

Knowledge, Attitude and Usage of Pulse Oximeter among Pediatric Resident Doctors

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ABSTRACT

Background: Pulse oximetry is a simple, affordable, non-invasive method for the assessment of patients' oxygen saturation. Given the importance and wide use of pulse oximeter it is currently regarded as the fifth vital sign. Despite the importance of pulse oximeter, a proportion of clinicians are unaware of its mechanism of use, advantages, and limitations.

Objectives: To assess the knowledge, attitude and usage of pediatrics resident doctors towards the pulse oximeter, and to assess the factors affecting them.

Methods: This is an analytic cross-sectional study conducted among pediatrics resident doctors in Sudan Medical Specialization Board during the period of January 2022 to May 2022. A minimal sample size of 269 was calculated and simple random sampling was used to select participants. Data was collected through a questionnaire assessing the socio-demographic characteristics, training on pulse oximeter, availability of pulse oximeter, usage of pulse oximeter, knowledge regarding pulse oximeter, and attitude towards pulse oximeter. Data was analyzed using SPSS version 26, and p-values less than 0.05 were considered significant.

Results: A total of 274 participants were involved in the study. 168 didn't receive training on the use of pulse oximeter. A good number of the participants were classified as having good knowledge (48.5%), while 56.9% were classified as having a positive attitude. Pulse oximeter was used routinely by 87.2% of the participants to record the saturation of the critically-ill children. Frequency of participants with good knowledge was significantly higher among senior resident doctors compared to the junior ones ($P=0.017$).

Conclusion: Although the use of pulse oximeter among pediatric residents is good, their knowledge regarding its uses or drawbacks is sub-optimal. Thus the implementation of a training program will greatly improve the right and safe practice of pulse oximetry by pediatric residents.

Keywords

Pulse Oximeter, Knowledge, Attitude and Usage, Doctors.

Introduction

Pulse oximetry is a diagnostic method that used for a simple, continuous, and non-invasive estimation of patient oxygenation

and thus has become the standard of care in a multitude of clinical settings [1]. Its pediatric applications have also expanded impressively, to the point that oxygen saturation by pulse oximetry (SpO_2) has been suggested as the fifth vital sign [2]; Its painless and reliable method for measuring arterial oxygen saturation and often used in the assessment of children with symptoms suggestive

of Hypoxia because of the difficulty in subjecting them to taking repeated blood gases [3]. It provides standard care for transport of patients in hospital or between hospitals, interventional sedation, and bedside monitoring in critical illnesses [4]. However, despite its widespread use and the reliance placed on the information offered by pulse oximetry, the underlying principles and the associated limitations of pulse oximetry are not always entirely understood by health care professionals [5].

This technology could add valuable information to physicians in the evaluation of sick children, especially in resource-poor settings where more expensive methods for arterial blood gases estimation or even not available. The pulse oximeter measures the discrepancy in the absorption of red and infrared light by hemoglobin and oxy-hemoglobin in fractions of blood under the sensor probe. It then calculates the percentage of hemoglobin saturated with oxygen [6].

Limitations and measurement errors during the use of pulse oximetry devices are problematic and may be caused by patient-related factors or device-related factors. Methemoglobin, carboxyhemoglobin, cyanotic heart diseases and signal disturbance due to poor perfusion, patient movement, and incorrect probe use may cause misleading pulse oximetry results [7]. Today, pulse oximetry devices are frequently used in the monitoring of patients in many clinics. However, many physicians are unaware of the limitations of using this technology. The aim of this study is to assess the knowledge, attitude, and usability of pulse oximeter among pediatrics registrars in Sudan.

Materials and Methods

This is a multicenter, analytic and hospital-based cross-sectional study. The study area was the pediatric hospitals to which pediatric residents of the Sudan Medical Specialization Board (SMSB) are distributed for their residency training. Data collection was carried out during the period of January 2022 to May 2022. The study population was all the pediatrics residents registered at the Sudan Medical Specialization Board (SMSB) during the study period. Pediatrics resident registered in SMSB and currently at practice were included. Residents not on practice or refused to participate were excluded. The minimum required number for sample size was calculated using the Yamane formula: the minimum required sample size is 269 pediatric resident doctors. A total of 274 participants were included.

A questionnaire was used for data collection. It consisted of four parts: Socio-demographic characteristics, training on pulse oximeter, availability of pulse oximeter, usage of pulse oximeter, knowledge regarding pulse oximeter, and attitudes towards pulse oximeter. Data was firstly reviewed, ordered, and coded and then the Statistical Package for the Social Sciences (SPSS) version 26 was used for data analysis. Descriptive statistics were applied to all the study variables in the form of frequencies and percentages. Inferential statistics were conducted in the form of Chi-Square test to assess the factors associated with the use of pulse oximeter,

knowledge regarding pulse oximeter, and attitude towards pulse oximeter. P-values less than 0.05 were considered significant.

