

Health promotion and teacher performance within distance learning through the sustainability-based action teacher model

Nia Erlina

*Department of Natural Science, Universitas Pendidikan Ganesha,
Singaraja, Indonesia*

I Nengah Suparta

*Department of Mathematics, Universitas Pendidikan Ganesha,
Singaraja, Indonesia*

Komang Hendra Setiawan

*Faculty of Medicine, Universitas Pendidikan Ganesha,
Singaraja, Indonesia*

Muchtaruddin Mansyur

Faculty of Medicine, SEAMEO RECFON, Universitas Indonesia, Jakarta, Indonesia

Paken Pandiangan

*Department of Physics Education, Universitas Terbuka,
Tangerang Selatan, Indonesia, and*

Iwan Wicaksono

Faculty of Teacher Training and Education, Universitas Jember, Jember, Indonesia

Abstract

Purpose – This paper describes the effectiveness of the sustainability-based action teacher model in distance learning, focusing on health and teacher performance.

Design/methodology/approach – In this quasi-experimental research, 34 primary school teachers (B accredited) from three areas participated in a one-group pretest–posttest design. Health parameters (blood pressure, blood sugar and uric acid) and performance indicators (knowledge, performance observation, satisfaction and self-expectation) were compared before and after the intervention using a *T*-test. Consistency across regions was analyzed using one-way ANOVA. Ethical approval was obtained from the Committee of the Faculty of Medicine, Udayana University, in line with the Helsinki Declaration.

Findings – Health checks (blood pressure) and clinical laboratory results (blood sugar and uric acid) showed a decrease, with varying supportive factors. Cognitive function results remained in the normal category. Furthermore, nutritional status, seen from the body mass index, waist-to-hip ratio and waist-to-height ratio, showed that the proportion of decrease was greater than the increase. Teacher performance, assessed through knowledge tests, performance observations and self-satisfaction and expectations, showed significant improvement.

Research limitations/implications – The program was conducted through group remote learning. The maintenance phase in the transtheoretical model was only partially achieved, and the termination phase was not yet reached.

© Nia Erlina, I Nengah Suparta, Komang Hendra Setiawan, Muchtaruddin Mansyur, Paken Pandiangan and Iwan Wicaksono. Published in the *Asian Association of Open Universities Journal*. Published by Emerald Publishing Limited. This article is published under the Creative Commons Attribution (CC BY 4.0) license. Anyone may reproduce, distribute, translate and create derivative works of this article (for both commercial and non-commercial purposes), subject to full attribution to the original publication and authors. The full terms of this license may be seen at <http://creativecommons.org/licences/by/4.0/legalcode>

Deepest gratitude is dedicated to the Southeast Asian Ministers of Education Organization for providing valuable supervisor and financial assistance in completing this research under contract number: 064c/RECFON-SK/II/2022.



Social implications – The model fosters teachers’ awareness and motivation, facilitating behavioral changes in health and performance, thus addressing the challenges of achieving sustainable development in education.

Originality/value – Health promotion intervention model that integrates health literacy with teacher competencies. This research contributes to improving physical health, cognitive function, nutritional status and teacher performance.

Keywords Health promotion, Teacher work performance, Distance learning, SuBAT

Paper type Research paper

1. Introduction

Health conditions affect education quality as they are essential for performing daily activities. Productivity, including teacher performance, is directly influenced by health levels (MacLeod *et al.*, 2022; Sultana and Hossain, 2023). Optimal health enhances employee productivity, while noncommunicable diseases (NCDs) negatively impact individual performance and, consequently, organizational productivity (Lawana *et al.*, 2023). According to earlier research, regulating body weight, eating a balanced diet and getting regular exercise all greatly lower the risk factors for NCDs (Awuchi *et al.*, 2020; On *et al.*, 2021). However, preliminary observations show that only 4 out of 38 respondents have utilized the NCD POSBINDU health service, with just one attending regularly, while more than 80% of respondents are unaware of the service.

In this research, a companion program was developed to support the government’s community-based NCD control efforts through the suboptimal Integrated Development Post (*Posbindu*) program. Furthermore, teachers’ knowledge of health and NCD risk factors remains low (Erlina *et al.*, 2023), emphasizing the need for targeted intervention programs (Kumar *et al.*, 2022). Interventions can impact participants’ interactions with content (Peramunugamage *et al.*, 2024).

