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Examination of uric acid levels in Karonsih, Semarang: invasive and non-invasive approaches based on research

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ABSTRACT

Regularly monitoring uric acid levels is essential for preventing and managing gout, where excess uric acid accumulates in joints and causes pain and swelling. Traditionally, invasive blood sample methods are used for this measurement, which can be uncomfortable and increase medical waste. This community service project, organized by the Physics Department of Universitas Islam Negeri Walisongo Semarang in collaboration with the Ngabdi Neliteni Ngabekti (N3) community organization, compares invasive and non-invasive approaches for uric acid level assessment among residents in Karonsih, Semarang. A newly developed non-invasive device was evaluated alongside standard invasive methods based on participant comfort, accuracy, and feedback. Results indicate that, although the non-invasive device showed a mean error rate of 40.52%, it was preferred for its comfort and non-invasive nature. These findings highlight the potential of non-invasive technology in community health monitoring and underline the importance of regular health check-ups facilitated by collaborations between community organizations, educational institutions, and government bodies.

Keywords:
Examination of uric acid levels; Invasive and non-invasive approaches; Karonsih; Semarang.

Introduction

Health check-ups play a vital role in early disease detection and prevention, and uric acid measurement is a critical part of these check-ups, particularly in preventing gout. Uric acid is produced when the body metabolizes purines, which are present in various foods and drinks. Elevated uric acid levels can lead to gout, characterized by joint pain and swelling (Bhavendra & Wardana, 2021). Traditional methods of uric acid measurement, such as lancet-based blood sampling, are invasive, causing discomfort and generating medical waste.

Recent innovations have focused on developing non-invasive methods that provide an alternative to traditional invasive methods. These non-invasive methods aim to increase patient comfort and reduce medical waste. A promising advancement in this area is developing a non-invasive device by the Physics Department at Universitas Islam Negeri Walisongo Semarang (Sumarti et al., 2022).

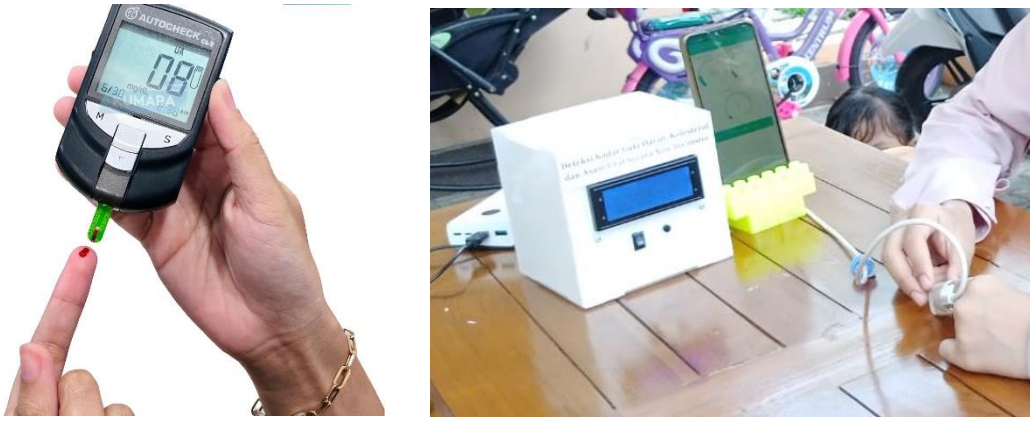
This device was tested through a community service program in Karonsih, Semarang, organized in collaboration with the Ngabdi Neliteni Ngabekti (N3) organization. This study aimed to evaluate the accuracy, user comfort, and effectiveness of the non-invasive device compared to traditional methods, providing a foundation for future developments in community-based health monitoring.

Methods

The community service project involved three main stages: preparation, implementation, and evaluation.

Stage I: Preparation

The team, including lecturers, students, and N3 community members, conducted a preliminary survey in Karonsih, Semarang, to select the most suitable location for the activity. They sent an official notification letter to the local neighborhood head (RT) for coordination. Equipment was prepared, comprising invasive and non-invasive uric acid measuring tools, including the Authocheck 3-in-1 device and the newly developed non-invasive device (Figure 1).



(a) (b)

Figure 1. Uric acid level measurement tools: (a) invasive method using the Authocheck 3 in 1 device, and (b) non-invasive method using a device developed by lecturers and students of Universitas Islam Negeri Walisongo Semarang

Stage II: Implementation
The event occurred on Saturday, June 8, 2024, from 3:00 PM to 5:00 PM WIB at the RT Hall in Karonsih. The team conducted uric acid examinations using both methods, and lecturers from the Physics Department explained each method's principles. Community members were engaged in discussions on uric acid levels, health implications, and preventive strategies.

