults obtaining medications from a single pharmacy in Ankara, which limits the generalizability of the results. In a country like Türkiye, characterized by high cultural diversity, obtaining data from different regions and socioeconomic groups could contribute to a broader assessment of the validity of the pictograms. Second, while this study included pictograms developed by the FIP, that older adults are most likely to encounter, it is important to note that there are nearly 200 pictograms developed by both FIP and USP. Therefore, the need for validity assessments of additional pictograms should not be overlooked. Finally, this study focused exclusively on the validity of the pictograms; thus, exploring different research designs (such as comparing the effectiveness of text-plus-visual, versus text-only formats) could be beneficial. Such studies would enhance the understanding of the role of pictograms in information dissemination and could provide valuable insights for developing more effective health communication strategies tailored to older adults.

Conclusion

The findings of this study indicate that medication instructions need to be made more accessible and comprehensible for older adults. In this context, incorporating pictograms into medication instructions when providing healthcare services to older adults in Türkiye and adapting these visuals to local culture could be considered an effective strategy to enhance medication adherence. In societies like Türkiye, where health literacy is low, it is crucial to ensure that the effectiveness of pictograms is optimized by considering cultural appropriateness in their design. Additionally, visual aids should be tailored to accommodate individuals with lower educational levels, thereby improving understanding and adherence to medication regimens.

Ethics

Ethics Committee Approval: It has been approved by the Medical and Health Sciences Research Board and the Ethics Committee of Başkent University (approval number: 23/15, date: 18.01.2023).

Informed Consent: Informed consent was obtained from all participants.

Footnotes

Authorship Contributions

Concept: F.Y., B.K., Design: F.Y., B.K., Data Collection or Processing: B.K., Analysis or Interpretation: F.Y., Z.Ö., Literature Search: F.Y., Z.Ö., Writing: F.Y., Z.Ö.

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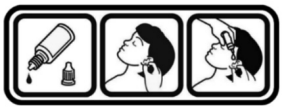
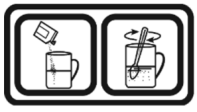
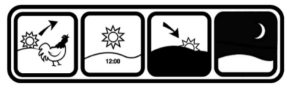
Appendix 1. Pictograms used in questionnaire form

No	Pictograms	Meaning	No	Pictograms	Meaning
1		1 drop in the left ear	9		Keep in the fridge
2		1 drop in the right eye	10		Shake
3		Inject under the skin	11		Do not drive
4		2 tablets	12		Do not crush
5		Dissolve 1 sachet in water	13		Take with food
6		Inhale	14		Morning, noon, evening, night
7		Night	15		Seek medical advice
8		Do not drink alcohol			