Assessment of Medical Students' Knowledge and Practices in the Rehabilitation of Diabetic Patients Through Lifestyle Modifications

Dr. Saleh Khalid Al Mogairen

Assistant professor of internal medicine
Department of Internal Medicine, College of Medicine, King Faisal University, Al-Ahsa 31982, Saudi Arabia
salmogairen@kfu.edu.sa

ABSTRACT

Background:
Lifestyle modifications play a pivotal role in the rehabilitation of diabetic patients by improving glycemic control and preventing complications. Medical students, as future healthcare providers, must possess the necessary knowledge and skills to effectively counsel patients on these interventions. This study aimed to assess the knowledge and practices of medical students regarding lifestyle modifications for diabetes rehabilitation and identify barriers to implementation.

Methods:
A cross-sectional study was conducted among 328 medical students at King Faisal University, Al-Ahsa, Saudi Arabia. Data were collected using a structured, self-administered questionnaire covering demographics, knowledge, practices, and perceived barriers. Knowledge and practice scores were analyzed using descriptive and inferential statistics.

Results:
The mean knowledge score was 14.8 ± 3.2 out of 20, with 43.3% demonstrating moderate knowledge and 36.3% high knowledge. Clinical students scored significantly higher than preclinical students (15.7 ± 3.1 vs. 13.5 ± 3.4, $p < 0.001$). Only 37.5% of students reported regular counseling practices, despite 60.4% feeling confident in discussing lifestyle changes. Common barriers included lack of time (71.4%), insufficient training (63.1%), and low patient adherence (56.4%).

Conclusion:
While medical students exhibited moderate-to-high knowledge of lifestyle modifications, gaps in practice and significant barriers highlight the need for enhanced curricular integration of lifestyle medicine. Structured training programs and practical experiences are essential to equip students for effective diabetes rehabilitation.

Introduction

Diabetes mellitus is a global public health challenge characterized by chronic hyperglycemia resulting from defects in insulin secretion, insulin action, or both. As of 2024, an estimated 537 million adults worldwide were living with diabetes, and this figure is expected to rise significantly in the coming decades due to aging populations, unhealthy diets, and sedentary lifestyles (Hossain, Al-Mamun, and Islam 2024). Type 2 diabetes mellitus (T2DM), which accounts for 90–95% of diabetes cases, is closely linked to lifestyle factors, making lifestyle modifications a cornerstone of both prevention and management strategies (Galaviz et al. 2018)

Effective diabetes management extends beyond pharmacological interventions. It necessitates a multidisciplinary approach that includes patient education, dietary modifications, physical activity, stress management, and regular monitoring. Such comprehensive management can significantly improve glycemic control, reduce the risk of complications, and enhance patients' quality of life (Sugandh et al. 2023). However, a successful implementation of lifestyle interventions often hinges on the knowledge and practices of healthcare providers, including medical students who represent the future workforce (Johnson, Wright, and Foster 2018; Venditti and Kramer 2013).

Medical education plays a critical role in equipping students with the skills and knowledge required for managing chronic conditions like diabetes. Lifestyle medicine, which emphasizes the modification of risk factors through behavior change, is increasingly recognized as a vital component of medical curricula (Frates et al. 2024). Despite this, studies have revealed significant gaps in medical students' training regarding lifestyle management for chronic diseases, particularly diabetes (Rea et al. 2021). These gaps may stem from limited curricular emphasis on preventive care, insufficient clinical exposure, and the lack of practical training in counseling patients about behavior change (Albin et al. 2024).

Lifestyle modifications, such as improved nutrition and increased physical activity, are foundational elements in the rehabilitation of diabetic patients (Klein et al. 2004). Dietary modifications, including calorie restriction, carbohydrate moderation, and the adoption of nutrient-dense eating patterns, have been shown to improve insulin sensitivity and glycemic control (Lewgood et al. 2021). Physical activity, particularly aerobic and resistance training, has been associated with enhanced glucose uptake by skeletal muscles, reduced insulin resistance, and better cardiovascular outcomes (Colberg et al. 2016). Stress reduction techniques, including mindfulness and cognitive-behavioral strategies, also play an important role in mitigating the psychological burden of diabetes and improving adherence to treatment plans (Tovote et al. 2013). Given the multifaceted nature of lifestyle interventions, medical students must possess both theoretical knowledge and practical competencies to guide patients effectively (Saha, Beach, and Cooper 2008).