Preventing NCD risk factors takes multi-sector collaboration (Amerzadeh *et al.*, 2020) and broader societal understanding of health (Buja *et al.*, 2020). Health awareness is the foundation for promoting healthy lifestyles and preventing NCDs (Liu *et al.*, 2020). Schools and teachers, as key educational facilitators, help prevent NCD through the modeling of healthy behaviors and education (Dadaczynski and Hering, 2021; Kumar *et al.*, 2022). Continuous teacher competency development should also be enhanced (Amhag *et al.*, 2019) by integrating professional, pedagogical and technological skills to meet the demands of the Industrial 5.0 era (Caena and Redecker, 2019).

The integration of technology and digital learning is essential in modern education to facilitate distance learning (Haleem *et al.*, 2022). Distance learning offers several advantages, including accessibility, affordability, flexibility, improved pedagogy and supportive policies (Rosak-Szyrocka *et al.*, 2022). Distance learning allows learners to access materials regardless of time and place at an affordable cost (Coman *et al.*, 2020). However, distance learning makes teacher–student interaction reduced (Rakhmatullaev, 2023). Despite this limitation, distance learning remains a widely adopted alternative in today’s learning landscape (Ferri *et al.*, 2020).

Indonesia faces various challenges in improving education quality (Sukmayadi and Yahya, 2020). Despite the pivotal role of teachers in shaping education quality, key indicators have yet to show significant progress (Strøm and Falch, 2020). Teacher competence is essential for student learning outcomes (Blömeke *et al.*, 2022), requiring proficiency in pedagogy, personality, social skills and professionalism to meet the growing demands of the profession. Professionalism is further enhanced through technological skills, contextual approaches and the effective application of knowledge. Teachers must integrate educational values into learning outcomes using an Education for Sustainable Development (ESD) approach (Gericke and Torbjörnsson, 2022). Implementing ESD supports the development of educational competencies that enhance teacher performance and value-based instruction. Moreover, innovative educational strategies should be developed to promote preventive, curative and health-promotion initiatives.

Health literacy is the challenge in education and healthcare (Paakkari and Okan, 2020). Public health literacy remains generally low, even among teachers (Walker, 2023). Many teachers over the age of 40 often experience headaches, fatigue and joint pain, often linked to unhealthy daily habits such as minimal physical activity, poor dietary choices and inadequate fruit and vegetable intake (Erlina, 2023; Opara and Maduka, 2020). Health literacy interventions are more commonly implemented in clinical populations than in non-clinical communities like teachers (Nutbeam and Lloyd, 2021). However, innovations in health education, such as social media and digital learning resources, are helping to bridge this gap (Stellefson *et al.*, 2020).

The sustainability-based action teacher (SuBAT) model is an intervention designed to enhance teachers' health, nutritional status, and performance. SuBAT integrates health literacy with teacher competencies, aligning with sustainable development principles. It was developed through an analysis of healthcare simulation (Sollid *et al.*, 2019), guidance for healthcare leaders (Geerts *et al.*, 2021) and video-based interaction (Budiastra *et al.*, 2019). The model consists of seven phases: (1) pre-upgrading orientation, (2) preliminary body and mental scan, (3) learning with experts, (4) preparation in action, (5) action, (6) body and mental scan for evaluation and (7) sustaining action and communication. Cognitive function improvements are expected in phases 1 and 2, performance enhancements in phases 3 and 4 and overall physical and cognitive benefits in the final three phases.

SuBAT is grounded in theories of self-confidence, metacognition, social learning, self-management, behavioral change, self-efficacy and motivation. Various health intervention studies highlight the effectiveness of such programs (Countdown, 2022; McGill *et al.*, 2021).

2. Statement of problem and question research

This research presents the academic community's role in advancing the UN's Sustainable Development Goals (SDGs) related to health and education. WHO Global Health Estimates state that since 2000, NCDs have been the world's leading cause of mortality, impacting not just the general public but also educators, who play a crucial role in raising the standard of education (Szymkowiak *et al.*, 2021). Enhancing teacher performance is, therefore, essential for strengthening education systems (Madani, 2019). Empirical evidence underscores the need to improve teachers' knowledge and awareness of health and nutrition (Erlina *et al.*, 2023).

