

Functional Health and Pharmacotherapy Literacy Related to Vitamin D Supplementation Among Adults: A Cross-Sectional Pilot Study

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Abstract

Introduction: Health literacy (HL) and pharmacotherapy literacy (PTHL) are key determinants of the safe and effective use of medications and dietary supplements, including vitamin D. Limited HL has been widely associated with medication errors, poor adherence, and inappropriate supplement use. In Bosnia and Herzegovina (B&H), only a few studies have examined HL and none have evaluated PTHL, indicating a significant evidence gap.

Objective: This study aimed to assess functional HL and PTHL related to vitamin D supplementation among adults attending a community pharmacy in Tuzla Canton, B&H.

Methodology: A prospective cross-sectional study was conducted among 47 adults from three cities in Tuzla Canton who visited private pharmacies. Functional HL was assessed using the Short Test of Functional Health Literacy in Adults (S-TOFHLA), while PTHL was measured using the Bosnian version of the Pharmacotherapy Literacy Questionnaire (PTHL-B&H). Associations between literacy levels and sociodemographic characteristics (age, gender, and education) were analyzed.

Results: Low PTHL was observed in 61.7% of participants, while 44.7% demonstrated adequate functional HL. Gender was not significantly associated with either literacy measure, whereas older age and lower educational attainment were significantly associated with lower HL and PTHL levels ($p < 0.05$).

Conclusion: Despite the limited sample size and regional focus of the study, the findings reveal substantial gaps in HL and PTHL related to vitamin D supplementation, particularly among older and less-educated adults, highlighting the need for targeted pharmacist-led educational interventions to support safe and informed supplement use.

Keywords: adherence; PTHL; patient safety; sociodemographic factors; S-TOFHLA

Funkcionalna zdravstvena i farmakoterapijska pismenost u vezi sa suplementacijom vitaminom D kod odraslih: presječna pilot studija

Sažetak

Uvod:

Zdravstvena pismenost (HL) i farmakoterapijska pismenost (PHTL) ključni su faktori za sigurnu i učinkovitu primjenu lijekova i dodataka prehrani, uključujući vitamin D. Ograničena HL često je povezana s pogreškama u uzimanju lijekova, lošom adherencijom i nepravilnom uporabom dodataka prehrani. U Bosni i Hercegovini (BiH) provedene su samo rijetke studije o HL, dok PHTL dosad nije istraživana, što ukazuje na značajan nedostatak dokaza.

Cilj:

Cilj studije bio je procijeniti funkcionalnu HL i PHTL u vezi sa suplementacijom vitaminom D kod odraslih osoba koje posjećuju privatne ljekarne u Tuzlanskom kantonu, BiH.

Metodologija:

Provedena je prospektivna presječna studija među 47 odraslih iz tri grada Tuzlanskog kantona koji su posjetili privatne ljekarne. Funkcionalna HL procijenjena je pomoću *Short Test of Functional Health Literacy in Adults (S-TOFHLA)*, dok je PHTL mjerena prilagođenom verzijom *Pharmacotherapy Literacy Questionnaire (PHTL-B&H)*. Analizirane su povezanosti razine pismenosti s dobi, spolom i obrazovanjem.

Rezultati:

Niska PHTL zabilježena je kod 61,7% sudionika, dok je 44,7% imalo adekvatnu funkcionalnu HL. Spol nije bio značajno povezan ni s jednom mjerom pismenosti, dok su starija dob i niže obrazovanje bili značajno povezani s nižom HL i PHTL ($p < 0,05$).

Zaključak:

Unatoč ograničenom uzorku i regionalnu ograničenost studije, rezultati pokazuju značajne nedostatke u HL i PHTL vezano za suplementaciju vitaminom D, osobito među starijim i manje obrazovanim osobama, što ukazuje na potrebu ciljane edukacije koju provode farmaceuti za potporu sigurnoj i informiranoj uporabi dodataka prehrani.

Ključne riječi: adherencija; PHTL; sigurnost pacijenata; sociodemografski faktori; S-TOFHLA

Introduction

Functional health literacy (HL) enables individuals to access, understand, and apply health information for informed healthcare decisions and disease prevention (1, 2). While HL has been extensively studied in Europe, data on HL in Bosnia and Herzegovina (B&H) are scarce. The population has faced multiple challenges over the past three decades, including war, migration, and post-war socio-political transitions, compounded by a high illiteracy rate (4.3%) and poor living conditions, likely contributing to lower HL and higher morbidity. Although a few studies have assessed HL in B&H (3-5), none have specifically addressed pharmacotherapy literacy (PHTL), and no studies have been conducted in Tuzla Canton. To our knowledge, this is the first study in this region to evaluate both HL and PHTL, highlighting the need for targeted educational interventions to improve patient outcomes.

