

ORIGINAL RESEARCH Article

Knowledge of statins' therapeutic and pleiotropic actions: A comparative analysis among Health Science Students by gender and institution type

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Article number: 232, **Received:** 02-11-2025, **Accepted:** 10-12-2025, **Published online:** 12-12-2025

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HOW TO CITE THIS

Alasbily et al. Knowledge of statins' therapeutic and pleiotropic actions: A comparative analysis among Health Science Students by gender and institution type. *Mediterr J Pharm Sci.* 2025; 5(4): 78-84.
[Article number: 232]. <https://doi.org/10.5281/zenodo.17901569>

Keywords: Composite knowledge score, Health Science students, knowledge assessment, pleiotropic effect, statins

Abstract: Statins are commonly prescribed lipid-lowering agents, recognized not only for their cardiovascular benefits but also for a range of pleiotropic effects. Despite their clinical significance, awareness of these broader effects among future healthcare professionals remains unclear. This study aimed to assess the knowledge and understanding of statins, including their pleiotropic properties, among clinical-stage Health Science students and across their gender as well as institution type. A cross-sectional survey was carried out among 370 clinical stage medical and dental students in governmental and private universities. Data were collected using an online questionnaire (19-item). A Composite Knowledge Score was calculated to assess student comprehension, and subgroup differences were examined using the Chi-square test. Of the 370 participants invited, 303 responded, resulting in a response rate of 81.9%. Of these respondents, 59.1% were female and 40.9% male. A total of 59.6% attended the private university, while 40.4% were from the governmental institution. Distribution by faculty was as follows: 56.0% from Medicine and 44.0% from Dentistry. Based on the Composite Knowledge Score, 27.2% of students demonstrated poor knowledge, 44.7% had good understanding, and 28.1% achieved excellent scores. Medical students scored significantly higher than dental students, while no significant differences were observed with respect to gender or university type. Overall, Health Science students exhibited moderate awareness of statins and their pleiotropic effects. These results highlight the need for targeted educational initiatives to enhance comprehension of the full therapeutic potential of statins across disciplines.

Introduction

Statins rank among the most commonly prescribed medications worldwide and play a central role in managing hypercholesterolemia, as well as in preventing atherosclerotic cardiovascular disease (ASCVD). Statins use extends across diverse patient populations, including individuals with diabetes, coronary artery disease (CAD), familial hypercholesterolemia, metabolic syndrome, and chronic kidney disease [1]. The primary mechanism of statins involves competitive inhibition of HMG-CoA reductase, the rate-limiting enzyme in hepatic cholesterol

synthesis. By suppressing this pathway, intracellular cholesterol levels decline, LDL receptors on hepatocytes are upregulated, and clearance of LDL cholesterol from the bloodstream is enhanced [2, 3]. Beyond their lipid-lowering activity, statins exhibit a variety of additional effects-commonly referred to as pleiotropic effects. These encompass anti-inflammatory, antioxidant, and endothelial-stabilizing actions, as well as bone-preserving, antimicrobial, and pro-angiogenic properties [2, 4, 5]. Such effects have sparked interest in the potential applications of statin therapy across numerous medical fields, including dentistry, ophthalmology, neurology, oncology, and even certain cancer therapies [6-8]. A thorough understanding of statin therapy among healthcare professionals, including those still in training, is critical to ensure its appropriate and effective use in clinical practice. However, studies assessing knowledge and awareness have produced mixed findings. While some suggest an acceptable comprehension of statins in lipid management, others highlight significant gaps [9-12]. Evidence from Libya, in particular, remains limited. Given that undergraduate Health Science students form the future healthcare workforce, it is important that they are well-informed not only about the primary indications of statins but also about their broader therapeutic and pleiotropic effects. Against this backdrop, the present study aims to evaluate the knowledge of Health Science students in Libya regarding the therapeutic and pleiotropic benefits of statins.

Material and methods

This observational cross-sectional study was conducted electronically via Google Forms in Benghazi, Libya, from December 2024 to March 2025. The study population comprised clinical-stage students (in 4th and 5th academic years, as well as internship-level) enrolled in Medicine and Dentistry programs at public (University of Benghazi) and private (Libyan International University) institutions in Benghazi, Libya. A self-generated online questionnaire containing 19 items was created to gather demographic information (age, gender, year of study) and assess participants' knowledge of statins, with a particular focus on their therapeutic indications and pleiotropic effects. The instrument was subjected to a pilot study and its internal consistency was assessed, yielding moderate reliability for the scale. Based on the eligible student population, the minimum required sample size was 291. To increase precision, a target sample size of 370 students was set, of whom 303 ultimately responded. Inclusion criteria were students in the specified academic years who provided informed consent. Exclusion criteria were students outside the specified academic years, those not enrolled in Medicine or Dentistry programs, or those who did not provide consent.