Ethical approval for this study was obtained from the Research Ethics Committee of Sudan Medical Specialization Board and the Education Development Center. A written informed consent was obtained from all resident doctors included.

Results

A total of 274 participants were involved in this study. The majority were in the age group of 25-30 years (N=142, 51.8%), females (N=221, 80.7%), and were single (N=141, 51.5%) (Table 1). Residents at R1 were 71 (25.9%), R2 were 14 (5.1%), R3 were 94 (34.3%) and R4 were 95 (34.6%) of the study participants respectively (Figure 1).

114 (41.6%) of residents were working in a tertiary hospital, 112, (40.9%) in secondary hospitals, 42 (15.3%) primary hospitals and six participants (2.2%) were working in a private facility (Figure 2). The majority of participants didn't receive training on the use of pulse oximeter (N=168, 61.3%). A pulse oximeter was available in the hospital for 235 participants (85.8%), while it wasn't available for 39 participants (14.2%). It was used to routinely record the saturation for children with critical conditions by 239 participants (87.2%), while 35 participants (12.8%) didn't use it.

The vast majority of the involved residents, 265 (96.7%) identified that hypoxemia can occur due to conditions other than pneumonia, 262 (95.6%) identified that high oxygen levels can be harmful, 185 (67.5%) identified that pulse oximeter can identify patients at high risk of death, 243 (88.7%) stated that pulse oximeter can detect the improvement or deterioration in patients' condition, 241 (88%) identified that pulse oximeter readings can change the plan and 226 participants (82.5%) stated that all in-patients should have their oxygen saturation taken at admission (Figure 3).

Participants were classified as having good knowledge (N=133, 48.5%), fair knowledge (N=129, 47.1%), and poor knowledge (N=12, 4.4%) (Table 2). Regarding attitude towards pulse oximeter, 154 participants (56.2%) disagreed to the opinion that pulse oximeter is difficult to use, while 148 participants (54%) were disagreed that pulse oximeter readings are difficult to interpret, and 142 participants (51.8%) strongly agreed that pulse oximeter principles and interpretation should be taught in the beginning of pediatric training (Table 3).

Most of the participants were classified as having positive attitude (N=156, 56.9%), while 118 participants (43.1%) were classified as having negative attitude. Analysis didn't show a statistically significant association between participant's residency level and the routine use of pulse oximeter to record saturation in children with critical condition (Table 4). In addition, having training on the use of pulse oximeter also didn't show a significant association to the routine use of pulse oximeter (Table 5). Participants' residency

level showed a significant association to the level of knowledge regarding pulse oximeter. The frequency of participants with good knowledge showed an incremental increase as participants' level of residency increased, being 32% among R1 residents, 50.0% among R2 residents, 53.2% among R3 residents and 55.8% among R4 residents (Table 6). Receiving previous training on the use of pulse oximeter however didn't show an association to their level of knowledge. Participants' residency level didn't show a significant association to their attitude towards pulse oximeter. Additionally, having training on the use of pulse oximeter wasn't significantly associated to attitudes towards pulse oximeter. The level of knowledge in this study was not associated to the attitudes towards pulse oximeter.

Table 1: Characteristics of the study participants.

Category	Frequency	Percent
Age		
20-25	1	0.4
25-30	142	51.8
30-35	101	36.9
More than 35	30	10.9
Gender		
Male	53	19.3
Female	221	80.7
Marital status		
Single	141	51.5
Married	133	48.5

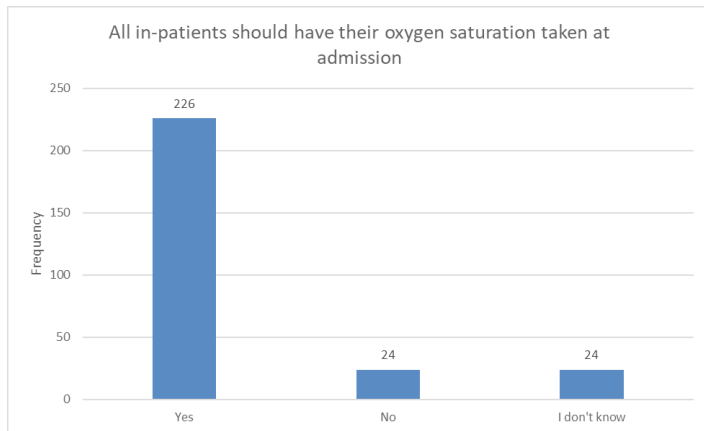


Figure 1: Study participants' residency level.

Table 2: Classification of the study participants according to their level of knowledge.

