SHORT RESEARCH ARTICLE

Pilot Study on The Nutritional Assessment and Intervention Kiosk: Utility and User-Centric Performance Evaluation in Combating Malnutrition

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ABSTRACT

Background: To combat double burden of malnutrition, Nutritional Assessment and Intervention Kiosk (NAIK) has been proposed as a potential solution. which provides personalized nutritional assessments and interventions, leveraging the latest digital health technologies. The present pilot study reports user-centric performance evaluation and utility of NAIK to determine its impact on managing malnutrition.

Methodology: The 406 samples were purposively selected to include children aged 2–5 years and their mothers living in urban slum areas of Gautam Budh Nagar District of Uttar Pradesh through the online-based NAIK. In order to evaluate the users' ability to utilize the developed system, the participants were tasked with completing a series of assigned usability tasks. The user-centric performance evaluation of the system was also evaluated.

Results: Out of total 406 sample, till the third visit 123 subjects (30.29%) were retained. A significant majority of respondents found NAIK platform easy to use but most users did feel the need for professional assistance. Overall, the assessments reveal that the NAIK platform is well-received by users. However, minor improvements could enhance clarity and reduce the learning curve for new users.

Conclusions: The positive user feedback on the usability of NAIK further supports its potential as a valuable tool for nutritional interventions in low-resource settings.

Key-words: Double burden of malnutrition, digital health technologies, Nutritional Assessment and Intervention Kiosk, Population Health Informatics, Nutrition Informatics

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INTRODUCTION

The double burden of malnutrition characterized by the simultaneous presence of undernutrition and overnutrition within individuals, families, and populations presents a significant challenge to global public health. This issue is prevalent in both developed and developing countries, where the persistence of undernutrition is coupled with rising rates of overweight and obesity.[1] Undernutrition, especially among children, is associated with stunted growth, cognitive impairments, and increased vulnerability to infectious diseases.[2] Conversely, overnutrition, which often leads to overweight and obesity, is linked to the growing incidence of non-communicable diseases such as type 2 diabetes, cardiovascular diseases, and certain cancers.[3] The dual nature of this health challenge necessitates a multifaceted approach to nutrition interventions that can effectively address both dimensions of malnutrition simultaneously.

Addressing the double burden of malnutrition requires more than traditional methods; it demands innovative and integrated solutions that combine prevention with treatment. This includes tackling fundamental issues such as poverty, inadequate education, and limited access to healthcare services, which are often underlying causes of malnutrition.[4] Recent advancements in technology offer promising solutions, particularly through the use of mobile health (mHealth) applications and digital tools that provide personalized nutrition recommendations and support.[5] These technologies have demonstrated potential in enhancing dietary behaviors and health outcomes, yet their implementation, utility and user-centric performance, especially in low-resource settings, remain insufficiently explored.[6]

While mHealth applications have been studied extensively, there is limited research on the feasibility and impact of online-based nutritional assessment and intervention kiosks, particularly in household settings with limited resources.[7] This gap underscores the need for empirical studies to assess the usability, and user-centric performance evaluation, and cultural appropriateness of such interventions in real-world scenarios. Evaluating these aspects is essential for determining whether digital tools can be successfully integrated into low-resource settings to improve nutritional outcomes.[8]

In response to this knowledge gap, the Nutritional Assessment and Intervention Kiosk (NAIK), a nutrition informatics digital intervention approach has been proposed as a potential solution. By offering tailored dietary guidance and support, NAIK could address both undernutrition and overnutrition in a cohesive manner, making it a valuable tool for households affected by the double burden of malnutrition. NAIK integrates the latest advances in digital health technology to offer tailored dietary recommendations and support, potentially transforming the way nutritional challenges are managed in low-resource settings. The user-centric performance evaluation and utility of NAIK was evaluated through a pilot study to determine its impact on managing and combating malnutrition in household settings.[9] Its evaluation will provide critical insights into its potential as a scalable and effective intervention tool, contributing to the broader efforts to combat malnutrition globally.

The present pilot study reports the utility and user-centric performance evaluation of the Nutritional Assessment and Intervention Kiosk (NAIK). The features of the NAIK have been previously detailed in a protocol paper.[9]

METHODOLOGY

The samples were purposively selected to include children aged 2–5 years and their mothers living in urban slum areas of Gautam Budh Nagar District of Uttar Pradesh. Data was collected from mothers (primary caregivers) in the selected locality through the online-based NAIK to assess and offer intervention.

406 subjects were enrolled in the study who were explained about the objective of the study and informed consent (translated in Hindi) were taken from them. After every two months the subjects were asked to visit again. So, out of total sample, 123 subjects (30.29%) retained till the third visit i.e., after four months.

In order to evaluate the users' ability to utilize the developed system, the participants were tasked with completing a series of assigned usability tasks. The System Usability Scale (SUS) questionnaire was then used to assess the system's usability. The questionnaire consisted of closed-ended questions that were answered on a 5-point scale ranging from "Strongly agree" to "Strongly disagree." The user-centric performance evaluation of the system was also evaluated by recording the time taken by the participants to complete the tasks, the ease with which they completed the tasks, the level of assistance required for task completion, and the number of attempts taken to complete each task. All of these factors were assessed on a 5-point Likert scale.