Data were collected through an online questionnaire, which gathered demographic information and assessed participants' knowledge of statins, with a particular focus on their therapeutic indications and pleiotropic effects, and was analyzed by SPSS version 25. To quantify understanding, a Composite Knowledge Score (CKS) was calculated, categorizing students' knowledge as poor (<6.5), good (6.5-9.75), or excellent (>9.75). Subgroup differences were analyzed using the Chi-square test, with statistical significance set at $p < 0.05$.

Ethical approval: The approval for the study was obtained from the Research Ethics Committee at the Libyan International Medical University (Ref.; BMS-2024-00289, 23-06-2025). All procedures adhered to the ethical standards and guidelines established by the Faculty of Applied Medical Sciences, Benghazi, Libya.

Results

The study included 303 students from various Health Science faculties across public and private universities in Benghazi, Libya, yielding a response rate of 81.9% from the 370 students invited to participate.

General characteristics of the sample: **Table 1** summarizes the demographic profile of the participants. Females comprised the larger proportion of the sample, accounting for 59.1%, while males represented 40.9%. Most respondents, 86.4%, were between 18 and 26 years of age. Regarding academic affiliation, over half of the students were enrolled in the Faculty of Medicine at 56.0%, followed by Dentistry at 44.0%. With respect to university type, the majority of participants attended a private institution, 59.6%, while the remainder were enrolled in a public university.

Table 1: Demographic and academic characteristics of Health Science students

Characteristic	Category	N (303)	Percentage (%)
Gender	Male	124	40.9
	Female	179	59.1
Age	18-26	261	86.4
	≥ 27	41	13.6
College	Medicine	170	56.0
	Dentistry	133	44.0
University Type	Private University	180	59.6
	Governmental University	123	40.4

Assessment of participants knowledge: Participants' understanding of statins was evaluated using the CKS and categorized into three levels. Nearly half of the students, 44.7%, demonstrated a good level of knowledge, while 27.2% exhibited poor understanding. A smaller proportion, 28.1%, achieved an excellent score. These distributions are presented in **Figure 1**.

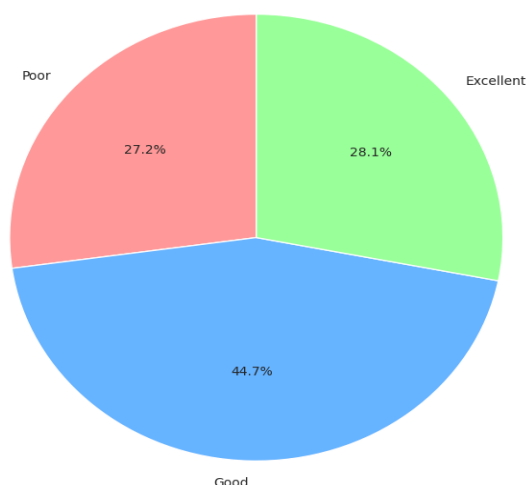


Figure 1: Distribution of CKS among Health Science students.

Comparison of CKS across subgroups: To explore differences in knowledge levels among demographic and academic subgroups, inferential analyses were performed using the Pearson Chi-square test.

Medicine versus dentistry students: A significant difference in CKS was observed between students from the Medicine and Dentistry faculties. Medical students scored notably higher than their dental counterparts, with the Pearson Chi-square test yielding a P-value of 0.029. These results are illustrated in **Figure 2** and further detailed in **Figure 3**.

