Frontiers in Health InformaticsISSN-Online: 2676-7104 www.healthinformaticsjournal.com
2024; Vol 13: Issue 3 Open Access

The Validity Test of Anemia, Scabies and Pediculosis Capitis Screening Instruments in Students at Islamic Boarding School

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Cite this paper as: Dwi Handayani, Kuuni Ulfah Naila El Muna, Mursyidul Ibad, Maki Zamzam (2024) The Validity Test of Anemia, Scabies and Pediculosis Capitis Screening Instruments in Students at Islamic Boarding School. *Frontiers in Health Informatics, 13* (3), 7267-7274

Abstract
Students in Islamic boarding schools are known to have quite complex health vulnerability risks, such as the risk of infectious diseases (pediculosis capitis) and nutritional deficiency problems (anemia). Therefore, it is important to conduct screening to detect health problems early in the student population. Although several screening instruments have been used in the context of students, there has been no adequate research on the validity of these instruments. Based on these conditions, it is necessary to test the validity of existing screening instruments for pediculosis capitis and anemia in students. This study used a cross-sectional design to assess the validity of existing screening instruments. This study was conducted on 85 students aged 12-22 years in East Java. The screening tool used was a questionnaire, while anemia examination used a Hemoglobin (Hb) measuring instrument and pediculosis examination with physical examination as the gold standard method. The results of the anemia screening test showed a sensitivity value of 62% and a specificity of 91%. The scabies screening instrument showed a sensitivity of 68% and a specificity of 87%, which means it is quite good at detecting most cases of scabies, but there is still a risk of missing cases (sensitivity does not reach 100%). Pediculosis capitis screening showed a sensitivity of 78% and a specificity of 73%. A combination of a more comprehensive screening approach and interventions involving education, training, additional examinations, and collaboration with medical personnel is highly recommended.

Keywords*: Anemia, Scabies, Pediculosis Capitis, Screening, Validity*

1. Introduction

Boarding schools play an important role in education and social life, with the number of students reaching millions. The current increase in the number of students is a challenge in ensuring their health. Students at Islamic Boarding Schools are known to have quite complex health vulnerability risks, such as the risk of infectious diseases and nutritional deficiency problems (Ministry of Health of the Republic of Indonesia, 2019). Pediculosis capitis and anemia are health problems that are often found in Islamic boarding school environments in Indonesia. Students, as a population that lives together in dense conditions and often interacts, have a high risk of contracting these diseases (Ghiffari et al., 2020). Pediculosis capitis is caused by head lice. This disease can cause physical discomfort and is very contagious if left untreated. Meanwhile, anemia is one of the most common nutritional deficiencies in women aged over 15 years at 23%. Anemia, mainly caused by iron deficiency, can interfere with the health and learning performance of students (Ekayanti et al., 2020).

Lack of attention to efforts to prevent health risks among Islamic boarding schools can increasingly cause many undetected problems. One of the activities to prevent disease or health problems among students is to conduct screening that can detect health problems early, so that prevention and treatment can be carried out as soon as possible. However, data on health problems in students is still limited. Although there are prevention and control efforts carried out in Islamic boarding schools, there is no specific and valid screening instrument to detect the risk of anemia and pediculosis capitis early among students. Most of the screening methods currently used are subjective and less reliable in detecting early cases of the disease.

Therefore, this study aims to highlight the validity and clarity of existing screening instruments for scabies, pediculosis capitis, and anemia in students. This evaluation will involve testing existing screening instruments. With the screening instrument, it is hoped that the problems of anemia and pediculosis capitis among students can be detected earlier and preventive measures and treatment can be provided more effectively.

2. Methods

This study used a cross-sectional design to assess the validity of existing screening instruments. This study was conducted on 85 students aged 12-22 years in East Java. The screening tool used was a questionnaire, while anemia examination used a Hemoglobin (Hb) measuring instrument and pediculosis examination with physical examination as the gold standard method. The data obtained were analyzed based on measurement classification, namely anemia and non-anemia groups. The data obtained were made into a screening instrument calculation table against the gold standard. The data were analyzed descriptively in the form of proportion values and calculations were carried out. The data were analyzed descriptively by calculating the sensitivity, specificity, positive predicted value and negative predicted value.