With increasing societal mobility and technological advancements, distance learning has emerged as a viable solution for addressing health and education challenges. Online health interventions have demonstrated effectiveness in promoting well-being (Linardon *et al.*, 2020; White *et al.*, 2022). However, challenges remain in the widespread implementation of health promotion programs and electronic-based physical health interventions through distance learning (Cheng *et al.*, 2020; Meherali *et al.*, 2020).

SuBAT is an innovative intervention model that integrates the economic, environmental and social pillars of sustainability while addressing the intersection of health and education. By evaluating its effectiveness in enhancing physical health, cognitive function and nutritional well-being as well as improving teacher performance through distance learning, this research aims to contribute to the achievement of the 2030 Agenda for Sustainable Development.

3. Method

This quantitative experimental design was performed using a pretest-posttest structure, a single group and a replication class without a control group (Fraenkel and Wallen, 2009). The SuBAT trial was conducted to assess its suitability based on the conditions and characteristics of teachers within a limited sample. The research design consisted of a single group observed at the pretest stage (O1), followed by the implementation of the hypothetical model as the treatment (X) and then a posttest (O2) to measure outcomes.

This research implemented SuBAT using blended learning as a model for health and education promotion with the phases outlined in Table 1.

3.1 Participants

A total of 34 teachers from three elementary schools participated in this research, with a four-month intervention covering the provinces of North (7), South (11) and West (16) Bali. Participants were selected using a purposive sampling technique. The chosen schools were primary schools that received a B rating in the 2021 National School Accreditation Assessment.

3.2 Data collection and analysis

This research adheres to the principles of scientific excellence and has obtained ethical permit No. 2574/UN14.2.2VII.14/LT/2022 from the Ethics Commission of the Faculty of Medicine, Udayana University, in accordance with the Helsinki Declaration. The ethical review assessed key aspects, including scientific validity and research methodology.

Quantitative analysis was employed to evaluate improvements in teacher health and performance. Health assessments included physical and cognitive function evaluations as well as nutritional status measurements. Physical health tests focused on key NCD risk factors, such as blood pressure, blood sugar and uric acid levels. The Mini Mental State Examination (MMSE), which measures direction, attention and recollection, was used to evaluate cognitive function. Nutritional status was measured using anthropometric indicators, including body mass index (BMI), waist-to-hip ratio (WHR) and waist-to-height ratio (WHtR). Teacher performance was assessed through knowledge tests, observations and response questionnaires. See Table 2.

The hypothesis in this research is as follows:

3.2.1 Treatment impact test. The treatment impact test was performed using the Wilcoxon test and *T*-test to determine any significant difference between health outcomes and nutritional status between pretest and posttest.

H_0 . There is no difference in health test results, nutritional status and performance between pretest and posttest. The null hypothesis is rejected (Sig < 0.05).

Table 1. Details of SuBAT phases

No.	Phases	Teacher activities	Blended learning
1.	Pre-upgrading orientation	Observe phenomena and analyze self-potential	Remote support: Video, WhatsApp
2.	Preliminary body and mental scan	Conduct physical and mental health evaluation	Face-to-face, Printed modules
3.	Learning with experts	Enhance knowledge and engage in interactive dialogue with experts	Remote support: Zoom meeting
4.	Preparation in action	Develop and simulate a health care plan and teacher performance productivity in institutions	Remote support: WhatsApp, Printed modules
5.	Action	Implement the program design in family and institutional settings	Remote support: WhatsApp, Printed modules
6.	Body and mental scan for evaluating	Conduct periodic health measurements and follow-up actions	Face-to-face, Printed modules
7.	Sustain of action and communication	Maintain program success, envision a future filled with health and achievement and provide useful recommendations	Remote support: Printed modules

Source(s): The authors

Table 2. Variety of SuBAT test

Test	Sub-test	Good category	Data analysis Quantitative	Qualitative
Physical health	Blood pressure Blood sugar Uric acid	120/80 mmHg 70–100 mg/dL 3.4–7.0 mg/dL (M) 2.4–6.0 mg/dL (F)	Wilcoxon test/T-test and Kruskal–Wallis/One-way ANOVA	Triangulation method
Cognitive function	MMSE	24–30		
Nutritional status	BMI WHR	18.5–24.9 0.9 (L) 0.8 (P) 0.5		
Performance	WHtR Knowledge test Performance observation Self-satisfaction response Interview	70–100 70–100 70–100		

Source(s): The authors

H_a. There is a difference in health test results, nutritional status and performance between pretest and posttest. The alternative hypothesis is accepted (Sig ≥ 0.05).