Vitamin D, a fat-soluble hormone precursor, is critical for calcium and phosphorus metabolism and supports musculoskeletal, immune, and endocrine function (6). Vitamin D deficiency (VDD) affects over one billion people worldwide, particularly vulnerable groups such as pregnant women, young children, and individuals with limited sun exposure. Supplement use is increasing, but gaps remain in understanding the role of HL and PHTL in ensuring proper use, particularly regarding dosing and safety. In B&H, vitamin D is available as dietary supplements or medicinal products in doses ranging from 1,000 to 50,000 IU (7).

Given the pivotal role of HL and PHTL in promoting safe and effective use of vitamin D supplements, this study aimed to assess functional HL and pharmacotherapy literacy among adults visiting pharmacies in Tuzla Canton. By examining knowledge, attitudes, and practices related to vitamin D, this research seeks to identify factors influencing supplement use and provide evidence to guide healthcare professionals and policymakers in designing targeted educational interventions.

Methods

Study Design

This prospective, cross-sectional survey assessed functional health literacy and pharmacotherapy literacy related to vitamin D supplementation among adults visiting a pharmacy in Tuzla, Bosnia and Herzegovina, using a validated self-report instrument.

Data Collection

Data were collected in May and June 2025 at private pharmacies in Tuzla. The study was approved by the Ethics Committee for Scientific Research of the University of Tuzla (approval number: 03/8-285-

1-3/25, 20 January 2025), and all participants provided voluntary informed consent. A pilot study with 20 patients was conducted prior to the main survey to refine the questionnaire and ensure comprehension.

The main survey was administered anonymously, on paper, by trained interviewers during routine pharmacy visits, either while patients obtained medicines or sought advice.

Questionnaire

The survey comprised three sections:

1. *Sociodemographic information*: Eight questions on gender, age, body weight, occupation, education, and self-assessed health status.
2. *Pharmacotherapy literacy (PTHL-B&H)*: Ten multiple-choice questions assessing knowledge, understanding, and interpretation of vitamin D supplementation information, with a single response per question. Scores were expressed as a percentage and categorized as Low ($\leq 60\%$), Medium (60–80%), and High ($> 80\%$).
3. *Functional health literacy (S-TOFHLA)*: Translated and adapted for Tuzla Canton, the S-TOFHLA consists of two parts (A and B). Correct answers scored 1 point; incorrect answers 0. Total scores were categorized as Inadequate (0–16), Marginal (17–22), and Adequate (23–36). Participants with adequate HL are expected to comprehend most health-related materials, while those with inadequate or marginal literacy may experience difficulties.

Statistical Analysis

Descriptive statistics were calculated using SPSS version 21. Chi-square tests assessed associations between sociodemographic factors and pharmacotherapy and functional HL levels. A p-value < 0.05 was considered statistically significant.

Results

Demographics

A total of 47 participants completed the survey, of whom 29 (61.7%) were female. The mean age was 46.8 ± 13.2 years, with 24 participants younger than 50 and 23 aged 50 or older (Figure 1). Most participants had a high school education (27; 57.4%), while six had primary education and three held a Master's degree. The majority resided in Tuzla (35; 74.5%), with smaller numbers from Živinice (8; 17.0%) and Banovići (3; 6.4%). Overall, 42.6% rated their health as poor/fair, yet 76.6% reported visiting a doctor once a year or less (Figure 2).

Pharmacotherapy literacy (PTHL-B&H)

As shown in Table 1, 61.7% of participants demonstrated low PTHL, 21.3% medium, and 17.0% high. Gender was not significantly associated with PTHL ($p=0.815$), whereas older age and lower education were significantly associated with lower scores (age: $p=0.013$; education: $p<0.001$).

Functional health literacy (S-TOFHLA)

S-TOFHLA results (Table 2) indicated adequate HL in 44.7% of participants, with 27.7% each having marginal or inadequate HL. Gender was not significantly associated with HL ($p=0.756$). Older age and lower education were significantly associated with lower S-TOFHLA scores (age: $p<0.001$; education: $p<0.001$). All participants aged 20–30 and those with university degrees achieved adequate HL.