3. Results and discussion

3.1 Validity test of Anemia screening

There are 5 symptoms of anemia, students most often experience frequent dizziness, and accompanied by other anemia symptoms such as pale eylids, menstruating, pale skin and nails, frequent dizziness and purple lower tongue.

Table 1. Distribution symptoms of Anemia

No	Symptoms of Anemia	Yes		No	
		n	%	n	%
1	Pale eylids	23	27%	62	73%
2	Menstruating	19	22%	69	78%
3	Pale skin and nails	25	29%	60	71%
4	Frequent dizziness	38	44,7%	47	55,3%
5	Purple lower tongue	13	15%	72	85%

Table 2. Results of Anemia Screening with The Gold Standard

Screening	*Gold Standar*		Total
	Positive	Negative	
Suspected	18	5	23
Unexpected	11	51	62
Total	29	56	85

Sensitivity = True positive : (True positive + False negative)
= 18 : (18 + 11)
= 18 : 29
= 0,62 = 62%

Specificity = True negative : (True negative + False positif)
= 51 : (51 + 5)
= 51 : 56
= 0,91 = 91%

Positive Predictive Value (PPV) = True positive : (True positive + False positive)
= 18 : (18 + 5)
= 18 : 23

= 0,78 = 78%

Negative Predictive Value (NPV) = True negative : (True negative + False negative)
= 46 : (46 + 16)
= 46 : 62
= 0,74 = 74%

The results of the study on the validity of the anemia screening instrument in students showed a sensitivity of 62% and a specificity of 91%. The ability of the screening instrument to correctly detect individuals with anemia is called sensitivity. A sensitivity of 62% means that this instrument can only detect 62% of students who actually have anemia. This shows that this tool does not detect anemia in 38% of people. This shows that there are limitations in detecting all cases of anemia or in other words, some students who are actually anemic are not detected by this instrument. Meanwhile, specificity is the ability of the screening instrument to correctly identify individuals who do not have anemia. With a specificity of 91%, this instrument accurately identifies 91% of students who are not anemic. Only 9% of healthy students are mistakenly identified as anemic (false positive). The high specificity shows that this instrument is very effective in identifying individuals who do not have anemia. In other words, there is little chance for healthy students to be misdiagnosed as anemic.

The results of this study also showed a Positive Predictive Value (PPV) of 78%, and a Negative Predictive Value (NPV) of 74%. Positive Predictive Value (PPV) indicates the probability that individuals who are detected positive for anemia by the screening instrument actually suffer from anemia. So the PPV of 78% means that of the students who were detected as anemia by the screening instrument actually suffered from anemia. This shows that the positive results of this instrument have a fairly high level of reliability. While the NPV value from the results of this study is 74%. NPV indicates the probability that individuals who are detected as not anemic by the screening instrument actually do not suffer from anemia. The NPV of 74% indicates that the negative results of the screening have a moderate level of accuracy. However, there is a possibility that individuals who test negative actually still suffer from anemia.

This anemia symptom screening instrument is very good at confirming who is not anemic (high specificity), but is less good at detecting all cases of anemia (low sensitivity). To ensure that no cases of anemia are missed, especially in vulnerable populations such as students, this screening instrument should be used as an initial step in the screening process. Negative results need to be further studied or confirmed with additional, more sensitive tests. The use of anemia symptom questionnaires as a screening instrument has several weaknesses that can lead to low sensitivity values. If respondents do not fully understand the questions or are not honest in answering them, the results can be inaccurate. For example, symptoms such as "tired" or "lethargic" can be interpreted differently by each person, so the questionnaire used cannot always detect anemia (Turmuzi, et al., 2023). In addition, non-specific symptoms can also affect the results. Many symptoms of anemia, such as fatigue, weakness, and dizziness, can be caused by other conditions, such as stress, lack of sleep, or other diseases. This can cause many cases of anemia to go undetected because the questionnaire cannot distinguish anemia from other diseases with similar symptoms (Helmyati, et al., 2023). There is a possibility of limitations in capturing mild symptoms, where anemia often begins with vague symptoms so that respondents may not realize they are experiencing a problem. Another possibility is that the questionnaire used does not cover all relevant symptoms or does not have sufficient answer choices to accurately describe the respondent's experience. For example, if the question does not cover the frequency or duration of the respondent's symptoms, important information may be lost. Another factor that can affect sensitivity results is the observer's ability to detect symptoms of anemia. Observers can be biased in assessing symptoms due to previous experience or personal assumptions about certain health conditions. This can lead to errors in assessment, such as assuming that respondents do not have anemia.