3.2.2 Intervention consistency test. ANOVA and Kruskal–Wallis tests were used to determine the consistency of intervention results across three schools – northern, southern and western schools under the following hypotheses.

H₀: The null hypothesis is rejected (Sig < 0.05). There are differences in the consistency of intervention results between northern, southern and western schools.

H_a: The alternative hypothesis is accepted (Sig ≥ 0.05). There is consistency in the intervention results across northern, southern and western schools.

4 . Findings and discussions

4.1 Health

The health tests in the SuBAT program examine various physical health indicators (blood pressure, blood sugar levels and uric acid levels) and the MMSE. Table 3 presents the health conditions of participants, emphasizing disturbances in blood pressure, blood sugar and uric acid levels. The data indicate a reduction in the proportion of participants diagnosed with Stage 1 hypertension (18%), diabetes (9%) and hyperuricemia (21%). The literature currently under publication emphasizes the importance of dietary and lifestyle changes in reducing modifiable risk factors for NCDs, such as hypertension, hyperglycemia, hypercholesterolemia and hyperuricemia (Nomura *et al.*, 2022). Moreover, research has established a correlation between elevated uric acid levels and hypertension (Borghi *et al.*, 2022), both of which contribute to the onset of cardiovascular diseases and strokes (Mansyur *et al.*, 2021; Mills *et al.*, 2020).

Table 3 illustrates a positive shift in participants’ physical health, as evidenced by a decrease in the proportion of individuals with hypertension, diabetes and elevated uric acid levels. Concurrently, a greater number of participants achieved normal levels of uric acid, blood sugar and blood pressure. These health improvements can be attributed to the lifestyle and dietary modifications adopted by participants during the SuBAT program. The program’s

Table 3. Pretest and posttest results of NCD risk factors

Examination results	Category	Number (%) Pretest	Posttest	Difference
Blood pressure	Normal	65	74	9
	Pre-hypertension	9	18	9
	Hypertension St 1	24	6	18
	Hypertension St 2	3	3	0
Fasting blood sugar	Normal	50	62	12
	Pre-diabetes	26	24	3
	Diabetes	24	15	9
Uric acid	Normal	59	79	21
	High	41	21	21
MMSE	Normal	100	100	0
	Probable	0	0	0
	Definite	0	0	0
BMI	Underweight	6	0	6
	Normal	41	47	6
	Overweight	41	47	6
	Obesity 1	12	6	6
WHR	Normal	44	50	6
	Overweight	56	50	6
WHtR	Very slim	3	3	0
	Normal	24	32	9
	Overweight	74	65	9

Source(s): The authors

structured phases align with the transtheoretical model of behavior change (Hashemzadeh *et al.*, 2019), guiding individuals through the stages of awareness (precontemplation, contemplation and preparation), followed by action (implementation of changes) and culminating in maintenance and termination, where sustained health improvements are achieved.

The SuBAT model reinforces prior research advocating for the integration of health education within school curricula to enhance public awareness of NCDs (Kumar *et al.*, 2022). Specifically, phases five and six of the program focus on the implementation of behavioral changes, while the final phase corresponds with the maintenance and termination stages, wherein participants endeavor to sustain these behavioral modifications as permanent aspects of their lifestyle. The SuBAT program aligns with existing research on the management and prevention of NCDs, supporting evidence that behavioral interventions are among the most effective strategies for long-term lifestyle modifications (Budreviciute *et al.*, 2020).

Every subject showed no symptoms of cognitive dysfunction, as shown in Table 3, with scores on the MMSE falling within the normal range. Anthropometric measurements revealed a 6% reduction in the prevalence of Obesity 1 (BMI), a 6% decrease in the waist-to-hip ratio (WHR) and a 9% reduction in the waist-to-height ratio (WHtR). However, changes among participants classified as overweight or obese were limited, with only six individuals achieving a BMI within the normal range by the conclusion of the SuBAT program. Some participants with an “overweight” WHtR transitioned to the “normal” category, while six participants moved from the “overweight” to the “normal” WHR classification. Achieving a normal BMI, WHR or WHtR status typically requires substantial weight loss, which is often facilitated by rigorous dietary restrictions and intensive exercise regimens (Zafar *et al.*, 2019). While diet and physical activity programs have been widely recognized as effective components of disease prevention strategies (Salas-Salvadó *et al.*, 2019), the SuBAT program did not impose stringent dietary restrictions but instead promoted a balanced diet and simple physical

activities. Given the relatively short duration of the research, the results did not indicate significant changes in overall weight status among participants.