Discussion

Health literacy (HL) is essential for understanding and adhering to health instructions, particularly among older adults who often manage multiple medications. While the Short Test of Functional Health Literacy in Adults (S-TOFHLA) is a widely validated tool for assessing functional HL, it has limitations, particularly in evaluating numeracy skills. Pharmacotherapy literacy (PTHL) was introduced to assess patients' ability to access, interpret, calculate, and apply critical medication information effectively (1, 2, 8). Low HL has been associated with misinterpretation of prescription labels, difficulties with multi-step instructions, and suboptimal medication management (9). Age, educational attainment, cognitive function, and sensory abilities are well-established factors influencing HL (10, 11).

In this study, we evaluated functional HL and PTHL regarding vitamin D supplementation among adults visiting pharmacies in Tuzla Canton, Bosnia and Herzegovina. Our results indicate a predominance of low HL and PTHL within the sample. Gender was not significantly associated with HL or PTHL, consistent with previous systematic reviews showing no robust gender differences in literacy (12). Age and education emerged as significant predictors, with older participants and those with lower educational attainment demonstrating lower HL and PTHL scores (age: $p<0.001$; education: $p<0.001$), corroborating findings from regional and international studies (1, 13, 14). These trends highlight the importance of tailoring literacy interventions to vulnerable populations, particularly older adults and those with limited formal education.

Over half of participants exhibited low PTHL scores regarding vitamin D supplementation, underscoring the challenges patients face in understanding medication information even for widely used supplements. Vitamin D pharmacotherapy can be complex due to varying doses, formulations,

and the need for monitoring serum levels, placing patients with limited HL at risk of suboptimal or unsafe use (15). Pharmacists play a critical role in bridging this gap by providing evidence-based guidance on indications, dosing, monitoring, and potential adverse effects, while simultaneously improving patients' HL and PTHL (16). Nearly 28% of participants had inadequate or marginal HL, further highlighting the need for targeted interventions, particularly among older adults and those with lower educational attainment.

Educational attainment strongly influenced both HL and PTHL. Participants with university degrees demonstrated higher S-TOFHLA scores, with all achieving adequate HL, whereas those with only primary education were more likely to have inadequate or marginal HL. These findings align with previous evidence that higher education enhances patients' ability to engage actively in healthcare decision-making and seek supplementary health information (17). Promoting educational opportunities and implementing structured patient education programs could significantly improve HL and medication management skills.

Age-related differences in HL and PTHL were evident. Younger participants exhibited predominantly adequate literacy levels, while older adults, particularly those over 50, demonstrated lower scores. These results are consistent with prior research showing that aging is associated with decreased reading comprehension, reasoning, and numeracy skills, which can negatively affect medication management and health outcomes (13, 18). Interventions tailored to older adults, including simplified educational materials, pharmacist-led counseling, and age-appropriate communication strategies, are recommended to mitigate these disparities.

This study has several limitations. The relatively small sample size and recruitment from few pharmacies may limit the generalizability of the findings to the broader population of Tuzla Canton. The cross-sectional design allows for assessment of associations but cannot establish causality. Additionally, the use of self-administered questionnaires may introduce reporting bias, and the focus on vitamin D supplementation restricts the applicability of results to other medications or supplements. Future studies with larger, multicenter samples and longitudinal designs are warranted to validate and expand upon these findings.

Overall, this study underscores the urgent need for strategies to enhance functional HL and pharmacotherapy literacy, particularly among older adults and individuals with lower educational attainment. By integrating literacy assessments and patient education into routine pharmacy practice, healthcare providers can identify patients at risk of misunderstanding medication instructions and tailor interventions accordingly. These efforts can empower patients to make informed healthcare decisions, improve adherence, and optimize therapeutic outcomes, ultimately contributing to safer and more effective pharmacotherapy in the community.

Conclusion

In conclusion, this study provides initial insights into the state of functional health literacy (HL) and pharmacotherapy literacy (PTHL) among adults in Tuzla Canton, Bosnia and Herzegovina. A substantial proportion of participants demonstrated low pharmacotherapy literacy, highlighting the challenges many patients face in understanding and managing their medications.

These findings emphasize the need for targeted educational interventions to improve both general HL and PTHL, particularly among older adults and individuals with lower educational attainment. Enhancing literacy can empower patients to make informed healthcare decisions, engage more actively in their treatment, and ultimately improve health outcomes.