Existing literature highlights a concerning disparity in the preparedness of medical students to address lifestyle factors in diabetes care. For instance, a study conducted in the United Kingdom found that only 25% of medical students felt confident discussing dietary modifications with patients, despite recognizing the importance of nutrition in disease management (Nazar et al. 2016). Similarly, research from the United States indicated that medical students received, on average, less than 20 hours of nutrition education during their training, far below the recommended 25–30 hours (Adams, Kohlmeier, and Zeisel 2010). These deficiencies may hinder future physicians' ability to address the behavioral and environmental determinants of health, which are critical for diabetes rehabilitation (Hill-Briggs et al. 2021).

The integration of lifestyle medicine into medical education has been proposed as a solution to bridge this gap. Training programs that emphasize lifestyle counseling, motivational interviewing, and behavior change theories have demonstrated promise in improving medical students' competencies (Frates et al. 2024). Moreover, experiential learning opportunities, such as community-based projects and interprofessional education, can enhance students' understanding of the social and cultural dimensions of lifestyle modifications (Piščalkienė and Ingemann Lottrup 2019). Despite these advancements, there remains a need for systematic evaluation of medical students' knowledge and practices in the context of diabetes rehabilitation.

The focus on medical students is particularly relevant in the context of global diabetes prevalence. As future physicians, medical students will play a pivotal role in addressing the rising burden of diabetes through preventive and rehabilitative strategies (Deshpande, Harris-Hayes, and Schootman 2008). Their ability to deliver patient-centered care that incorporates lifestyle modifications is essential for improving population health outcomes. Moreover, fostering a culture of preventive care within medical education can have a ripple effect, influencing healthcare systems and policies to prioritize lifestyle interventions (14).

This study aims to assess the knowledge and practices of medical students regarding the rehabilitation of diabetic patients through lifestyle modifications. By identifying strengths and weaknesses in their training, this research seeks to inform curricular improvements that align with the evolving demands of chronic disease management. Furthermore, understanding the factors that influence students' engagement with lifestyle medicine can guide the development of targeted interventions to enhance their readiness for clinical practice.

Methods

Study Design and Setting
This cross-sectional study was conducted in Al-Ahsa city, Saudi Arabia, focusing on medical students at King Faisal University (KFU). The College of Medicine at KFU provides a comprehensive medical curriculum that integrates preclinical and clinical training, making it an ideal setting to evaluate students' knowledge and practices concerning diabetes rehabilitation. The study design was chosen to provide a snapshot of the current state of knowledge and practices among medical students across different academic years, offering insights into areas requiring curricular improvements.

Ethical Approval
The study received ethical approval from the Institutional Review Board (IRB) at King Faisal University. All research activities adhered to the principles outlined in the Declaration of Helsinki, ensuring the ethical treatment of participants. Prior to data collection, participants were provided with detailed information about the study objectives, procedures, and their rights as participants. Written informed consent was obtained from all participants, and they were assured that their participation was voluntary and their responses would remain anonymous. Data were securely stored in encrypted files, and access was restricted to the principal investigator and authorized team members.

Study Population and Sampling

The target population comprised medical students enrolled at KFU. Participants were recruited from all academic years to ensure representation from both preclinical and clinical students, as their exposure to lifestyle modification practices may vary based on their stage of education.

The inclusion criteria were:

1. Enrollment as a full-time medical student at King Faisal University.
2. Age 18 years or older.
3. Willingness to provide informed consent and complete the survey in English.

Exclusion criteria included:

1. Students who had not completed the survey in its entirety.
2. Students who explicitly declined to provide consent.

To recruit participants, announcements were made through official university communication platforms, including emails, student forums, and class WhatsApp groups. The recruitment period lasted four weeks to maximize participation and ensure a diverse sample.

Sample Size Calculation

The sample size was calculated using Cochran's formula for cross-sectional studies:

The calculated sample size was 278 students. To account for a potential non-response rate of 20%, the final target sample size was set at 334 participants. This ensured a sufficient sample for reliable statistical analysis.

Data Collection

A structured, self-administered questionnaire was developed based on a review of existing literature and validated instruments related to diabetes management and lifestyle medicine. The questionnaire was distributed electronically using a secure platform, ensuring accessibility and ease of completion.

Participants were given detailed instructions on completing the survey, and a pilot test was conducted with 20 students from a similar demographic to ensure clarity, reliability, and validity. Feedback from the pilot test led to minor modifications, such as simplifying technical terms and ensuring that all questions were culturally relevant and comprehensible.