4.2 Teacher performance

Teacher performance was assessed through health and nutrition knowledge tests, performance observations and self-satisfaction responses. The health and nutrition knowledge test serves as an indicator of teachers’ health literacy, which is essential for fostering a healthy lifestyle in alignment with ESD. As presented in Table 4, the results indicate an improvement in teachers’ knowledge test scores, suggesting an enhancement in their understanding of health and nutrition concepts.

The overall performance of teachers significantly improved following their participation in the SuBAT program. The knowledge component demonstrated a 97% increase in the “Very Good” category, while performance observations recorded a 100% improvement in the same category. Self-satisfaction and expectation responses improved by 56% in the “Very Good” category, as highlighted in Table 4. The SuBAT program emphasized education on NCDs, their management, balanced meal planning and the importance of physical activity, all of which were reinforced through a digital pocketbook. Despite being delivered remotely, participants engaged in interactive discussions with experts and peers via online group chats, facilitating knowledge exchange on health, nutrition and performance. The preliminary body and mental scan phase applied metacognitive theory for monitoring and evaluation, enabling the identification of health, nutrition and performance-related issues, which were subsequently addressed through targeted interventions. In the learning with experts phase, supported by social learning theory, knowledge acquisition was further reinforced through expert-led and peer interactions. Research confirms that such educational and interactive approaches effectively enhance public health literacy (Li et al., 2022; Jung et al., 2022). The effectiveness of the SuBAT model is further substantiated by studies demonstrating that health literacy interventions contribute to improved knowledge, attitudes and behaviors related to health (Heine et al., 2021).

The observed improvement in teacher performance is closely linked to the assessment of teacher quality, particularly in areas such as technology integration and sustainability in accreditation points. Beyond health education, the SuBAT program incorporates training on technology use in teaching and the implementation of ESD approaches, which are integrated into the school curriculum through remote learning strategies. A key component of the program involved teachers participating in aquaponics activities – an integrated system for cultivating fish and vegetables – which not only promoted physical activity and provided a sustainable source of healthy food but also served as an educational tool for instilling sustainability values. The integration of ESD is further reinforced through the use of

Table 4. Pretest and posttest results on teacher performance

Component	Category	Number Pretest	Posttest	Difference
Knowledge	Low	31	0	31
	Good	3	1	2
	Very Good	0	33	33
Performance observation	Low	22	0	22
	Good	12	0	12
	Very Good	0	34	34
Self-satisfaction and expectation response	Low	2	0	2
	Good	17	0	17
	Very Good	15	34	19
Source(s): The authors				

aquaponics as a learning medium, aligning with broader sustainability goals. The research demonstrates a significant enhancement in teacher performance, with the average score increasing from 55.35 (low) to 94.52 (very high), a change largely attributed to the comprehensive training provided by the SuBAT program. The accumulated experience gained through these activities played a crucial role in improving teacher performance (Podolsky *et al.*, 2019).

The SuBAT model aligns with school-based intervention programs, albeit with variations in school activities and a distinct focus on teaching and learning (Yüksel *et al.*, 2020). An increase in teachers' self-satisfaction with their performance was observed, with scores rising from 74.80 at the beginning of the program to 96.60 upon completion. This suggests that teachers felt significantly more satisfied with their professional performance after participating in the program. Teacher satisfaction is strongly linked to increased motivation, enthusiasm, and commitment to the school's vision, which in turn positively influences student learning outcomes (Lopes and Oliveira, 2020; Ortan *et al.*, 2021). The SuBAT program, supported by theories such as motivation theory, self-efficacy and behavioral change theory, fosters a positive educational culture by enhancing health, lifestyle and teacher performance. In the "sustain of action and communication" phase, teachers focus on maintaining the program's success and disseminating its positive impacts to colleagues and the wider community. This phase aligns with motivation theory, which posits that positive lifestyle changes can sustain long-term motivation for healthy living. Increased motivation and situational support contribute to greater energy in achieving life goals, while fostering a positive school culture is essential for enhancing teachers' professionalism (Muhsin *et al.*, 2020).

3.5 Percentage change in health test results and teacher performance

Figure 1 shows the percentage change in health, nutritional status, and performance of SuBAT participants.