Approval of Institutional Ethical Review Board: The study was approved by the University Research Ethics Committee of DIT University, Uttarakhand, India (Protocol Number – DITU/UREC/2022/04/11) and conducted in accordance with the ethical principles of the Declaration of Helsinki.

RESULTS

Participant Characteristics: among 123 sample size, a total of 15.44% (n=19) mothers didn't attend school. The mean age of the subjects was 33.2 ± 6.2 years with most women being in 20-30 years category

(43.90%). Majority had attended primary school (30.08%). Majority of the mothers belonged from lower-middle economic strata (71.9%) and remaining were from upper-middle strata (Table 1).

Utility Assessment

The utility of the NAIK platform was evaluated using a set of questions aimed at understanding the ease of use, organization, and overall user experience. The responses indicated a positive perception of the platform's usability as depicted in Table 2:

Ease of Use: A significant majority of respondents found the NAIK platform easy to use, with a high proportion agreeing with this statement. This suggests that the platform's design and interface are user-friendly.

Need for Professional Assistance: Most users did feel the need for professional assistance to use the NAIK platform.

Organization of Assessment Steps: The majority of participants agreed that the assessment steps in NAIK were well-organized and easy to follow, reflecting the platform's logical structure.

Confidence and Understanding: Users generally felt confident using the platform, and mostly disagreed regarding the difficulty of understanding and using NAIK.

Complexity and Learning Curve: Responses indicated that the platform can be learnt while many found it to be time taking experience to completely learn the platform but overall participants disagreed when ask about the complexity of the platform.

Future Use and Pre-existing Knowledge: Many participants expressed a willingness to use the NAIK platform for future self-care management, though a notable portion believed that some pre-existing knowledge would be helpful to fully understand the platform.

User-Centric Performance Evaluation

The user-centric performance evaluation of the NAIK software was assessed based on user experience with task completion, ease of navigation, and system responsiveness as depicted in Table 3:

Navigation and Task Completion: Users reported varying experiences with navigating the main menu and completing tasks, though the majority found it easy or very easy. The time taken to complete tasks was generally rated as slow.

Data Entry and Assistance: Data entry was considered not so straightforward by most users, with a majority often requiring assistance. This reflects requirement of professional assistance while using the software.

Attempts and Error Frequency: Participants typically needed 2-3 attempts to complete tasks, and errors or issues were encountered infrequently. This suggests that the software is stable and reliable.

Table 1: Demographic Details of Mothers (N=123)

Demographic Characteristics	Frequency (%)
Age Group (Years) (33.2 ± 6.2)	
(20-30)	54 (43.9)
(31-40)	50 (40.65)
(41-50)	19 (15.44)
Education	
No formal schooling	19 (15.44)
Less than primary school	27 (21.95)
Primary school completed	37 (30.08)
Secondary school completed	9 (7.31)
High school completed	25 (20.32)
College/University completed	4 (3.25)
Post graduate degree	2 (1.62)
Marital Status	
Married	109 (88.61)
Separated	14 (11.38)
Socio economic status	
Lower Middle	292 (71.9)
Upper Middle	114 (28.1)

Table 2: The utility of the Nutritional Assessment and Intervention Kiosk (NAIK) platform

Variables	Strongly Disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly Agree 5
I think the NAIK platform was easy to use.	-	1.62 (2)	36.58 (45)	45.52 (56)	16.26 (20)
I think I would require the help of a professional to use the NAIK platform smoothly.	-	9.75 (12)	46.34 (57)	43.90 (54)	-
In NAIK, the different assessment steps were well-organized and easy to follow.	-	-	31.70 (39)	52.84 (65)	15.44 (19)
I found NAIK difficult to use.	32.52 (40)	61.78 (76)	5.69 (7)	-	-
I felt confident using the NAIK platform.	-	36.58 (45)	52.03 (64)	11.38 (14)	-
I found the NAIK very difficult to understand.	33.33 (41)	60.16 (74)	6.50 (8)	-	-
I think for anyone it would be quick to learn how to use the NAIK platform	4.87 (6)	45.53 (56)	49.59 (61)	-	-
I think there are too many complexities in the NAIK platform.	5.69 (7)	45.53 (56)	43.09 (53)	4.87 (6)	0.81 (1)
I think I would like to use NAIK frequently for my future self-care management.	-	24.39 (30)	35.77 (44)	27.64 (34)	12.2 (15)
There is a need for some pre-existing knowledge to understand this platform properly.	-	26.02 (32)	33.33 (41)	30.89 (38)	9.75 (12)

Table 3: The user-centric performance evaluation of the Nutritional Assessment and Intervention Kiosk (NAIK) platform