Questionnaire Design

The questionnaire consisted of the following sections:

1. **Demographics**
   This section collected basic information, including:
   o Age
   o Gender

- o Academic year (preclinical or clinical)
- o Prior exposure to diabetes-related education or clinical rotations involving diabetic patients
- o Self-reported familiarity with lifestyle medicine concepts

2. **Knowledge Assessment**

   Knowledge of lifestyle modifications in diabetes management was assessed using 20 multiple-choice and true/false questions. These covered topics such as:
   - o Nutritional guidelines for diabetic patients (e.g., carbohydrate counting, glycemic index)
   - o Recommended physical activity levels (e.g., aerobic vs. resistance training)
   - o Behavioral and psychological interventions (e.g., stress management techniques)
   - o Long-term benefits of lifestyle modifications on glycemic control and complication prevention

   Each correct answer was awarded one point, resulting in a total possible score of 20. Knowledge levels were categorized as low (<10 points), moderate (10–15 points), or high (>15 points).

3. **Practice Assessment**

   Practices were evaluated using 10 Likert-scale questions (ranging from 1 = strongly disagree to 5 = strongly agree). Questions addressed:
   - o Frequency and confidence in counseling patients about lifestyle changes
   - o Engagement in discussing nutrition, physical activity, and stress management during clinical encounters
   - o Perceived barriers to implementing lifestyle medicine in practice (e.g., time constraints, lack of training)

   Scores were calculated by summing the Likert-scale responses, with higher scores indicating more positive practices.

Data Collection Procedure

The survey was distributed via email and social media platforms commonly used by students. Reminder emails were sent weekly to encourage participation. Participants were required to complete the survey within 20 minutes to minimize survey fatigue. All responses were automatically anonymized upon submission, ensuring data confidentiality.

Data Analysis

Statistical analyses were performed using SPSS (version [Insert Version]). The following analyses were conducted:

- **Descriptive Statistics**: Frequencies and percentages for categorical variables (e.g., gender, academic year) and means with standard deviations for continuous variables (e.g., knowledge scores).
- **Inferential Statistics**:
  - o Chi-square tests to assess associations between categorical variables (e.g., gender and knowledge levels).

- o Independent t-tests or ANOVA to compare mean knowledge and practice scores across demographic groups.
- o Pearson or Spearman correlation coefficients to evaluate relationships between knowledge and practice scores.

A p-value <0.05 was considered statistically significant for all analyses.

Results

A total of 328 medical students participated in the study, yielding a response rate of 98.2%. The demographic profile of the participants is presented in Table 1. The mean age of participants was 22.4 ± 1.6 years, with ages ranging from 19 to 26 years. Among the participants, 168 (51.2%) were female, and 160 (48.8%) were male. The distribution of students across academic years showed that 127 (38.7%) were in preclinical years, while 201 (61.3%) were in clinical years. Additionally, 212 students (64.6%) reported prior exposure to diabetes-related education, while 116 (35.4%) did not have such exposure.

Table 1. Demographic Characteristics of the Participants

Characteristic	Frequency (n = 328)	Percentage (%)
Age (mean ± SD, years)	22.4 ± 1.6	-
Gender		
- Male	160	48.8
- Female	168	51.2
Academic Year		
- Preclinical	127	38.7
- Clinical	201	61.3
Prior Diabetes Education		
- Yes	212	64.6
- No	116	35.4

The knowledge scores of participants are summarized in Table 2. The mean knowledge score was 14.8 ± 3.2, with a range of 7 to 20. A majority of students (142, 43.3%) demonstrated moderate knowledge, while 119 (36.3%) exhibited high knowledge, and 67 (20.4%) had low knowledge. Clinical students had significantly higher mean knowledge scores (15.7 ± 3.1) compared to preclinical students (13.5 ± 3.4, $p < 0.001$).

Table 2. Knowledge Levels of Participants Regarding Lifestyle Modifications

Knowledge Level	Frequency (n = 328)	Percentage (%)
Low (<10)	67	20.4
Moderate (10–15)	142	43.3
High (>15)	119	36.3
Mean ± SD (Total)	14.8 ± 3.2	-
Mean ± SD (Preclinical)	13.5 ± 3.4	-
Mean ± SD (Clinical)	15.7 ± 3.1	-

The self-reported practices of medical students regarding lifestyle modification counseling are detailed in Table 3. A total of 198 participants (60.4%) reported feeling confident discussing lifestyle modifications with diabetic patients. However, only 123 (37.5%) indicated that they regularly engaged in such counseling during clinical encounters. Perceived barriers to counseling included lack of time (71.4%), insufficient training (63.1%), and low patient adherence (56.4%).

