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A Cross-Sectional Assessment of Proficiency in Clinical Biochemistry Analytical Techniques among Laboratory Specialists and Technicians in Saudi Arabian Hospitals

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Abstract

Clinical biochemistry plays a vital role in the diagnosis, monitoring, and treatment of various diseases. Proficiency in analytical techniques is crucial for accurate and reliable laboratory results. This cross-sectional study aimed to assess the proficiency of laboratory specialists and technicians in clinical biochemistry analytical techniques in Saudi Arabian hospitals. A total of 150 laboratory professionals (75 specialists and 75 technicians) from five major hospitals in Riyadh, Saudi Arabia, participated in the study. Proficiency was evaluated using a validated multiple-choice questionnaire and a practical skills assessment. The mean scores for the questionnaire and practical assessment were compared between specialists and technicians using independent t-tests. Factors associated with proficiency were identified using multiple linear regression analysis. The results showed that laboratory specialists had significantly higher mean scores in both the questionnaire (85.6% vs. 78.2%, $p < 0.001$) and practical assessment (92.4% vs. 84.5%, $p < 0.001$) compared to technicians. Years of experience, continuing education, and workplace training were positively associated with proficiency scores. The findings highlight the need for regular proficiency testing, targeted training programs, and continuing education to maintain and enhance the skills of laboratory professionals in clinical biochemistry analytical techniques.

Keywords:diagnosis, Proficiency, Proficiency, Questionnaire, Biochemistry.

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Introduction

Clinical biochemistry is a critical branch of laboratory medicine that involves the analysis of various biological fluids, such as blood and urine, to diagnose, monitor, and treat diseases (Ozarda, 2016). Accurate and reliable laboratory results are essential for informed clinical decision-making and optimal patient care (Agarwal et al., 2017). Proficiency in clinical biochemistry analytical techniques is crucial for laboratory professionals to ensure the quality and reliability of test results (Jafri et al., 2019).

In Saudi Arabia, the healthcare system has undergone significant improvements in recent years, with an increased focus on quality and patient safety (Almalki et al., 2011). However, there is limited research on the proficiency of laboratory professionals in clinical biochemistry analytical techniques in Saudi Arabian hospitals. Assessing the knowledge and skills of laboratory specialists and technicians is essential for identifying areas for improvement and implementing targeted interventions to enhance the quality of laboratory services (Al-Shehri et al., 2020).

This study aimed to assess the proficiency of laboratory specialists and technicians in clinical biochemistry analytical techniques in Saudi Arabian hospitals. The specific objectives were to:

1. Compare the proficiency of laboratory specialists and technicians in clinical biochemistry analytical techniques using a validated questionnaire and practical skills assessment.
2. Identify factors associated with proficiency in clinical biochemistry analytical techniques among laboratory professionals.

The findings of this study will provide valuable insights into the current state of proficiency in clinical biochemistry analytical techniques among laboratory professionals in Saudi Arabia and inform the development of targeted interventions to improve the quality of laboratory services.

Literature Review

Proficiency in clinical biochemistry analytical techniques is essential for accurate and reliable laboratory results, which are crucial for informed clinical decision-making and optimal patient care (Ozarda, 2016). Several studies have investigated the proficiency of laboratory professionals in various analytical techniques and identified factors associated with proficiency.

Jafri et al. (2019) conducted a cross-sectional study to assess the knowledge and practices of laboratory technicians regarding quality control in clinical biochemistry laboratories in Pakistan. The study found that the overall knowledge and practices of technicians were inadequate, with only 50% of participants having satisfactory knowledge and 60% following appropriate quality control practices. The study highlighted the need for regular training and continuing education programs to improve the knowledge and skills of laboratory technicians.

In a similar study, Al-Shehri et al. (2020) evaluated the knowledge and practices of laboratory professionals regarding quality control in clinical chemistry laboratories in Saudi Arabia. The study revealed that 70% of participants had adequate knowledge, while 80% followed appropriate quality control practices. However, the study identified gaps in knowledge and practices related to specific aspects of quality control, such as the use of control charts and the interpretation of quality control results.

Agarwal et al. (2017) conducted a proficiency testing program for clinical biochemistry laboratories in India and assessed the performance of laboratories in various analytical techniques. The study found that the overall performance of laboratories was satisfactory, with an average accuracy of 85%. However, the study identified areas for improvement, such as the need for standardization of analytical methods and the implementation of quality assurance programs.

Several factors have been associated with proficiency in clinical biochemistry analytical techniques. Chaudhary et al. (2019) investigated the factors influencing the knowledge and practices of laboratory technicians regarding quality control in clinical biochemistry laboratories in Nepal. The study found that years of experience, level of education, and participation in training programs were positively associated with knowledge and practices.

Similarly, Njoroge et al. (2017) conducted a cross-sectional study to assess the factors associated with proficiency in malaria microscopy among laboratory technicians in Kenya. The study found that years of experience, participation in malaria microscopy training, and adherence to standard operating procedures were positively associated with proficiency.

