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Research

Knowledge And Awarnesss Among Undergraduate Dental Students About Non Invasive Portable Hemoglobin Concentration Monitoring System Using Optical Sensor For Anemia Disease

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Abstract

Anemia is a condition in which red blood cells are not able to carry adequate oxygen to the body's tissues, and is widely found in nearly a quarter of the world population. The typical method to screen for the iron-deficiency anemia, which is the major anemia found in the world, is to implement a blood test called a complete blood count (CBC). Therefore, this research presents an alternative method using an optical technique to measure hemoglobin concentration, which is the common indicator for diagnosing anemia. The light absorbance of the oxyhemoglobin at the wavelength of 660 nm and the deoxyhemoglobin at the wavelength of 880 nm were measured using the MAX30100 sensor. These wavelengths of light are obtained from red and infrared (IR) LEDs. The concept is based on the different absorption coefficients of blood at different electromagnetic wavelengths. This fact is used to indirectly calculate the hemoglobin concentration of blood through the modified Beer–Lambert law. Moreover, the result has been further converted to absolute hemoglobin concentration using a calibration curve derived from the cyanmethemoglobin test, which is the regular method for hemoglobin determination. The experiment shows that an accuracy of 90.9% can be achieved by our proposed noninvasive method. Therefore, the noninvasive portable hemoglobin concentration monitoring by the optical sensor has an acceptable result when compared with the invasive method, with less pain and lower risk of infection, as well as shorter processing time.

Keywords: Non-invasive hemoglobin monitoring, Optical sensor technology, Portable hemoglobin concentration monitor, Anemia detection.

INTRODUCTION

Anemia is a common health condition that affects many individuals worldwide and can have a significant impact on overall and oral health. Low hemoglobin levels can lead to symptoms such as weakness, fatigue, and pale oral mucosa, which are often observed in dental patients. Early detection of anemia is important for proper treatment and management. Traditionally, hemoglobin levels are measured using blood tests, which can be uncomfortable and time-consuming. However, modern non-invasive portable hemoglobin monitoring systems use optical sensor technology to measure hemoglobin levels quickly and painlessly without the need for a blood sample. This technology can be useful in dental practice, where identifying anemia early can help improve patient care. This study aims to assess the knowledge and awareness of undergraduate dental students about these non-invasive hemoglobin monitoring systems and their potential benefits in dentistry. Understanding students' awareness of this technology can help improve its adoption in dental practice, leading to better patient outcomes.

Aim And Objectives

To assess the knowledge and awareness of undergraduate dental students regarding non-invasive portable hemoglobin concentration monitoring systems using optical sensor technology for the detection and management of anemia in dental practice.

1) To evaluate the awareness level of undergraduate dental students about anemia and its impact on oral health.
2) To assess the knowledge of students regarding non-invasive hemoglobin monitoring technology using optical sensors.

METHOD

A cross-sectional survey was conducted among 245 dental students, comprising 84 males (34.3%) and 161 females (65.7%), including 72 third-year BDS students, 99 fourth-year BDS students and 74 interns. The survey included 11 questions exploring awareness, perceptions, On non invasive portable hemoglobin concentration monitoring system using optical sensor for anemia disease for pre-clinical Curriculum. Responses were analyzed based on gender and year of study using chi-square tests to identify statistically significant differences.

Methodology:

A) study design and area:- A cross sectional study was carried out at tertiary care teaching hospital Khammam
B) Study population: The health care students including those of III year IV year and Interns who responded to the offline paper print questionnaire survey.
C) Study Instrument: A self administered questionnaire was designed based on knowledge attitude and awareness on the shade matching ability had total 11 questions. Each participant has to fill their demographic data like Name, age, and year of study. Participant has to select one option from the answers provided against questions the questions were based on knowledge attitude and awareness among dental students.
D) Pilot study: A pilot study was conducted on a group of students to assess the validity and reliability of study
E) Sampling method: The sampling method used is convenience method
F) Inclusion criteria: The students who were interested in study and who are willing to participate
G) Exclusion criteria: students who are not willing to participate are excluded
H) Organizing the study: The study was designed in a paper based version of the self administered questionnaire of 11 questions focusing on knowledge, awareness. Includes the sections of demographic data: Name, Age, Sex and Year of study demographic information and asked to answer all questions by selecting one option from the provided answers. I) Statistical analysis: Data from the filled questionnaire was conducted in a tabular form in an excel worksheet and evaluated for analysis. the analysis was performed by SSPS version 29

RESULTS

A total of 245 students took part in this with female (65.7%) and male of (34.3%). Age of the participants ranging from 18-25years. In this study females were more likely to demonstrate awareness of non invasive portable hemoglobin concentration monitoring system than males. Significantly Interns showed greater familiarity with advanced applications than fourth year students**.**

AGE					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Age	245	2	26	22.13	1.638

Gender				
	N	**Percent**	**Valid Percent**	**Cumulative Percent**

Valid	MALE	84	34.3	34.3	34.3
	FEMALE	161	65.7	65.7	100.0
	Total	245	100.0	100.0	

Year of study					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	III BDS	72	29.4	29.4	29.4
	IV BDS	99	40.4	40.4	69.8
	INTERNS	74	30.2	30.2	100.0
	Total	245	100.0	100.0	