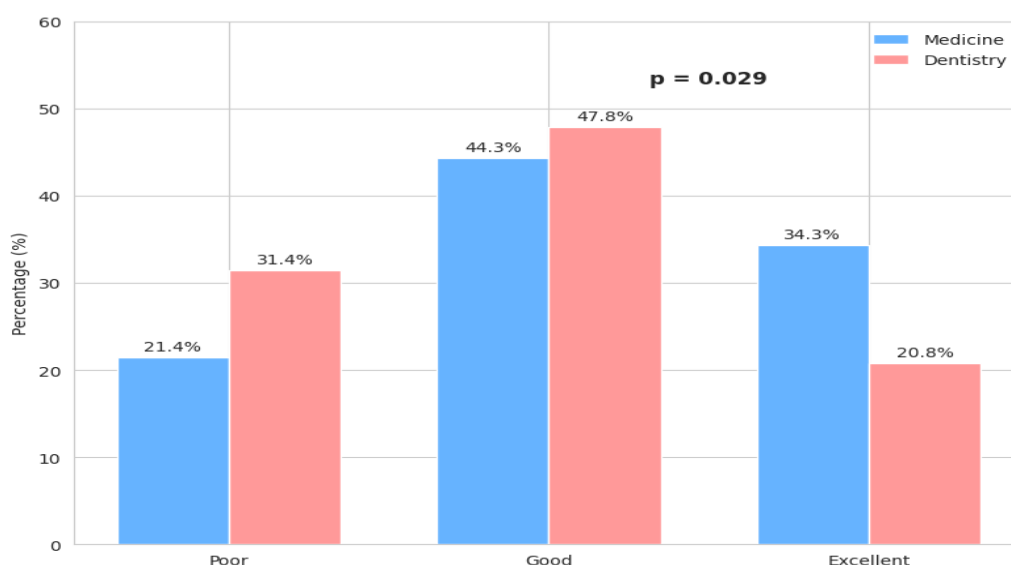


Figure 2: CKS performance in medicine versus dentistry faculties

Gender-based comparison: Analysis of CKS scores by gender revealed no statistically significant differences. The Pearson Chi-square test yielded a P-value of 0.12, indicating that knowledge levels were similar between male and female students. These findings are presented in **Figure 3**.

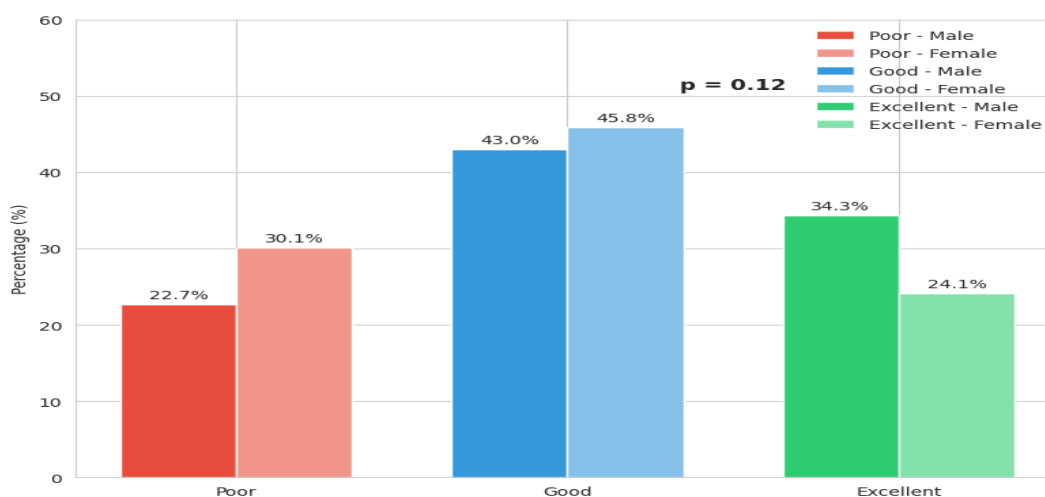


Figure 3: Distribution of CKS by gender

Governmental versus private universities: Among medical students, no significant difference in CKS scores was observed between those enrolled in private and governmental universities. The Pearson Chi-square test produced a P-value of 0.726, suggesting that university type did not have a meaningful impact on students' knowledge levels. These results are shown in **Figure 4**.

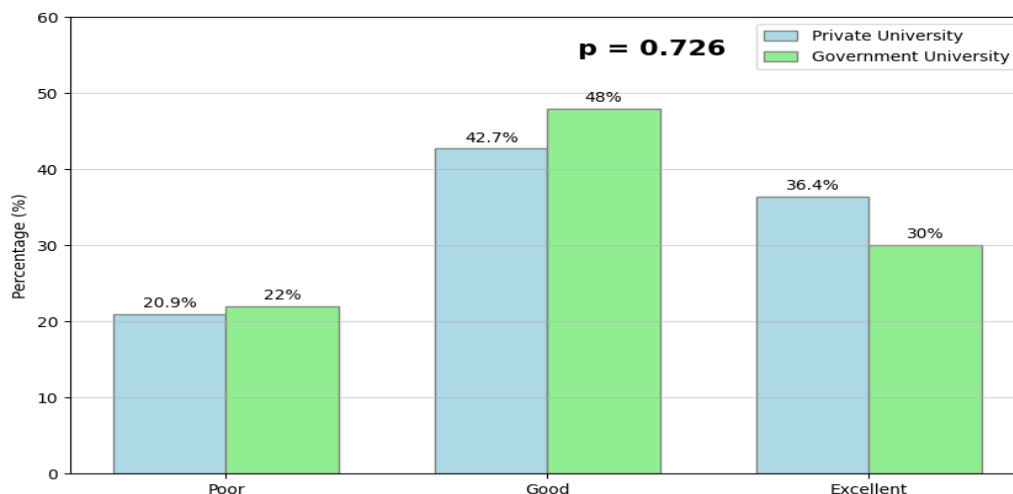


Figure 4: CKS performance in students from private versus governmental universities