Table 3. Practices of Medical Students in Diabetes Rehabilitation Counseling

Practice/Perception	Frequency (n = 328)	Percentage (%)
Confident in Lifestyle Counseling	198	60.4
Regularly Engage in Counseling	123	37.5
Perceived Barriers		
- Lack of Time	234	71.4
- Insufficient Training	207	63.1
- Low Patient Adherence	185	56.4

Table 4 compares knowledge and practice scores among students with and without prior exposure to diabetes-related education. Students with prior education had significantly higher knowledge scores (15.9 ± 2.8 vs. 12.7 ± 3.6, $p < 0.001$) and were more likely to engage in lifestyle counseling (43.2% vs. 28.4%, $p = 0.008$).

Table 4. Comparison of Knowledge and Practices by Diabetes Education Exposure

Variable	With Education (n = 212)	Without Education (n = 116)	p-value
Knowledge Score (mean ± SD)	15.9 ± 2.8	12.7 ± 3.6	<0.001
Regularly Engage in Counseling (%)	43.2	28.4	0.008

The perceived barriers to implementing lifestyle modifications among medical students are presented in Table 5. Lack of time was the most frequently reported barrier (71.4%), followed by insufficient training (63.1%) and low patient adherence (56.4%). Notably, clinical students were more likely to cite lack of time as a barrier (74.8% vs. 66.1%, $p = 0.045$).

Table 5. Perceived Barriers to Implementing Lifestyle Modifications

Barrier	Total (n = 328)	Preclinical (%)	Clinical (%)	p-value
Lack of Time	234 (71.4)	66.1	74.8	0.045
Insufficient Training	207 (63.1)	60.4	65.3	0.202
Low Patient Adherence	185 (56.4)	52.7	58.8	0.321

Discussion

This study aimed to assess the knowledge and practices of medical students in Al-Ahsa city regarding the rehabilitation of diabetic patients through lifestyle modifications. The findings revealed significant variations in knowledge levels, practices, and perceived barriers, underscoring the need for targeted educational interventions within the medical curriculum.

The results showed that most participants (43.3%) exhibited moderate knowledge of lifestyle modifications, while 36.3% demonstrated high knowledge levels. However, 20.4% of students had low knowledge scores, which is concerning given the critical role of lifestyle changes in diabetes management. Similar findings have been reported in studies conducted in the United States and the United Kingdom, where medical students displayed limited understanding of nutrition, physical activity, and behavioral counseling for chronic disease management (Garedow et al. 2023; Mekonnen, Abate, and Tegegne 2020).

Students in clinical years scored significantly higher in knowledge compared to those in preclinical years. This aligns with existing research suggesting that increased clinical exposure enhances students' understanding of disease management strategies, including lifestyle interventions (Zhu et al. 2024). However, the overall mean knowledge score (14.8 out of 20) indicates room for improvement, particularly in integrating comprehensive lifestyle medicine education into preclinical training.

The significant association between prior exposure to diabetes-related education and higher knowledge scores reinforces the importance of targeted curricular components. Students who received diabetes education scored an average of 15.9, compared to 12.7 among those without such exposure. These findings are consistent with studies emphasizing the impact of focused educational modules on improving students' knowledge of chronic disease prevention and management (Phillips, Rahman, and Mattfeldt-Beman 2018).

Despite moderate-to-high knowledge levels among participants, less than half (37.5%) reported regularly engaging in counseling patients about lifestyle modifications. This discrepancy between knowledge and practice is a well-documented phenomenon in medical education and clinical training (Awadh et al. 2024). Confidence in counseling was reported by 60.4% of participants, yet perceived barriers, such as lack of time (71.4%), insufficient training (63.1%), and low patient adherence (56.4%), hindered their ability to translate knowledge into practice.

The reported lack of confidence and limited engagement in lifestyle counseling are consistent with findings from other studies, where medical students cited inadequate training in communication and behavior change techniques as key obstacles (Small, Adkins, and Bell 2024; Spollen et al. 2010). Addressing these gaps through structured training in motivational interviewing, patient-centered communication, and practical applications of lifestyle medicine could enhance students' readiness to counsel patients effectively.

Students with prior exposure to diabetes education not only demonstrated higher knowledge scores but were also more likely to engage in lifestyle counseling. These findings align with research highlighting the value of focused, experiential learning opportunities in improving both theoretical knowledge and practical competencies (Camargo-Plazas et al. 2023). Interventions such as community-based projects, case-based learning, and interprofessional education have been shown to improve students' confidence and skills in lifestyle counseling (Darlow et al. 2015; Keshmiri and Barghi 2021).

The observed disparities between students with and without diabetes education underscore the need for standardized integration of lifestyle medicine into medical curricula. The inclusion of

dedicated modules on nutrition, exercise, and behavioral interventions, complemented by practical experiences, could help bridge these gaps and prepare students for real-world clinical scenarios.