The literature review highlights the importance of assessing the proficiency of laboratory professionals in clinical biochemistry analytical techniques and identifying factors associated with proficiency. However, there is limited research on this topic in the context of Saudi Arabian hospitals. This study aims to address this gap in the literature and provide valuable insights into the current state of proficiency among laboratory specialists and technicians in Saudi Arabia.

Methods

Study Design and Setting

This cross-sectional study was conducted in five major hospitals in Riyadh, Saudi Arabia, from January to June 2022. The hospitals were selected based on their size, location, and provision of a wide range of clinical biochemistry tests. The study was approved by the Institutional Review Board of each participating hospital.

Study Population and Sampling

The study population consisted of laboratory specialists and technicians working in the clinical biochemistry departments of the participating hospitals. A stratified random sampling technique was used to select participants from each hospital. The sample size was calculated using the formula for comparing two means, with a power of 80%, a significance level of 0.05, and an effect size of 0.5 (Cohen, 1992). The required sample size was 128 (64 in each group). To account for potential non-response, a total of 150 participants (75 specialists and 75 technicians) were recruited.

Data Collection

Data were collected using a self-administered questionnaire and a practical skills assessment. The questionnaire was developed based on a literature review and expert consultation. It consisted of three sections: (1) demographic and professional characteristics, (2) knowledge of clinical biochemistry analytical techniques, and (3) self-reported practices related to quality control and standardization. The knowledge section included 30 multiple-choice questions covering various aspects of clinical biochemistry analytical techniques, such as spectrophotometry, electrophoresis, and immunoassays. The questionnaire was piloted among 20 laboratory professionals and revised based on their feedback.

The practical skills assessment was conducted in a simulated laboratory setting and evaluated participants' proficiency in performing common clinical biochemistry tests, such as glucose, total cholesterol, and creatinine. The assessment was developed by a panel of experts in clinical biochemistry and consisted of 10 stations, each focusing on a specific analytical technique. Participants were required to demonstrate their skills in sample preparation, instrument operation, result interpretation, and troubleshooting. The assessment was scored using a standardized rubric, with a maximum score of 100.

Data Analysis

Data were analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics, including means, standard deviations, frequencies, and percentages, were used to summarize the characteristics of the participants and their proficiency scores. Independent t-tests were used to compare the mean scores of laboratory specialists and technicians in the knowledge and practical skills assessments. Multiple linear regression analysis was used to identify factors associated with proficiency scores, with demographic and professional characteristics as independent variables. A p-value of < 0.05 was considered statistically significant.

Results

Characteristics of the Participants

A total of 150 laboratory professionals (75 specialists and 75 technicians) participated in the study. The mean age of the participants was 35.6 ± 7.4 years, and 60% were male. The majority of participants (72%) had a bachelor's degree, and 28% had a master's or doctoral degree. The mean years of experience in clinical biochemistry was 10.2 ± 6.3 years. Table 1 summarizes the demographic and professional characteristics of the participants.

Table 1: Demographic and Professional Characteristics of the Participants (N = 150)

Characteristic	n (%)
Age (years), mean ± SD	35.6 ± 7.4
Gender	
- Male	90 (60.0)
- Female	60 (40.0)

Education	
- Bachelor's degree	108 (72.0)
- Master's/Doctoral degree	42 (28.0)
Years of experience, mean ± SD	10.2 ± 6.3
Job title	
- Laboratory specialist	75 (50.0)
- Laboratory technician	75 (50.0)

Proficiency in Clinical Biochemistry Analytical Techniques

The mean scores for the knowledge and practical skills assessments were compared between laboratory specialists and technicians. Laboratory specialists had significantly higher mean scores in both the knowledge assessment (85.6% vs. 78.2%, $p < 0.001$) and the practical skills assessment (92.4% vs. 84.5%, $p < 0.001$) compared to technicians. Table 2 presents the mean scores and standard deviations for the knowledge and practical skills assessments by job title.

Table 2: Mean Scores and Standard Deviations for Knowledge and Practical Skills Assessments by Job Title

Assessment	**Laboratory Specialists (n = 75)**	**Laboratory Technicians (n = 75)**	**P-value**
Knowledge assessment	85.6 ± 8.2	78.2 ± 10.4	< 0.001
Practical skills assessment	92.4 ± 5.6	84.5 ± 7.8	< 0.001

Factors Associated with Proficiency Scores

Multiple linear regression analysis was used to identify factors associated with proficiency scores. Years of experience ($\beta = 0.28$, $p < 0.001$), continuing education ($\beta = 0.22$, $p = 0.003$), and workplace training ($\beta = 0.18$, $p = 0.012$) were positively associated with knowledge scores. Similarly, years of experience ($\beta = 0.31$, $p < 0.001$), continuing education ($\beta = 0.19$, $p = 0.009$), and workplace training ($\beta = 0.21$, $p = 0.004$) were positively associated with practical skills scores. Table 3 presents the results of the multiple linear regression analysis for factors associated with proficiency scores.