Variables	Responses Score 1	Responses Score 2	Responses Score 3	Responses Score 4	Responses Score 5
How easy was it to navigate the main menu of the NAIK software? N(%))	Very difficult -	Difficult -	Neutral 17.89 (22)	Easy 60.16 (74)	Very easy 21.95 (27)
How quickly were you able to complete the assigned tasks using the NAIK software? (N(%))	Very slowly 38.21 (47)	Slowly 40.65 (50)	Neutral 21.14 (26)	Quickly -	Very quickly -
How easy was it to enter data into the NAIK software (N(%))	Very difficult -	Difficult 31.71 (39)	Neutral 45.53 (56)	Easy 22.76 (28)	Very easy -
How often did you require assistance to complete the tasks using the NAIK software? (N(%))	Always 31.70 (39)	Often 52.03 (64)	Sometimes 16.26 (20)	Rarely -	Never -
How many attempts did you need to successfully complete each task? (N(%))	> 5 attempts 4.06 (5)	3-5 attempts 17.07 (21)	2-3 attempts 0.37 (46)	1-2 attempts 32.52 (40)	1 attempt 8.94 (11)
How efficiently did the NAIK software respond to your inputs? (N(%))	Very Inefficiently 0(0)	Inefficiently -	Neutral 11.38 (14)	Efficiently 58.53 (72)	Very efficiently 30.08 (37)
How clearly were the instructions for each task presented in the NAIK software? (N(%))	Very unclear -	Unclear -	Neutral 26.82 (33)	Clear 51.21 (63)	Very clear 21.95 (27)
How confident did you feel while using the NAIK software to complete the tasks? (N(%))	Very unconfident -	Unconfident 24.39 (30)	Neutral 37.39 (46)	Confident 34.95 (43)	Very confident 3.25 (4)
How would you rate the overall time required to complete tasks in the NAIK software? % (N)	Very time-consuming 29.26 (36)	Time-consuming 51.21 (63)	Neutral 17.07 (21)	Quick 2.43 (3)	Very quick -
How often did you encounter errors or issues while using the NAIK software? (N(%))	Very frequently -	Frequently -	Sometimes 0.81 (1)	Rarely 52.84 (65)	Never 46.34 (57)

System Responsiveness and Clarity: The software was rated efficiently in responding to inputs, and instructions for tasks were generally clear. This is crucial for ensuring a smooth user experience and minimizing confusion.

Overall Confidence and Time Efficiency: Users generally felt confident while using the software and rated the overall time required to complete tasks as acceptable. This indicates that the NAIK software is effective in its intended purpose, providing a user-friendly interface for nutritional assessment and intervention.

Overall, the utility and user-centric performance evaluation assessments reveal that the NAIK platform is well-received by users, with positive feedback on its usability and functionality. However, minor improvements could enhance clarity and reduce the learning curve for new users. These findings support the continued use and potential expansion of the NAIK platform in nutritional intervention efforts.

Discussion

The findings from this pilot study highlight positive user feedback on the usability of NAIK. Most participants found the platform easy to use, with 61.78% disagreeing that it was difficult to navigate, and 52.03% expressing confidence in using it. These usability results align with other studies on digital health interventions, which highlight the necessity of user-friendly interfaces and adequate training for maximizing impact.[5,7] However, some users suggested improvements for better clarity and a reduced learning curve. This feedback is critical for enhancing the user interface and overall user experience. Similar usability challenges and successes have been reported in other mHealth studies, such as those by Orji et al.[5] and Hurlimann et al.[7], which highlight the importance of user-friendly design and adequate training for effective utilization of digital health tools.

Strength and Limitations

The findings from this pilot study highlight the potential of NAIK as a scalable solution for addressing malnutrition in low-resource settings. The positive user feedback and significant improvements in nutritional status underscore the feasibility of integrating digital health tools into public health strategies.

Despite its strengths, the study has few limitations. The sample size, although sufficient for a pilot study, may not be representative of the broader population in similar settings. Additionally, the retention rate of participants was low (30.29%), which could bias the results. Future studies should aim for larger sample sizes and improved participant retention strategies to validate these findings.

Conclusion

This pilot study demonstrates the utility and user-centric performance evaluation (potential essence of user-centered design, performance measures, and user feedback) of the NAIK platform in addressing

the double burden of malnutrition in urban slum areas. The positive user feedback on the usability of NAIK further supports its potential as a valuable tool for nutritional interventions in low-resource settings. The study underscores the importance of integrating digital health tools like NAIK in public health strategies to combat malnutrition. Future research should focus on scaling up the intervention, addressing the identified limitations, and exploring long-term impacts on both maternal and child health outcomes.

The successful implementation of NAIK in this pilot study provides a strong foundation for future research and public health strategies aimed at combating malnutrition. Future research should focus on long-term evaluations of NAIK to assess its sustainability and broader applicability. Additionally, exploring the integration of NAIK with other public health initiatives could amplify its utility and user-centric performance and reach, thereby contributing to global efforts to combat malnutrition. As Haddad et al. [4] suggested, addressing the socioeconomic determinants of health, such as poverty and education, in conjunction with nutritional interventions, is crucial for achieving sustainable health outcomes.

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