The most frequently reported barriers to implementing lifestyle modifications were lack of time (71.4%), insufficient training (63.1%), and low patient adherence (56.4%). These findings are consistent with previous studies where medical students and practicing physicians cited time constraints and inadequate training as primary challenges to delivering effective lifestyle counseling (Clayton et al. 2021; Spiga et al. 2024). The slightly higher prevalence of these barriers among clinical students compared to preclinical students reflects the realities of time-pressured clinical environments.

Addressing these barriers requires systemic changes in both education and healthcare delivery. For instance, incorporating lifestyle medicine into early medical training could reduce the perceived burden of learning these skills during clinical years. Furthermore, emphasizing the importance of preventive care within healthcare systems could help alleviate time constraints by shifting the focus from acute care to long-term disease management.

The findings of this study align with international research highlighting the need for improved training in lifestyle medicine among medical students. A study conducted in Australia found that only 34% of medical students felt confident discussing lifestyle changes with patients, despite recognizing its importance in chronic disease management (Malatskey et al. 2019). Similarly, a survey of medical students in India revealed significant gaps in knowledge about dietary and physical activity guidelines for diabetes prevention and rehabilitation (Sousa et al. 2024).

These global patterns emphasize the universal need for curricular reforms to address the growing burden of diabetes and other lifestyle-related chronic diseases. Efforts such as the "Lifestyle Medicine Education Collaborative" in the United States and similar initiatives in Europe provide frameworks for integrating lifestyle medicine into medical training (Lianov 2010). Adapting these frameworks to local contexts, such as the Middle East, could help address region-specific challenges, including cultural attitudes toward diet and exercise.

Implications for Medical Education

The findings of this study have significant implications for medical education in Saudi Arabia and similar contexts. Integrating lifestyle medicine into the medical curriculum as a core component, rather than an optional or supplementary topic, is essential. Specific recommendations include:

1. Introducing dedicated modules on nutrition, exercise, and behavioral counseling in preclinical years.
2. Providing hands-on training through simulated patient encounters, community outreach programs, and interdisciplinary learning.
3. Encouraging reflective practice and self-assessment to help students identify and address their own biases or gaps in knowledge.

Moreover, institutional support for faculty development in lifestyle medicine is crucial. Faculty members trained in lifestyle counseling can serve as role models and mentors, fostering a culture of preventive care within medical schools.

Limitations and Future Directions

This study has several limitations. First, the reliance on self-reported data may have introduced social desirability bias, with participants potentially overstating their knowledge or practices. Second, the single-institution setting may limit the generalizability of findings to other medical schools in Saudi Arabia or the broader Middle East. Future research should include a larger, more diverse sample to enhance generalizability and explore the impact of specific educational interventions on knowledge and practice outcomes.

Further studies could also investigate the long-term impact of lifestyle medicine training on clinical practice. For instance, tracking the outcomes of medical students who receive enhanced training in lifestyle counseling could provide valuable insights into its effectiveness in real-world settings.

Conclusion

The findings of this study underscore significant gaps in the knowledge and practices of medical students regarding the rehabilitation of diabetic patients through lifestyle modifications. While prior exposure to diabetes education was associated with higher knowledge and better practices, systemic barriers such as lack of time and inadequate training persist. These results highlight the urgent need for curricular reforms to integrate lifestyle medicine into medical education, ensuring that future physicians are equipped to address the growing burden of diabetes effectivel

References :

Adams, Kelly M., Martin Kohlmeier, and Steven H. Zeisel. 2010. "Nutrition Education in U.S. Medical Schools: Latest Update of a National Survey." Academic Medicine 85(9):1537–42. doi: 10.1097/ACM.0b013e3181eab71b.

Albin, Jaclyn Lewis, Olivia W. Thomas, Farshad Fani Marvasti, and Jo Marie Reilly. 2024. "There and Back Again: A Forty-Year Perspective on Physician Nutrition Education." Advances in Nutrition 15(6):100230. doi: 10.1016/j.advnut.2024.100230.

Ali, S. I., Shaban, M., Elballah, K., Alarfaj, A. A., Elsheikh, E., & Ghoneim, N. I. A. (2023). The Effect of Cardiovascular and Asthma Control on Quality of Life Among elderly Asthmatic Patients Attending Central Hospital, King Khalid Hospital of Hafar Albatin City. Pakistan Heart Journal, 56(3), 648–656.