Figure 1 illustrates improvements in physical health, with most participants experiencing better blood pressure, blood sugar and uric acid levels. Cognitive function remained stable for the majority, with some participants showing improvements, though initial assessments indicated no cognitive impairment. The absence of cognitive impairment is a key indicator of good mental health. Nutritional status also improved, as reflected in positive changes in BMI, waist-to-hip ratio (WHR) and waist-to-height ratio (WHtR). Teacher performance in knowledge, observational assessments and self-satisfaction also showed marked improvement, with uric acid levels demonstrating a 20% enhancement. The SuBAT

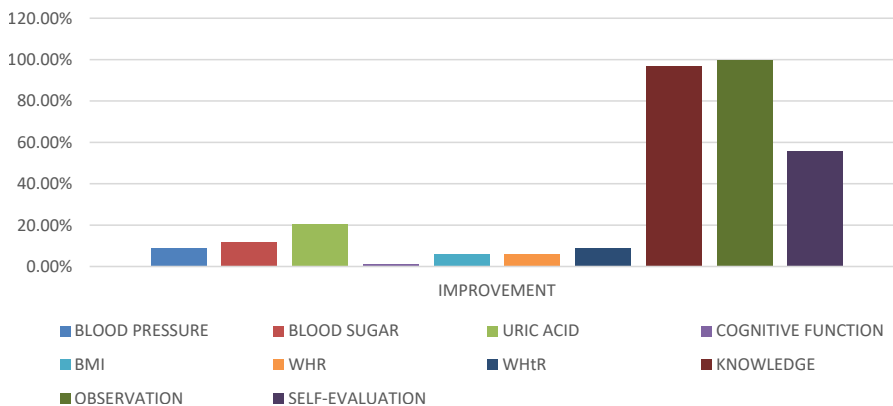


Figure 1. Changes in non-communicable disease (NCD) risk factors in the normal category and performance in the excellent category. **Source(s):** The authors

program required teachers' commitment to lifestyle and dietary changes, supported by high-quality instructional videos on health, nutrition and teaching performance. Behavior change was primarily driven by individuals' willingness to adopt healthier habits. While cognitive function remained largely stable, a positive correlation was observed between teacher self-efficacy, job satisfaction and cognitive function (Capone and Petrillo, 2020), ultimately contributing to a 100% improvement in teacher performance. As teacher performance continues to improve, it is expected to positively impact school accreditation as well.

3.6 Statistical test

Table A1 (Appendix) presents the results of blood pressure, blood sugar and uric acid tests across the three schools. While no significant differences were observed in most cases, certain variations were noted, particularly at the Western school. Although reductions in these health indicators were recorded, they did not reach statistical significance. At the Northern school, where the majority of teachers initially exhibited normal health conditions, no significant changes were detected. Similarly, while the southern school demonstrated some improvements, these changes were not statistically significant.

The SuBAT program aligns with eHealth-based multiple health behavior change interventions, which have been shown to be more effective when grounded in theoretical frameworks than non-theoretical approaches in promoting physical activity. Interventions utilizing traditional communication methods, such as SMS and phone calls, have been found to be more effective in fostering healthy eating patterns than modern internet-based approaches (Duan *et al.*, 2021). A similar trend was observed in the nutritional status measurements, with minimal significant changes, except for the WHtR results at the Western school. Notably, excessive workload may contribute to reduced motivation for prioritizing health.

The SuBAT program, which emphasizes health promotion through empowerment and training, is consistent with findings from other intervention programs that advocate for multi-component approaches, including at least 60 min of physical activity, healthy eating habits and lifestyle modifications. Moreover, transitioning from sedentary behavior to light or moderate physical activity has been associated with improved health outcomes, including enhancements in both physical and cognitive functions (DiPietro *et al.*, 2020). The effectiveness of the SuBAT model is further supported by previous research demonstrating the role of behavioral interventions in hypertension control among teachers (Mini *et al.*, 2019).