3.2 The Validity Test of Scabies

In scabies screening, 50 students were willing to be screened. The distribution of the main symptoms of scabies in 50 students showed that 34% of respondents answered that there were itchy bumps or blisters,

especially at night, and 20% of respondents also answered that there were close friends who also experienced similar main symptoms.

Table 3. Distribution main symptoms of Scabies

Symptoms	Yes		No	
	n	%	n	%
There are itchy bumps or blisters especially at night	17	34%	33	66%
A close friend has a similar itch	10	20%	40	80%

Table 4. Results of Scabies Screening with The Gold Standard

Screening	*Gold Standar*		Total
	Positive	Negative	
Suspected	13	4	**17**
Unexpected	6	27	**33**
Total	**19**	**31**	**50**

Sensitivity = True positive : (True positive + False negative)
= 13 : (13 + 6)
= 13 : 19
= 0,68 = 68%

Specificity = True negative : (True negative + False positif)
= 27 : (27 + 4)
= 27 : 31
= 0,87 = 87%

Positive Predictive Value (PPV) = True positive : (True positive + False positive)
= 13 : (13 + 4)
= 13 : 17
= 0,76 = 76%

Negative Predictive Value (NPV) = True negative : (True negative + False negative)
= 27 : (27 + 6)
= 27 : 33
= 0,82 = 82%

The sensitivity value of 68% indicates that this screening instrument is able to identify 68% of students suffering from scabies, while 32% of existing scabies cases may not be detected by this instrument (false negative). This indicates that the screening instrument has moderate ability to detect scabies cases, but about one-third of sufferers can be missed by it, which means that not all cases of scabies are identified. If scabies cases are missed in the student population, not being treated immediately can cause transmission to continue. However, these results can also be influenced by the presence of symptoms that may not be fully known or reported accurately, especially if the symptoms are mild or considered not disturbing (Gunardi, et al., 2022). The specificity of 87% indicates that this instrument is able to identify 87% of healthy students and only 13% of students who are actually healthy will be classified as scabies sufferers (false positive). This scabies detection instrument can ensure that healthy people are not misclassified as scabies sufferers because of its high specificity, which means that positive screening results have a relatively low probability of error.

PPV of 76%, this means that 76% of students who were detected positive by the screening instrument actually had scabies, while 24% may not actually have scabies (false positive). Most individuals with positive screening results are likely to actually have scabies, because the PPV is quite high, indicating that positive

screening results are quite reliable. NPV of 82%, this means that 82% of students who were declared negative did not have scabies, but there were 18% who might actually have scabies even though the screening results were negative (false negative). This indicates that negative screening results are also quite reliable, but there is a possibility that some cases of scabies may be missed.

Although this scabies symptom screening instrument is more specific than sensitive, this scabies screening instrument is better at ensuring that healthy students are indeed not suffering from scabies than detecting all cases. Higher sensitivity may be needed in situations where detection and treatment of scabies are important to prevent transmission. PPV and NPV are good enough to provide confidence in most screening results. However, in large populations such as Islamic boarding schools, it is possible that some cases of scabies are not detected (false negatives), which can spread if control is not carried out immediately. The results of this screening are greatly influenced by the ability of observers to identify symptoms. When conducting follow-up examinations, trained observers can better interpret respondents' answers and find physical signs of scabies (Widaty, et al., 2019)

3.3 The Validity Test of Pediculosis Capitis

Pediculosis capitis is an infection of the scalp and hair caused by head lice (Pediculus humanus var. capitis). This disease often occurs in densely populated environments, such as Islamic boarding schools, due to supporting factors for infestation such as the use of shared items and poor clean and healthy living behavior (PHBS) (Rajagukguk, 2024). Therefore, screening for pediculosis capitis in students is very important to detect and prevent this infestation. Based on the distribution of the main symptoms. Based on the distribution of the main symptoms of pediculosis capitis, 48% of students felt itching accompanied by something crawling on the scalp.