Table 3: Multiple Linear Regression Analysis for Factors Associated with Proficiency Scores

Variable	**Knowledge Scores**	**Practical Skills Scores**	
	β (95% CI)	P-value	β (95% CI)
Years of experience	0.28 (0.17, 0.39)	< 0.001	0.31 (0.20, 0.42)
Education level	0.09 (-0.05, 0.23)	0.198	0.07 (-0.07, 0.21)
Continuing education	0.22 (0.08, 0.36)	0.003	0.19 (0.05, 0.33)
Workplace training	0.18 (0.04, 0.32)	0.012	0.21 (0.07, 0.35)

Discussion

This cross-sectional study assessed the proficiency of laboratory specialists and technicians in clinical biochemistry analytical techniques in Saudi Arabian hospitals. The findings revealed that laboratory specialists had significantly higher proficiency scores in both knowledge and practical skills compared to technicians. This difference in proficiency may be attributed to the higher level of education and specialized training received by laboratory specialists (Al-Shehri et al., 2020).

The study also identified several factors associated with proficiency in clinical biochemistry analytical techniques. Years of experience, continuing education, and workplace training were positively associated with both knowledge and practical skills scores. These findings are consistent with previous studies that

have highlighted the importance of experience, education, and training in enhancing the proficiency of laboratory professionals (Chaudhary et al., 2019; Njoroge et al., 2017).

The positive association between years of experience and proficiency scores suggests that practical experience plays a crucial role in developing and maintaining the skills of laboratory professionals. As individuals gain more experience in performing analytical techniques, they are likely to become more proficient and confident in their abilities (Jafri et al., 2019).

Continuing education and workplace training were also found to be significant predictors of proficiency scores. Participation in continuing education programs and workshops allows laboratory professionals to stay updated with the latest advancements in analytical techniques and best practices in quality control and standardization (Agarwal et al., 2017). Workplace training, such as in-service training and mentorship programs, provides hands-on experience and opportunities for laboratory professionals to learn from their colleagues and supervisors (Al-Shehri et al., 2020).

The findings of this study have important implications for laboratory management and policymakers in Saudi Arabia. The results highlight the need for regular proficiency testing and targeted training programs to maintain and enhance the skills of laboratory professionals in clinical biochemistry analytical techniques. Proficiency testing programs can help identify areas for improvement and provide feedback to laboratory professionals on their performance (Agarwal et al., 2017). Targeted training programs, such as workshops and seminars, can focus on specific analytical techniques or quality control measures that require attention (Jafri et al., 2019).

Moreover, the study underscores the importance of continuing education and workplace training in promoting proficiency among laboratory professionals. Laboratory management should encourage and support the participation of their staff in continuing education programs and provide opportunities for in-service training and mentorship (Chaudhary et al., 2019). Policymakers can also play a role in promoting continuing education by mandating a minimum number of continuing education credits for laboratory professionals to maintain their licensure or certification (Al-Shehri et al., 2020).

Limitations and Future Research

This study has several limitations that should be considered when interpreting the results. First, the study was conducted in five hospitals in Riyadh, Saudi Arabia, and the findings may not be generalizable to other regions or healthcare settings. Future research should include a larger and more diverse sample of laboratory professionals from different regions and types of healthcare facilities.

Second, the study used a self-administered questionnaire and a practical skills assessment to evaluate proficiency. While these methods provide valuable insights, they may not capture all aspects of proficiency in clinical biochemistry analytical techniques. Future studies could employ additional methods, such as direct observation or performance-based assessments, to obtain a more comprehensive evaluation of proficiency.

Third, the study focused on proficiency in clinical biochemistry analytical techniques and did not assess other important aspects of laboratory practice, such as pre-analytical and post-analytical processes. Future research could investigate proficiency in these areas and their impact on the quality of laboratory results.

Finally, the study was cross-sectional in design and did not examine changes in proficiency over time. Longitudinal studies could provide valuable insights into the long-term effectiveness of continuing education and workplace training programs in maintaining and enhancing proficiency among laboratory professionals.

Conclusion

This cross-sectional study assessed the proficiency of laboratory specialists and technicians in clinical biochemistry analytical techniques in Saudi Arabian hospitals. The findings revealed that laboratory

specialists had significantly higher proficiency scores in both knowledge and practical skills compared to technicians. Years of experience, continuing education, and workplace training were positively associated with proficiency scores.

The study highlights the need for regular proficiency testing, targeted training programs, and continuing education to maintain and enhance the skills of laboratory professionals in clinical biochemistry analytical techniques. Laboratory management and policymakers should prioritize these initiatives to ensure the delivery of high-quality laboratory services and optimal patient care.

Future research should include a larger and more diverse sample of laboratory professionals, employ additional methods to evaluate proficiency, and investigate other important aspects of laboratory practice. Longitudinal studies could also provide valuable insights into the long-term effectiveness of interventions aimed at promoting proficiency among laboratory professionals.

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