Discussion

The primary objective of this cross-sectional study was to evaluate the CKS of 303 Health Science students in Benghazi with respect to the therapeutic and pleiotropic effects of statins. Overall, the results indicate a moderate level of knowledge: 44.7% of students achieved a good CKS, while 28.1% demonstrated an excellent score. These findings suggest that, although students have a foundational understanding of statin therapy, there is room for improvement before they transition into clinical practice. Gaps in knowledge could potentially affect patient care, adherence to evidence-based guidelines, and the safe and effective use of statins in various clinical settings. The observation of varied knowledge levels among future healthcare professionals aligns with findings from studies conducted among practicing clinicians in the region, which often report gaps in understanding statin therapy. For instance, Al-Ashwal and others [9] conducted an observational cross-sectional study involving 474 physicians and pharmacists in Yemen to assess their clinical knowledge of statin therapy and monitoring parameters. Similar to our student cohort, the study identified suboptimal understanding of statin dose intensities, potential drug-drug interactions, and appropriate monitoring practices. Particularly, factors such as academic degree, professional experience, and prior exposure to clinical guidelines were significantly associated with higher knowledge scores [9]. In another study, Al-Ashwal and others [10] evaluated ASCVD risk assessment among 270 practicing physicians in Yemen and reported limited knowledge and inadequate practices regarding risk stratification prior to initiating statin therapy. This regional trend of knowledge gaps is further reflected in the work of Rababa'h and others [11] who assessed the knowledge, awareness, and attitudes of 413 pharmacists in Jordan regarding CVD risk estimation. Their findings revealed suboptimal understanding of CVD risk assessment and the use of lipid-lowering agents, highlighting persistent educational challenges and emphasizing the need for strengthened undergraduate training in this area.

A key finding of this study was the significant difference in knowledge levels across disciplines, with medical students achieving higher CKS scores than their dental counterparts. This disparity likely reflects variations in curriculum focus, as Medicine and Pharmacy programs typically dedicate more time to advanced pharmacology and the comprehensive management of chronic conditions such as ASCVD. These results align with previous research, which has shown that specialized training is associated with greater pharmacotherapy knowledge [8]. In contrast, no significant differences were observed in CKS based on gender or university type. The absence of associations with these demographic factors may be due to the relative homogeneity of the student population,

including similarities in age, limited clinical exposure, and recent completion of comparable foundational coursework across institutions. The study also evaluated students' understanding of the pleiotropic benefits of statins, an area of considerable clinical importance. Evidence highlights the value of this knowledge: for example, Ozkan and others [12] conducted an observational study of 504 patients with CAD in Turkey and found that those who were aware of the pleiotropic and cardioprotective effects of statins showed higher treatment adherence and were more likely to achieve optimal LDL-C levels. These findings emphasize the need to strengthen the understanding of pleiotropic effects among Health Science students. A solid grasp of this topic would enable future clinicians to provide more comprehensive patient counseling, potentially improving adherence and outcomes in the management of chronic diseases. While these findings are important, the study has some limitations. Its cross-sectional design captures knowledge at a single point in time and does not allow for conclusions about causal relationships between educational exposure and knowledge outcomes. Nonetheless, the study provides valuable baseline data on Libyan Health Science students, offering regional insight into foundational gaps in understanding prior to graduation. The differences observed between medical and dental students, along with the generally moderate to suboptimal knowledge levels, underscore the need for curriculum planners to introduce more targeted and interprofessional education in pharmacotherapy and cardiovascular risk management.

Conclusion: Libyan Health Science students demonstrate moderate knowledge of statins and their pleiotropic effects. No differences were observed by gender or university type. These findings highlight persistent educational gaps and underscore the need for targeted, interprofessional curriculum enhancements to reinforce understanding of pharmacotherapy and cardiovascular risk management before students enter clinical practice.

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Authors' contribution: HMA conceived and designed the study. MAE, MME, MAA, HAM, MAS & AFA collected data. MME & MAS contributed to data analysis. HAE, Ham & AFA performed the analysis and data interpretation. HMA, MAS & AFA drafted and revised the manuscript. All authors reviewed and approved the final version of the manuscript.

Conflict of interest: The authors declare the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Ethical issues: The authors completely observed ethical issues, including plagiarism, informed consent, data fabrication or falsification, and double publication or submission.

Data availability statement: The raw data that support the findings of this article are available from the corresponding author upon reasonable request.

Author declarations: The authors confirm that they have followed all relevant ethical guidelines and obtained any necessary IRB and/or ethics committee approvals.

Generative AI disclosure: No Generative AI was used in the preparation of this manuscript.