Knowledge Level	Frequency	Percent
Good knowledge	133	48.5
Fair knowledge	129	47.1
Poor	12	4.4
Total	274	100

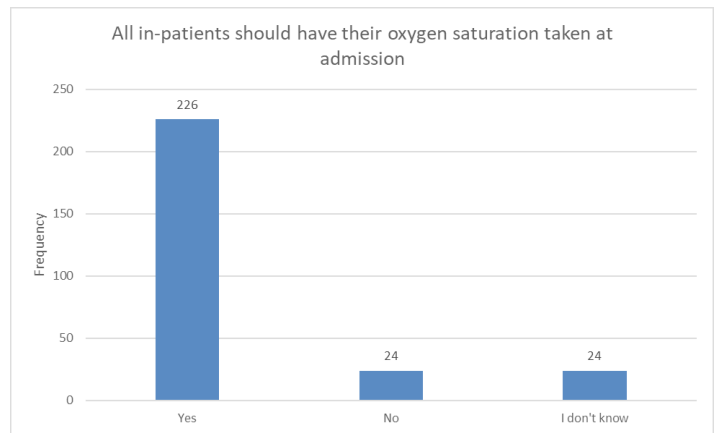


Figure 2: Work setting of the study participants.

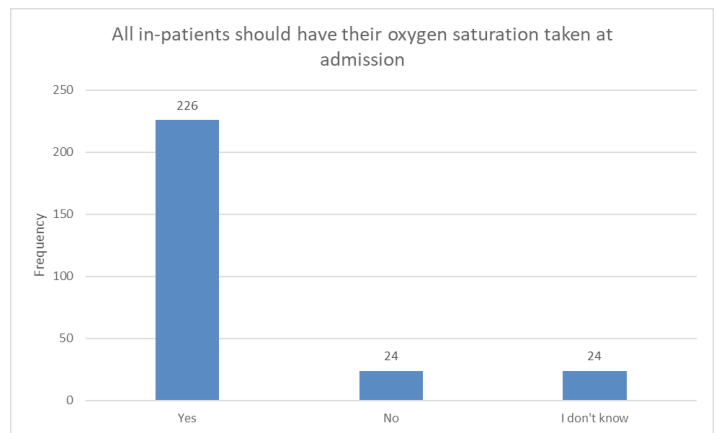


Figure 3: Assessment of oxygen saturation upon admission.

Table 3: Attitude of the study participants towards pulse oximeter.

Category	Frequency	Percent
Pulse oximeters are difficult to use		
Strongly agree	2	0.7
Agree	9	3.3
Neutral	8	2.9
Disagree	154	56.2
Strongly Disagree	101	36.9
Pulse oximeters are difficult to interpret		
Strongly agree	3	1.1
Agree	13	4.7
Neutral	16	5.8
Disagree	148	54
Strongly Disagree	94	34.3
Principles of pulse oximeter and interpretation should be taught in beginning of rotation		
Strongly agree	142	51.8
Agree	111	40.5
Neutral	17	6.2
Disagree	4	1.5
Strongly disagree	0	0.0

Table 4: Association of participants' residency level to the usage of pulse oximeter.

Residency levels	Do you routinely record saturation in children with critical conditions		Total	Chi-Square P-Value
	Yes	No		
R1	N	66	5	71
	R%	93.0%	7.0%	100.0%
	C%	27.6%	14.3%	25.9%
R2	N	11	3	14
	R%	78.6%	21.4%	100.0%
	C%	4.6%	8.6%	5.1%
R3	N	81	13	94
	R%	86.2%	13.8%	100.0%
	C%	33.9%	37.1%	34.3%
R4	N	81	14	95
	R%	85.3%	14.7%	100.0%
	C%	33.9%	40.0%	34.7%
Total	N	239	35	274
	R%	87.2%	12.8%	100.0%
	C%	100.0%	100.0%	100.0%

Table 5: Association of previous training on pulse oximetry to its usage.

Have you had any training on the use of pulse oximeters	Do you routinely record saturation in children with critical conditions		Total	Chi-Square P-Value
	Yes	No		
Yes	N	95	11	106
	R%	89.6%	10.4%	100.0%
	C%	39.7%	31.4%	38.7%
No	N	144	24	168
	R%	85.7%	14.3%	100.0%
	C%	60.3%	68.6%	61.3%
Total	N	239	35	274
	R%	87.2%	12.8%	100.0%
	C%	100.0%	100.0%	100.0%

Table 6: Association of participants' residency level to their level of knowledge regarding pulse oximeter.