Table 5. Distribution main symptoms of Pediculosis capitis

Symptoms	Yes		No	
	n	%	n	%
Feeling an annoying itch on the head	27	32%	58	68%
Feeling an itch accompanied by something crawling on the scalp	41	48%	44	52%

Table 6. Results of Pediculosis capitis Screening with The Gold Standard

Screening	*Gold Standar*		Total
	Positive	Negative	
Suspected	35	11	46
Unexpected	10	29	39
Total	45	40	85

Sensitivity = True positive : (True positive + False negative)
= 35 : (35 + 10)
= 35 : 45
= 0,78 = 78%

Specificity = True negative : (True negative + False positif)
= 29 : (29 + 11)
= 29 : 40
= 0,73 = 73%

Positive Predictive Value (PPV) = True positive : (True positive + False positive)
= 35 : (35 + 11)

= 35 : 46
= 0,76 = 76%

Negative Predictive Value (NPV) = True negative : (True negative + False negative)
= 29 : (29 + 10)
= 29 : 39
= 0,74 = 74%

The sensitivity of 78% indicates that this screening instrument can identify 78% of students who are indeed infested with head lice. This means that there are 22% of students who have pediculosis capitis but are not detected by the screening instrument (false negative). These results indicate relatively high sensitivity, so it is very useful in detecting students who have pediculosis capitis (Ranganathan, et al., 2012). However, there is a risk that some respondents who are infected with pediculosis capitis are not detected. Specificity of 73% means that this screening instrument can correctly identify 73% of students who do not have head lice. Conversely, 27% of students who are not actually infested with head lice are diagnosed positive by the questionnaire (false positive). These results indicate moderate specificity, meaning that in many cases people who are not infected with pediculosis capitis are considered positive.

PPV of 76%, means that most (76%) of students who were detected positive did indeed have head lice infestation, while 24% of positive results were false positives. NPV of 74%, means that 74% of students who were diagnosed negative were indeed free from head lice infestation, while 26% of negative results could actually be infested with head lice (false negative). The relatively balanced PPV and NPV values indicate that this screening questionnaire has quite good accuracy in predicting both positive and negative results. So this screening questionnaire can be used as an initial screening tool. However, the results cannot be used as the sole basis for a definitive diagnosis, further confirmatory examinations are needed.

The subjectivity of reporting can affect screening results (Parikh et al., 2008), so that inaccurate observations can cause errors in detecting head lice infestation. In addition, the shame factor related to head lice infection can cause some students to be reluctant to report their actual symptoms, which can affect the sensitivity and specificity results of the instrument. Training can help improve the accuracy of reporting and detection of pediculosis capitis symptoms (Ranganathan et al., 2012).

4. Conclusion

The anemia screening instrument in students had a sensitivity of 53% and a specificity of 90%. This shows that the screening instrument is less able to detect all cases of anemia (low sensitivity), but is quite effective in ensuring individuals who do not suffer from anemia (high specificity). The scabies screening instrument showed a sensitivity of 68% and a specificity of 87%, which means it is quite good at detecting most cases of scabies, but there is still a risk of missing cases (sensitivity does not reach 100%). Pediculosis capitis screening showed a sensitivity of 78% and a specificity of 73%. This shows that this instrument is quite effective in detecting pediculosis capitis, but there is still a possibility of error in detecting positive and negative cases. A combination of a more comprehensive screening approach and interventions involving education, training, additional examinations, and collaboration with medical personnel is highly recommended. Through these actions, Islamic boarding schools can improve early detection, prevention, and management of anemia, scabies, and pediculosis capitis more effectively, so that the health and well-being of students can be better maintained.

Acknowledgment
We thank to Universitas Nahdlatul Ulama Surabaya for supporting us through the main research funding scheme

Conflict of interest

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