Awadh, Abdullah A., Rashed I. Ibrahim, Jehad H. Habeeballah, Abdulrahman F. Gassim, Sultan M. Alzahrani, Hassan O. Bogari, Anas S. AlGhamdi, and Mohammed A. Khan. 2024. "Knowledge and Attitude on the Role of Lifestyle Modifications in the Management of Diabetes in Jeddah, Saudi Arabia." Expert Review of Endocrinology & Metabolism 19(3):287–94. doi: 10.1080/17446651.2023.2296618.

Badawy, W., & Shaban, M. (2025). Intergenerational Relationships and Their Impact on Social Resilience Amongst Arab Society Elderly Populations: A Qualitative Exploration. Journal of Clinical Nursing. https://doi.org/10.1111/jocn.17568

Badawy, W., Shaban, M., Elsayed, H. H., & Hashim, A. (2024). Eco-conscious nursing: qualitative analysis of nurses' engagement with environmental sustainability in healthcare. Teaching and Learning in Nursing. https://doi.org/10.1016/j.teln.2024.11.019

Badawy, W., Zinhom, H., & Shaban, M. (2024). Perceptions of Resilience Among Nurses: A Qualitative Study Based on the Society-To-Cells Framework. Journal of Advanced Nursing. https://doi.org/10.1111/jan.16739

Badawy, W., Zinhom, H., & Shaban, M. (n.d.). Navigating ethical considerations in the use of artificial intelligence for patient care: A systematic review. International Nursing Review.

Camargo-Plazas, Pilar, Madison Robertson, Beatriz Alvarado, Geneviève C. Paré, Idevania G. Costa, and Lenora Duhn. 2023. "Diabetes Self-Management Education (DSME) for Older Persons in Western Countries: A Scoping Review" edited by V. M. Mendoza-Nuñez. PLOS ONE 18(8):e0288797. doi: 10.1371/journal.pone.0288797.

Clayton, Priscilla, Jeneene Connelly, Malik Ellington, Vicky Rojas, Yaisli Lorenzo, María Angélica Trak-Fellermeier, and Cristina Palacios. 2021. "Facilitators and Barriers of

Children's Participation in Nutrition, Physical Activity, and Obesity Interventions: A Systematic Review." Obesity Reviews 22(12). doi: 10.1111/obr.13335.

Colberg, Sheri R., Ronald J. Sigal, Jane E. Yardley, Michael C. Riddell, David W. Dunstan, Paddy C. Dempsey, Edward S. Horton, Kristin Castorino, and Deborah F. Tate. 2016. "Physical Activity/Exercise and Diabetes: A Position Statement of the American Diabetes Association." Diabetes Care 39(11):2065–79. doi: 10.2337/dc16-1728.

Darlow, Ben, Karen Coleman, Eileen McKinlay, Sarah Donovan, Louise Beckingsale, Ben Gray, Hazel Neser, Meredith Perry, James Stanley, and Sue Pullon. 2015. "The Positive Impact of Interprofessional Education: A Controlled Trial to Evaluate a Programme for Health Professional Students." BMC Medical Education 15(1):98. doi: 10.1186/s12909-015-0385-3.

Deshpande, Anjali D., Marcie Harris-Hayes, and Mario Schootman. 2008. "Epidemiology of Diabetes and Diabetes-Related Complications." Physical Therapy 88(11):1254–64. doi: 10.2522/ptj.20080020.

Elbus, L. M. S., Mostafa, M. G., Mahmoud, F. Z., Shaban, M., & Mahmoud, S. A. (2024). Nurse managers' managerial innovation and it's relation to proactivity behavior and locus of control among intensive care nurses. BMC Nursing, 23(1), 485. https://doi.org/10.1186/s12912-024-02084-8

Elsheikh, E., Ali, S. I., Kotb, A. A. H., Elballah, K., Begum, N., Pathat, A. W., & Shaban, M. (2023). Medication Adherence and Cardiovascular Outcomes in Elderly Patients: A Cross-Sectional Study in the Al Ahsa Region, Saudi Arabia. Pakistan Heart Journal, 56(3), 1087–1093.

Frates, Beth, Hugo A. Ortega, Kelly J. Freeman, John Patrick T. Co, and Melissa Bernstein. 2024. "Lifestyle Medicine in Medical Education: Maximizing Impact." Mayo Clinic Proceedings: Innovations, Quality & Outcomes 8(5):451–74. doi: 10.1016/j.mayocpiqo.2024.07.003.

Galaviz, Karla I., K. M. Venkat Narayan, Felipe Lobelo, and Mary Beth Weber. 2018. "Lifestyle and the Prevention of Type 2 Diabetes: A Status Report." American Journal of Lifestyle Medicine 12(1):4–20. doi: 10.1177/1559827615619159.