The relevance of this study lies in its implications for clinical practice and public health: pharmacists and healthcare providers can use these findings to identify at-risk populations, develop strategies to improve patient education on vitamin D and other medications, and promote safe and effective medication use. Furthermore, as the first study in Bosnia and Herzegovina assessing PTHL, it establishes a foundation for future research and interventions aimed at improving pharmacotherapy outcomes in similar populations.

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Authors' Contributions

Maida Šljivić Husejnović conceived and designed the study, prepared the pilot PTHL test, drafted the manuscript, and contributed to data collection and interpretation. Maida Šljivić Husejnović, Enida Karić, and Belkisa Izić conducted the pilot study. Previously, Merima Ibišević, Alija Uzunović, and Maida Šljivić Husejnović translated the standardized S-TOFHLA into Bosnian and adapted it to the healthcare system of Tuzla Canton. Enida Karić carried out the main survey. Belkisa Izić, Merima Ibišević, and Alija Uzunović contributed to the interpretation of the results and critically reviewed the manuscript.

All authors approved the final version of the manuscript and agree to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Statement of Ethics

The study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Ethics Committee for Scientific Research of the University of Tuzla (approval number: 03/8-285-1-3/25; approved on 20 January 2025). Written informed consent was obtained from all participants prior to inclusion in the study.

Statement of Competing Interest

The authors declare no relevant conflicts of interest.

Statement of Data Availability

Not applicable. The underlying data contain potentially identifying participant information and are therefore not publicly available. Access to the data can be provided upon reasonable request to the corresponding author, subject to ethical approval and confidentiality agreements.

Statement of Generative AI Technologies Use

Generative AI (ChatGPT, OpenAI) was used solely to assist with language editing and formulation of sentences in the manuscript. The content, analysis, interpretation of data, and conclusions were entirely developed by the authors.

References

1. Levic M, Bogavac-Stanojevic N, Krajnovic D. The instruments used to assess health literacy and pharmacotherapy literacy of diabetes mellitus type 2 patients: a scoping review. *Front Public Health*. 2021;9:747807. doi:10.3389/fpubh.2021.747807
2. Krajnović D, Ubavić S, Bogavac-Stanojević N. Pharmacotherapy literacy of parents in the rural and urban areas of Serbia—are there any differences? *Medicina (Kaunas)*. 2019;55(9):590. doi:10.3390/medicina55090590
3. Todorovic N, Jovic-Vranes A, Djikanovic B, et al. Assessment of health literacy in the adult population registered to family medicine physicians in the Republic of Srpska, Bosnia and Herzegovina. *Eur J Gen Pract*. 2019;25(1):32–8. doi:10.1080/13814788.2019.1571579
4. Todorovic N, Jovic-Vranes A, Djikanovic B, Pilipovic-Broceta N, Vasiljevic N, Racic M. Health literacy: current status and challenges in the work of family doctors in Bosnia and Herzegovina. *Int J Environ Res Public Health*. 2019;16(8):1324. doi:10.3390/ijerph16081324
5. Rashadatjou T, Šimić J, Ruf V, Brkić S. Health literacy of migrants and refugees in transition countries—Bosnia and Herzegovina. *Zdravstveni Glasnik*. 2024;10(2):74–90. doi:10.47960/2303-8616.2024.2.10.74
6. Izić B, Šljivić Husejnović M, Jagodić H, Dautbašić A, Rustemović-Čorbić M. Immunomodulatory effect of vitamin D status in patients with autoimmune hypothyroidism – Hashimoto’s thyroiditis. *Proceedings of the VII Symposium of the Masters of Pharmacy of Tuzla Canton*. 2019;7:41–53.
7. Agency for Medicinal Products and Medical Devices of Bosnia and Herzegovina. *Registar lijekova Bosne i Hercegovine: Vitamini [e-book]*. https://almbih.gov.ba/wp-content/uploads/2024/03/Registar-za-objavu_slozeno.pdf. Accessed 2025-12-01.
8. Parker RM, Baker DW, Williams MV, Nurss JR. The test of functional health literacy in adults: a new instrument for measuring patients’ literacy skills. *J Gen Intern Med*. 1995;10:537–41. doi:10.1007/BF02640361
9. Wolf MS, Davis TC, Tilson HH, Bass III PF, Parker RM. Misunderstanding of prescription drug warning labels among patients with low literacy. *Am J Health Syst Pharm*. 2006;63(11):1048–55. doi:10.2146/ajhp050469
10. Morrow D, Clark D, Tu W, Wu J, Weiner M, Steinley D, Murray MD. Correlates of health literacy in patients with chronic heart failure. *Gerontologist*. 2006;46(5):669–76. doi:10.1093/geront/46.5.669