Regarding teacher performance, the results of the performance tests indicate significant improvements across all subtests, except for the knowledge test at the northern school. Performance indicators among teachers improved across all participants, reinforcing the well-documented effectiveness of teacher training programs in addressing challenges within educational institutions. The "Preparation in Action" phase of the SuBAT program involved participants designing and implementing professional teaching plans in schools. By incorporating behavioral change theory, participants made lifestyle adjustments based on personal experiences and peer interactions. In the subsequent "Action" phase, teachers further reinforced these behavior changes by integrating educational tools such as mini green gardens utilizing aquaponics. These findings suggest that lifestyle and dietary improvements indirectly contributed to enhanced teacher performance. Prior research has established that teacher training programs improve educators' competencies in developing innovative teaching methodologies and instructional strategies (Pozo-Rico *et al.*, 2020). Studies highlight a significant correlation between physical activity, healthy lifestyle behaviors and improved staff performance (Mohamed and Ghalab, 2022).

Table A2 (Appendix) presents the consistency of test outcomes across the participating schools, demonstrating overall stability, except for blood glucose measurements and waist-to-hip ratio (WHR). Variations in blood glucose results were influenced by several factors, including the proportion of participants with pre-existing health conditions, individual motivation to adopt healthier behaviors and differing workload demands across schools.

Research on community-based cardiovascular disease prevention programs highlights that individual motivation and student engagement play crucial roles in the successful adoption of healthy lifestyles. Such interventions provide guidance and involve public health officials in referring at-risk individuals to appropriate healthcare services (Ndejjo *et al.*, 2022).

Despite these variations, regional differences in geography, religion or ethnicity did not significantly affect the outcomes. The performance subtests also exhibited consistency across schools, suggesting that the effectiveness of the SuBAT program is not dependent on regional factors and is thus applicable in diverse community settings. This conclusion is further supported by the program's implementation in schools on the island of Bali, where institutions with both Hindu and Islamic backgrounds demonstrated similar results. These findings align with previous research, which suggests that health intervention programs, particularly those integrating technology, effectively promote health and prevent related issues (Gong *et al.*, 2021). Additionally, the SuBAT intervention supports the mounting data that e-mental health interventions are effective in treating and preventing eating disorders. To guarantee the long-term efficacy of such interventions and to raise their quality, more study is necessary (Linardon *et al.*, 2020).

The implementation of SuBAT is particularly relevant in the context of remote learning systems. The integration of appropriate instructional materials in distance learning environments enhances self-directed learning skills, especially among pre-service teachers (Erlina *et al.*, 2022). Online health interventions offer several advantages, including flexibility in time, location and cost as well as broader accessibility for participants in remote areas. However, these interventions also face challenges, such as limited Internet access and device availability, varying levels of digital literacy among teachers, reduced motivation due to minimal social interaction and instructional difficulties for facilitators (Fidalgo *et al.*, 2020; Sadeghi, 2019). The use of social media as a lifestyle monitor may be ineffective due to the risk of digital disruption (Kumar *et al.*, 2024). The adoption of remote monitoring systems continues to encounter obstacles, particularly in the use of digital health tools and the need for direct interpersonal interactions in healthcare services (Monaco *et al.*, 2021).

SuBAT's implementation was supported through a variety of communication tools, including videos, Zoom meetings and social media platforms such as WhatsApp, which facilitated participant engagement during the "Learning with Experts" phase. Printed materials, such as model books, pocketbooks and instructional guides, played a key role in supporting independent learning for both participants and healthcare professionals. However, a notable challenge during the monitoring phase was the suboptimal use of WhatsApp for self-management. Participants required repeated reminders to consistently report their health conditions, which affected their overall motivation. This challenge is consistent with prior research indicating that while technology enhances health literacy, additional solutions – such as improved health system navigation and more effective communication with service providers – are necessary for sustained engagement (Dunn and Hazzard, 2019).

4. Conclusion and recommendations

SuBAT model is a health promotion framework specifically designed for teachers. It is structured across seven phases and grounded in various psychological and behavioral theories, including self-confidence, metacognition, social learning, self-management, behavioral change, self-efficacy and motivation. The model's main goals are to improve teacher performance, encourage healthier lifestyles, lower risk factors for NCDs, improve nutritional status and encourage positive behavioral changes.

Research findings indicate significant improvements in participants' health, nutritional status and professional performance. While some quantitative health indicators did not demonstrate statistically significant changes, qualitative assessments revealed noticeable enhancements in participants' lifestyle habits. These improvements contributed to better management of NCD risk factors, healthier nutritional status and increased teacher

effectiveness. Notable progress was observed in teacher performance across various dimensions, including knowledge acquisition, observational assessments and self-reported satisfaction. Moreover, existing literature supports the positive relationship between health improvements and increased teacher performance.