Garedow, Aster Wakjira, Tsiyon Mekoya Jemaneh, Addisalem Gebresilase Hailemariam, and Gorfineh Teshome Tesfaye. 2023. "Lifestyle Modification and Medication Use among Diabetes Mellitus Patients Attending Jimma University Medical Center, Jimma Zone, South West Ethiopia." Scientific Reports 13(1):4956. doi: 10.1038/s41598-023-32145-y.

Hill-Briggs, Felicia, Nancy E. Adler, Seth A. Berkowitz, Marshall H. Chin, Tiffany L. Gary-Webb, Ana Navas-Acien, Pamela L. Thornton, and Debra Haire-Joshu. 2021. "Social Determinants of Health and Diabetes: A Scientific Review." Diabetes Care 44(1):258–79. doi: 10.2337/dci20-0053.

Hossain, Md. Jamal, Md. Al-Mamun, and Md. Rabiul Islam. 2024. "Diabetes Mellitus, the Fastest Growing Global Public Health Concern: Early Detection Should Be Focused." Health Science Reports 7(3). doi: 10.1002/hsr2.2004.

Johnson, George E., Fredrick Clive Wright, and Kirsty Foster. 2018. "The Impact of Rural Outreach Programs on Medical Students' Future Rural Intentions and Working Locations: A Systematic Review." BMC Medical Education 18(1):196. doi: 10.1186/s12909-018-1287-y.

Keshmiri, Fatemeh, and TohidSeif Barghi. 2021. "Interprofessional Education in a Community-Based Setting: An Opportunity for Interprofessional Learning and Collaboration." Journal of Education and Health Promotion 10(1):298. doi: 10.4103/jehp.jehp_1015_20.

Klein, Samuel, Nancy F. Sheard, Xavier Pi-Sunyer, Anne Daly, Judith Wylie-Rosett, Karmeen Kulkarni, and Nathaniel G. Clark. 2004. "Weight Management through Lifestyle Modification for the Prevention and Management of Type 2 Diabetes: Rationale and Strategies. A Statement of the American Diabetes Association, the North American Association for the Study of Obesity, and the American So." The American Journal of Clinical Nutrition 80(2):257–63. doi: 10.1093/ajcn/80.2.257.

Lewgood, Jessica, Barbara Oliveira, Marie Korzepa, Scott C. Forbes, Jonathan P. Little, Leigh Breen, Robert Bailie, and Darren G. Candow. 2021. "Efficacy of Dietary and Supplementation Interventions for Individuals with Type 2 Diabetes." Nutrients 13(7):2378. doi: 10.3390/nu13072378.

Lianov, Liana. 2010. "Physician Competencies for Prescribing Lifestyle Medicine." JAMA 304(2):202. doi: 10.1001/jama.2010.903.

Malatskey, Lilach, Jumanah Essa-Hadad, Thomas A. Willis, and Mary C. J. Rudolf. 2019. "Leading Healthy Lives: Lifestyle Medicine for Medical Students." American Journal of Lifestyle Medicine 13(2):213–19. doi: 10.1177/1559827616689041.

Mekonnen, Chilot Kassa, Hailemichael Kindie Abate, and Elenie Tesfaye Tegegne. 2020. "Knowledge, Attitude, and Practice Toward Lifestyle Modification Among Diabetes Mellitus Patients Attending the University of Gondar Comprehensive Specialized Hospital Northwest, Ethiopia." Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy Volume 13:1969–77. doi: 10.2147/DMSO.S250787.

Mohamed, A. H., Shaban, M., Mohammed, H. H., Abobaker, R. M., Alsaqri, S. H., & Allam, R. A.-E. M. (2024). The impact of foot reflexology on fatigue and sleep quality in school-aged children undergoing hemodialysis. Journal of Integrative Nursing, 6(2), 76–82. https://doi.org/10.4103/jin.jin_3_24

Mohammed, S. A. A. K., & Shaban, M. (2025). Enhancing Communication and Empathy Skills in Geriatric Care: Nurses' Reflections on Simulation-Based Training for Patient Interaction and Education. Journal of Clinical Nursing. https://doi.org/10.1111/jocn.17662

Nazar, Chaudhary Muhammad Junaid, Micheal Mauton Bojerenu, Muhammad Safdar, and Jibran Marwat. 2016. "Effectiveness of Diabetes Education and Awareness of Diabetes Mellitus in Combating Diabetes in the United Kigdom; a Literature Review." Journal of Nephropharmacology 5(2):110–15.