Distribution and comparison of responses based on gender

Item	**Respo nse**	**Males**		**Females**		**Chi-Square value**	**P value**
		n	**%**	**n**	**%**		
Q1	1	83	98.8	156	96.8	13.915	0.001*
	2	0	0	4	2.4		
	3	0	0	0	0		
	4	1	1.2	1	0.6		
Q2	1	49	58.3	78	61.4	8.445	0.038*
	2	31	36.9	54	63.5		
	3	3	3.50	20	87		
	4	1	1.10	9	90		
Q3	1	30	33	61	67	5.698	0.127
	2	50	39.1	78	60.9		
	3	3	18.8	13	81.2		
	4	1	10	9	90		
Q4	1	25	27.8	65	72.2	12.493	0.006*
	2	53	44.2	67	55.8		
	3	5	23.8	16	76.2		
	4	1	7.1	13	92.9		
Q5	1	21	30	49	70	10.422	0.015*
	2	55	42.6	74	57.4		
	3	6	18.2	27	81.8		
	4	2	15.4	11	84.6		
Q6	1	24	29.6	57	70.4	9.978	0.019*
	2	56	41.8	78	58.2		
	3	3	13.6	19	86.4		
	4	1	12.5	7	87.5		
Q7	1	27	38	44	62	6.714	0.082
	2	49	37.7	81	62.3		
	3	7	21.2	26	78.8		
	4	1	9.1	10	90.9		
Q8	1	24	34.8	45	65.2	5.352	0.148
	2	56	37.6	93	62.4		
	3	3	16.7	15	83.3		
	4	1	11.1	8	88.9		
Q9	1	22	31.9	47	68.1	7.245	0.064
	2	56	40	84	60		
	3	5	17.9	23	82.1		
	4	1	12.5	7	87.5		
Q10	1	21	25.0	48	29.8	13.179	0.004*
	2	59	70.2	79	49.0		
	3	4	4.70	34	21.1		
Q11	1	21	35.0	39	65	9.330	0.025*
	2	55	40.4	81	59.6		
	3	7	16.7	35	83.3		
	4	1	14.3	6	85.7		

P≤0.05 is statistically significant

DISCUSSIONS

Anemia is a disease concerning a decrease in hemoglobin concentration due to a reduction in hemoglobin synthesis. Anemia can be caused by several factors, including nutritional deficiencies and infectious diseases. In nutritional deficiency-related anemia, insufficient intake of iron, vitamin A, vitamin B12, pyridoxine and folate have been reported to contribute. Elderly people might easily suffer from anemia because of a decline in proteincalorie nutrition. In infectious disease-related anemia, patient with diseases interfering with plasma volume could result in a reduction in the circulating concentration of hemoglobin, as the hemoglobin concentration is defined as the quantity of hemoglobin in one unit of plasma volume. Patients with chronic heart failure, renal failure, liver failure and excessive sodium may suffer from an increase in circulating volume and hence a decrease in hemoglobin concentration. Patients with inflammatory intestine disease may suffer from enteric blood loss and finally, result in anemia. In normal people, hemoglobin concentration may be varied due to many reasons, including age, diastolic pressure, pulse pressure, albumin level and pharmacotherapy. Due to the variation of hemoglobin concentration, the WHO has classified the level of anemia based on the range of hemoglobin concentration. In normal males, hemoglobin concentration is 140–180 g/L, whereas in normal females, hemoglobin concentration is between 120 and 160 g/L. The standard clinically approved method for hemoglobin concentration measurement is called the cyanmethemoglobin method, in which a blood sample is drawn from a subject. Our proposed method of hemoglobin concentration measurement using the modified Beer–Lambert law is not intended to replace the cyanmethemoglobin method, rather, it is intended to be used as a screening test for anemia. Patients with negative results or at the boundary line will be encouraged to do further tests with a conventional cyanmethemoglobin hemoglobin concentration measurement method at the hospital. Moreover, as the proposed method is noninvasive and painless, it can be used for real-time monitoring of hemoglobin concentration.

The awareness and knowledge of non-invasive portable hemoglobin concentration monitoring systems using optical sensors among undergraduate dental students are crucial in enhancing early anemia detection in dental practice. Anemia can manifest in various oral symptoms, such as pale mucosa, glossitis, and delayed wound healing, making its identification essential for comprehensive patient care. Traditional methods of hemoglobin measurement involve invasive blood tests, which can be uncomfortable and time-consuming. However, advancements in optical sensor technology, including near-infrared (NIR) spectroscopy and photoplethysmography (PPG), offer a painless, quick, and efficient alternative for anemia screening. Despite its benefits, many dental students may lack sufficient awareness of these technologies due to limited exposure in their curriculum. Integrating training on non-invasive hemoglobin monitoring into dental education can improve students' ability to identify and manage anemic patients effectively. Furthermore, interdisciplinary collaboration between dental and medical professionals can enhance patient outcomes by ensuring timely diagnosis and treatment. While challenges such as cost, accuracy concerns, and limited training exist, increasing awareness through education and hands-on experience can encourage the adoption of these innovative diagnostic tools in dental practice.

CONCLUSION

Anemia is a prevalent health issue that can significantly impact both general and oral health. Early detection is essential for effective management, especially in dental practice, where anemia can affect wound healing, increase bleeding risk, and influence treatment outcomes. Traditional hemoglobin testing methods are invasive and time-consuming, whereas non-invasive portable hemoglobin concentration monitoring systems using optical sensors offer a quick, painless, and efficient alternative. This study highlights the importance of knowledge and awareness among undergraduate dental students regarding this innovative technology. Understanding and integrating non-invasive hemoglobin monitoring into dental practice can enhance early detection, patient care, and interdisciplinary collaboration between dentistry and general healthcare. However, the study findings may indicate gaps in awareness and knowledge among dental students, emphasizing the need for educational programs and hands-on training on emerging diagnostic tools. By incorporating non-invasive hemoglobin monitoring systems into dental education and practice, future dentists can contribute to better patient health outcomes and a more advanced approach to anemia screening in dentistry.

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