11. Levic M, Bogavac-Stanojevic N, Ubavic S, Krajnovic D. Pharmacotherapy literacy level and predictors of low literacy among diabetes mellitus type 2 patients in Serbia. *BMC Public Health*. 2023;23:1822. doi:10.1186/s12889-023-16639-y
12. Paasche-Orlow MK, Parker RM, Gazmararian JA, Nielsen-Bohlman LT, Rudd RR. The prevalence of limited health literacy. *J Gen Intern Med*. 2005;20(2):175–84. doi:10.1111/j.1525-1497.2005.40245.x
13. Kobayashi LC, Wardle J, Wolf MS, Von Wagner C. Aging and functional health literacy: a systematic review and meta-analysis. *J Gerontol B Psychol Sci Soc Sci*. 2016;71(3):445–57. doi:10.1093/geronb/gbu161
14. Chesser AK, Keene Woods N, Smothers K, Rogers N. Health literacy and older adults: a systematic review. *Gerontol Geriatr Med*. 2016;2:2333721416630492. doi:10.1177/2333721416630492
15. Máčová L, Bičíková M. Vitamin D: current challenges between the laboratory and clinical practice. *Nutrients*. 2021;13(6):1758. doi:10.3390/nu13061758
16. Awadh AA, Hilleman DE, Knezevich E, Malesker MA, Gallagher JC. Vitamin D supplements: The pharmacists' perspective. *J Am Pharm Assoc* (2003). 2021;61(4):e191–201. doi:10.1016/j.japh.2021.02.002
17. Smith SK, Dixon A, Trevena L, Nutbeam D, McCaffery KJ. Exploring patient involvement in healthcare decision making across different education and functional health literacy groups. *Soc Sci Med*. 2009;69(12):1805–12. doi:10.1016/j.socscimed.2009.09.056
18. Serper M, Patzer RE, Curtis LM, et al. Health literacy, cognitive ability, and functional health status among older adults. *Health Serv Res*. 2014;49(4):1249–67. doi:10.1111/1475-6773.12154

Table 1. Sociodemographic characteristics of patients stratified by PTHL-B&H level

Respondent's characteristics		Total N (%)	PTHL-B&H level			p
			Low N (%)	Medium N (%)	High N (%)	
Gender	female	29 (61.70)	17 (36.17)	7 (14.89)	5 (10.64)	0.815
	male	18 (38.30)	12 (25.53)	3 (6.38)	3 (6.38)	
Age	20-30	8 (17.02)	2 (4.26)	3 (6.38)	3 (6.38)	0.013
	31-50	16 (34.04)	8 (17.02)	3 (6.38)	5 (10.64)	
	51-65	23 (48.94)	19 (40.43)	4 (8.51)	0 (0.00)	
Education level	primary school	6 (12.77)	5 (10.64)	1 (2.13)	0 (0.00)	0.000
	high school	27 (57.45)	23 (48.94)	3 (6.38)	1 (2.13)	
	undergraduate and postgraduate studies	14 (29.78)	1 (2.13)	6 (12.77)	7 (14.89)	

Table 2. Sociodemographic characteristics of patients stratified by S-TOFHLA score

Respondent's characteristics		S-TOFHLA score			<i>p</i>
		Inadequate <i>N</i> (%)	Marginal <i>N</i> (%)	Adequate <i>N</i> (%)	
Gender	female	7 (14.89)	8 (17.02)	14 (29.79)	0.756
	male	6 (12.77)	5 (10.64)	7 (14.89)	
Age	20-30	0 (0.00)	0 (0.00)	8 (17.02)	0.000
	31-50	2 (4.26)	4 (8.51)	10 (21.28)	
	51-65	11 (23.40)	9 (19.15)	3 (6.38)	
Education level	primary school	5 (10.64)	1 (2.13)	0 (0.00)	0.000
	high school	8 (17.02)	12 (25.53)	7 (14.89)	
	undergraduate				
	and postgraduate studies	0 (0.00)	0 (0.00)	14 (29.79)	