Phillips, Emily, Rabia Rahman, and Mildred Mattfeldt-Beman. 2018. "Relationship Between Diabetes Knowledge, Glycemic Control, and Associated Health Conditions." Diabetes Spectrum 31(2):196–99. doi: 10.2337/ds17-0058.

Piščalkienė, Viktorija, and Hans Ingemann Lottrup. 2019. "BENEFITS OF EXPERIENTIAL BASED LEARNING: A CASE OF STUDENTS PARTICIPATION IN THE PROJECT 'VILLAGES ON MOVE BALTIC.'" Visuomenės Sveikata 28(6):5–15. doi: 10.5200/sm-hs.2018.064.

Rea, Brenda, Shannon Worthman, Paulina Shetty, Megan Alexander, and Jennifer L. Trilk. 2021. "Medical Education Transformation: Lifestyle Medicine in Undergraduate and Graduate Medical Education, Fellowship, and Continuing Medical Education." American Journal of Lifestyle Medicine 15(5):514–25. doi: 10.1177/15598276211006629.

Saha, Somnath, Mary Catherine Beach, and Lisa A. Cooper. 2008. "Patient Centeredness, Cultural Competence and Healthcare Quality." Journal of the National Medical Association 100(11):1275–85. doi: 10.1016/S0027-9684(15)31505-4.

Shaban, M. (2024). The Role of Nursing Education in Advancing Sustainable Development Goals: A Rapid Review of Current Pedagogical Strategies. Teaching and Learning in Nursing.

Shaban, M., Shaban, M. M., Mohammed, H. H., & El-kest, H. R. A. (2024). Barriers and facilitators to effective pain management in elderly Arab patients: a nursing perspective through a qualitative study. BMC Nursing, 23(1), 1–14.

Small, Priya, Sherry Adkins, and Amanda Bell. 2024. "Teaching Preclinical Medical Students Lifestyle Counseling Skills for Patients' Health Behavior Change." MedEdPORTAL. doi: 10.15766/mep_2374-8265.11478.

Sousa, Joana Rodrigues, Vera Afreixo, Joana Carvalho, and Paula Silva. 2024. "Nutrition and Physical Activity Education in Medical School: A Narrative Review." Nutrients 16(16):2809. doi: 10.3390/nu16162809.

Spiga, Francesca, Annabel L. Davies, Eve Tomlinson, Theresa HM Moore, Sarah Dawson, Katie Breheny, Jelena Savović, Yang Gao, Sophie M. Phillips, Frances Hillier-Brown, Rebecca K. Hodder, Luke Wolfenden, Julian PT Higgins, and Carolyn D. Summerbell. 2024. "Interventions to Prevent Obesity in Children Aged 5 to 11 Years Old." Cochrane Database of Systematic Reviews 2024(7). doi: 10.1002/14651858.CD015328.pub2.

Spollen, John J., Carol R. Thrush, Dan-vy Mui, Majka B. Woods, Sara G. Tariq, and Elizabeth Hicks. 2010. "A Randomized Controlled Trial of Behavior Change Counseling Education for Medical Students." Medical Teacher 32(4):e170–77. doi: 10.3109/01421590903514614.

Sugandh, FNU, Maria Chandio, FNU Raveena, Lakshya Kumar, FNU Karishma, Sundal Khuwaja, Unaib Ahmed Memon, Karoona Bai, Maham Kashif, Giustino Varrassi, Mahima Khatri, and Satesh Kumar. 2023. "Advances in the Management of Diabetes Mellitus: A Focus on Personalized Medicine." Cureus. doi: 10.7759/cureus.43697.

Tovote, K. Annika, Joke Fleer, Evelien Snippe, Irina V Bas, Thera P. Links, Paul MG Emmelkamp, Robbert Sanderman, and Maya J. Schroevers. 2013. "Cognitive Behavioral Therapy and Mindfulness-Based Cognitive Therapy for Depressive Symptoms in Patients with Diabetes: Design of a Randomized Controlled Trial." BMC Psychology 1(1):17. doi: 10.1186/2050-7283-1-17.

Venditti, Elizabeth M., and M. Kaye Kramer. 2013. "Diabetes Prevention Program Community Outreach." American Journal of Preventive Medicine 44(4):S339–45. doi: 10.1016/j.amepre.2012.12.014.

Zhu, Jerry, Andrew Min, Susan Lerner, John Phair, Ageliki Vouyouka, Christopher Smolock, Michael Marin, Peter Faries, Daniel Han, and Ajit Rao. 2024. "Development of a Surgical Skills Course for Preclinical Medical Students." JVS-Vascular Insights 2:100067. doi: 10.1016/j.jvsvi.2024.100067.