Residency levels	Level of Knowledge			Total	Chi-Square P-Value
	Good	Fair	Poor		
R1	N	23	45	3	71
	R%	32.4%	63.4%	4.2%	100.0%
	C%	17.3%	34.9%	25.0%	25.9%
R2	N	7	5	2	14
	R%	50.0%	35.7%	14.3%	100.0%
	C%	5.3%	3.9%	16.7%	5.1%
R3	N	50	42	2	94
	R%	53.2%	44.7%	2.1%	100.0%
	C%	37.6%	32.6%	16.7%	34.3%
R4	N	53	37	5	95
	R%	55.8%	38.9%	5.3%	100.0%
	C%	39.8%	28.7%	41.7%	34.7%
Total	N	133	129	12	274
	R%	48.5%	47.1%	4.4%	100.0%
	C%	100.0%	100.0%	100.0%	100.0%

Discussion

Pulse oximeter is a device that is used as a non-invasive assessor of oxygen saturation. The device is used in different aspects

of pediatrics care including general assessment, emergency department assessment, and intensive care units' assessment [8]. Despite its wide availability and value, healthcare workers justify its under use by the rationale that children who suffer hypoxemia will also exhibit signs related to it such as cyanosis or tachypnea, and may have an abnormal respiratory or cardiac examination. However, Infants (particularly those aged less than two months) may have a subtle presentation of pulmonary or cardiac conditions, and clinical signs are not as clear in this age group [9].

In this study, 274 pediatric residents currently registered in the Sudan Medical Specialization Board were recruited and studied. The aim of the study was to assess: the usage of pulse oximeter, residents' level of knowledge regarding pulse oximeter, attitudes towards pulse oximeter; and to determine the factors affecting the use of pulse oximeter, knowledge regarding pulse oximeter, and attitude towards the pulse oximeter.

A pulse oximeter was available in the hospital for 85.8% of the study participants, and 87.2% of the participants stated it that they use it routinely to record oxygen saturation in the critically-ill children. In a regional setting, Enoch et al found that in Nigeria, unlike in this study, there is a wide unavailability of pulse oximeter, which in turn resulted in its underuse [10].

Less than half of the participants were classified as having good knowledge regarding pulse oximeter in this study (48.5%). Drawbacks to the use of pulse oximeter was known to the majority of participants, but the drawbacks that were identified the most were low perfusion (28.9%), hypothermia (27.7%), and dyes (19.3%). This finding is higher than that reported in Turkey by Eyubuglo et al., as in their study, only 21% of the participants were familiar with the drawbacks of pulse oximetry [11]. In Greece, Fouzas et al. also reported a similar deficiency in the theoretical aspects of pulse oximetry (such as the limitations of its use) compared to practical knowledge (such as the normal oxygen saturation values) [12].

A significant association was noted between participants' residency level and their level of knowledge. Frequency of participants with good knowledge significantly increased as the residency level increased, being 32.4% among fresh residents (R1) compared to 55.8% among senior (R4) residents. This finding is in consistence with the previous literature, where Teoh et al found that senior doctors had a significantly higher knowledge score (70%) compared to junior doctors (65%) [13]. This could be attributed to the increasing level of knowledge and expertise that residents gain during the succession of years in their training, which may increase their awareness towards the importance of pulse oximeter in the practice compared to junior doctors.

In our study, attitudes towards pulse oximeter were positive among 56.9% of the involved participants. Training on pulse oximeter was not received by 61.3% of the participants, and 51.8% of the participants strongly agreed that a training should be started

in the beginning of residency. Similar findings were reported in UK by Davies et al., in their study where they found 84% of the participants didn't receive a training on pulse oximeter, and 65% of their participants supported the implementation of training on the use of pulse oximeter [14].

Conclusion

The majority of the study participants didn't receive training on the use of pulse oximeter and the vast majority routinely used it in the assessment of critically-ill children. Less than half of the study participants were classified as having good knowledge, while the majority was classified as having a positive attitude towards pulse oximeter. A significant association was found between participants' residency level and their knowledge regarding pulse oximeter, with higher frequencies of good knowledge being found among senior participants.

Recommendations

Given the important role that pulse oximeter plays in the assessment, monitoring, and detection of clinical conditions, we recommend:

- The implementation of a training program aimed to discussing the mechanism, uses, advantages, and drawbacks of pulse oximeter in the beginning or pediatrics rotations.
- Improving knowledge may not necessarily to improving in clinical competency so further research will need to be carried out to measure connection between knowledge and competency and to use that basis for education and training.

Limitations

By its nature (across-sectional), the study design and method adopted were limited by its collected information on residents' self-reported about knowledge, attitude and usage of pulse oximeter. Hence, the residents practice responses might prone to bias as overestimation of their attitude and practice. It is known that in such occasion people tend to express what they consider the right view behavior rather than the actual one.

Ethical Consideration

Ethical approval for this study was obtained from the Research Ethics Committee of Sudan Medical Specialization Board and the Education Development Center. A written informed consent was obtained from all resident doctors included.

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