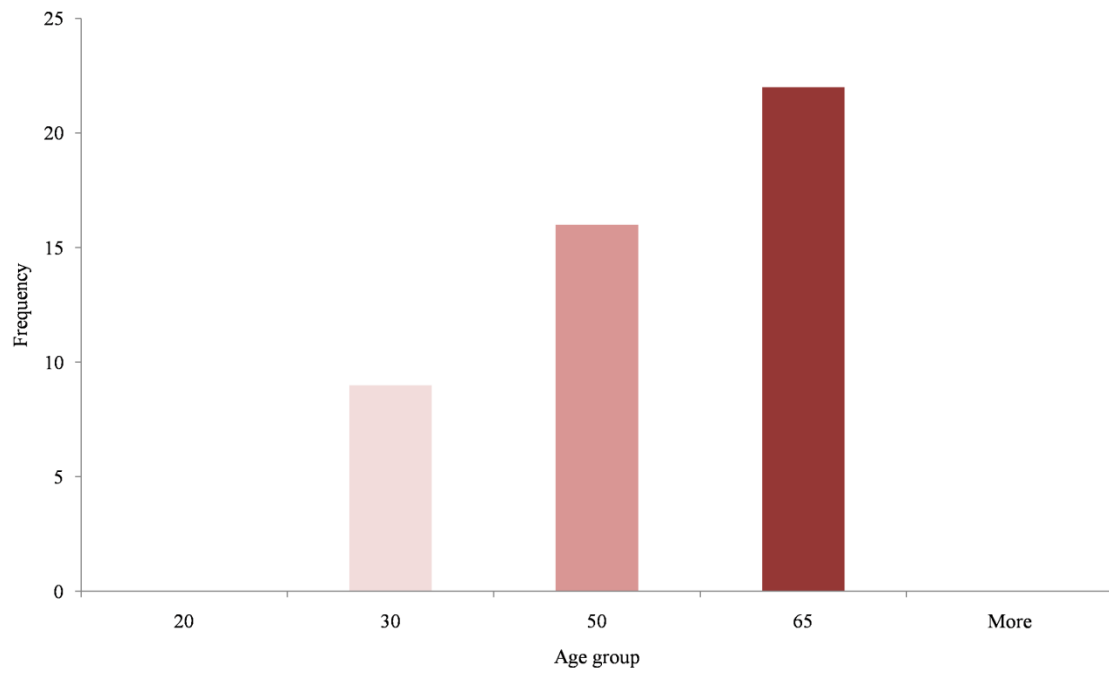


Figure 1. Histogram showing age distribution among patients

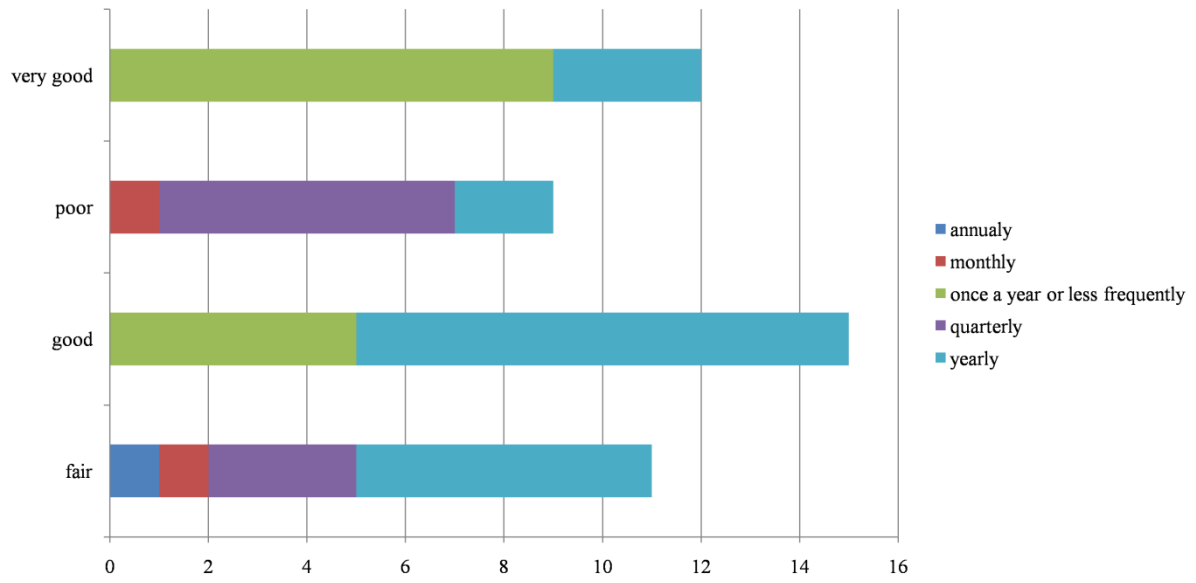


Figure 2. Distribution of self-rated health by frequency of doctor visits