S*tage III: Evaluation*
Feedback was gathered from participants through interviews, focusing on their experiences with the non-invasive device. Feedback was used to inform participants about maintaining uric acid levels within a healthy range. The community's reactions were documented, emphasizing the ease of use and comfort associated with the non-invasive device.

Results and Discussions

(a) (b)

Figure 2. Implementation of community service in Karonsih: (a) explanation of the working principles of invasive and non-invasive tools, as well as follow-up actions based on uric acid level examination results, and (b) the process of measuring uric acid levels using invasive and non-invasive methods

Figure 2 shows the implementation of community service in Karonsih, where uric acid level examinations were conducted using invasive and non-invasive methods. The lecturer, the resource person, explained the workings of invasive and non-invasive devices and the follow-up actions after the

examination. The community service activity saw active participation from Karonsih residents, who appreciated the explanation and demonstration of invasive and non-invasive devices.

As shown in Table 1, the results indicated that three residents had high uric acid levels above the normal threshold. Most residents' uric acid levels were within the normal range, but a few elevated levels were observed. Notably, individuals with high uric acid levels received advice on managing their condition, emphasizing diet adjustments and exercise (Sutarya et al., 2021). The non-invasive device, while comfortable for users, demonstrated a mean error rate of 40.52%, suggesting limitations in accuracy. It indicates that the device is still far from the standard equipment, likely due to device wear and tear, and it is necessary to recalibrate the device before each measurement. The results showed that the non-invasive device provided inaccurate readings. However, the community felt comfortable with this method as it did not require a finger prick to obtain a blood sample (Rahmita et al., 2020). While the non-invasive device provides a sustainable alternative, the high error rate indicates the need for recalibration and technical improvements to enhance measurement accuracy. These findings support the potential of non-invasive methods in routine community health assessments but highlight the need for further research and development to meet accuracy standards comparable to invasive methods.

Table 1. Results of uric acid measurement using invasive and non-invasive methods

No	Uric acid invasive (mg/dl)	Gender	Uric acid levels threshold 2.5-7.5 (F) 4.0-8.5 (M)	Uric acid non-invasive (mg/dl)	Error (%)
1	4.70	M	Normal	3.00	36.17
2	4.70	F	Normal	3.00	36.17
3	5.40	F	Normal	4.00	25.93
4	6.30	M	Normal	3.00	52.38
5	6.20	F	Normal	4.00	35.48
6	7.20	F	Normal	3.00	58.33
7	6.10	F	Normal	4.00	34.43
8	10.70	M	High	2.00	81.31
9	3.70	M	Normal	3.00	18.92
10	7.60	M	Normal	3.00	60.53
11	7.10	F	Normal	3.00	57.75
12	5.60	F	Normal	4.00	28.57
13	6.60	F	Normal	5.00	24.24
14	10.20	F	High	3.00	70.59
15	5.20	F	Normal	4.00	23.08
16	4.70	F	Normal	4.00	14.89
17	7.30	F	Normal	4.00	45.21
18	4.00	F	Normal	4.00	0.00
19	8.80	M	High	3.00	65.91
Mean	6.43			3.47	40.52

The examination results showed that the non-invasive method could be a comfortable and environmentally friendly alternative to invasive methods. Additionally, residents were enthusiastic and pleased with the activity as it gave them a better understanding of their health. It is recommended that such examinations be conducted regularly with the collaboration of the government, community, and educational institutions (Dr.Kariadi, 2022). These results indicate the community's positive reception of non-invasive testing, as it eliminates discomfort from finger pricks, making it more suitable for routine use in similar community programs.

Conclusion

The community service initiative demonstrated the potential and current limitations of non-invasive uric acid measurement technologies. Although the non-invasive device was well-received for its comfort and ease of use, its accuracy was considerably lower than the invasive method, with an average

error rate of 40.52%. Future work should focus on recalibrating and refining the device's sensitivity to reduce the error margin. Nevertheless, the project raised awareness among community members about the importance of regular health checks and the advantages of non-invasive testing in health monitoring. It is recommended that these health examinations continue in collaboration with community organizations, educational institutions, and government agencies to improve device reliability and foster sustainable community health practices.

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