Despite these promising outcomes, several challenges remain in the implementation of the SuBAT program. Economic constraints, logistical difficulties and internal barriers continue to pose obstacles, necessitating further investigation and refinement. Future research should focus on expanding the program's scale and incorporating more comprehensive mental health assessments, particularly those that examine emotional well-being. Additionally, financial challenges associated with sustaining healthy dietary practices remain a concern. One potential solution is the integration of personal food cultivation, wherein teachers acquire fundamental skills in farming and animal husbandry. This approach could enable them to access affordable organic food sources. Furthermore, the SuBAT intervention program holds potential for integration into existing government initiatives, such as *POSBINDU*.

References

- Amerzadeh, M., Salavati, S., Takian, A., Namaki, S., Asadi-Lari, M., Delpisheh, A., Farzadfar, F., Ghanei, M., Haghdoust, A.A., Haji-Aghajani, M., Hazrati, M., Heshmat, R., Jamshidi, H., Janbabaei, G., Malekzadeh, R., Ostovar, A., Peykari, N., Raeisi, A., Shanesaz, M.R., Taghavinejad, S.K. and Larijani, B. (2020), "Proactive agenda setting in creation and approval of national action plan for prevention and control of non-communicable diseases in Iran: the use of multiple streams model", *Journal of Diabetes and Metabolic Disorders*, Vol. 23 No. 2, pp. 1-12, doi: [10.1007/s40200-020-00591-4](https://doi.org/10.1007/s40200-020-00591-4).
- Amhag, L., Hellström, L. and Stigmar, M. (2019), "Teacher educators' use of digital tools and needs for digital competence in higher education", *Journal of Digital Learning in Teacher Education*, Vol. 35 No. 4, pp. 203-220, doi: [10.1111/ejed.12345](https://doi.org/10.1111/ejed.12345).
- Awuchi, C.G., Echeta, C.K. and Igwe, V.S. (2020), "Diabetes and the nutrition and diets for its prevention and treatment: a systematic review and dietetic perspective", *Health Sciences Research*, Vol. 6 No. 1, pp. 5-19, available at: <http://www.aascit.org/journal/hsr>
- Blömeke, S., Jentsch, A., Ross, N., Kaiser, G. and König, J. (2022), "Opening up the black box: teacher competence, instructional quality, and students' learning progress", *Learning and Instruction*, Vol. 79, 101600, doi: [10.1016/j.learninstruc.2022.101600](https://doi.org/10.1016/j.learninstruc.2022.101600).
- Borghi, C., Agnoletti, D., Cicero, A.F.G., Lurbe, E. and Virdis, A. (2022), "Uric acid and hypertension: a review of evidence and future perspectives for the management of cardiovascular risk", *Hypertension*, Vol. 79 No. 9, pp. 1927-1936, doi: [10.1161/HYPERTENSIONAHA.122.17956](https://doi.org/10.1161/HYPERTENSIONAHA.122.17956).
- Budiastra, K., Erlina, N. and Wicaksono, I. (2019), "Video-based interaction through teacher working group forum to increase elementary school teachers' professionalism", *The New Educational Review*, Vol. 57 No. 3, pp. 187-199, doi: [10.15804/tner.19.57.3.15](https://doi.org/10.15804/tner.19.57.3.15).
- Budreviciute, A., Damiaty, S., Sabir, D.K., Onder, K., Schuller-Goetzburg, P., Plakys, G., Katileviciute, A., Khoja, S. and Kodzius, R. (2020), "Management and prevention strategies for non-communicable diseases (NCDs) and their risk factors", *Frontiers in Public Health*, Vol. 8, p. 788, doi: [10.3389/fpubh.2020.574111](https://doi.org/10.3389/fpubh.2020.574111).
- Buja, A., Rabensteiner, A., Sperotto, M., Grotto, G., Bertoncetto, C., Cocchio, S., Baldovin, T., Contu, P., Lorini, C. and Baldo, V. (2020), "Health literacy and physical activity: a systematic review", *Journal of Physical Activity and Health*, Vol. 17 No. 12, pp. 1259-1274, doi: [10.1123/jpah.2020-0161](https://doi.org/10.1123/jpah.2020-0161).
- Caena, F. and Redecker, C. (2019), "Aligning teacher competence frameworks to 21st century challenges: the case for the European Digital Competence Framework for Educators (Digcompedu)", *European Journal of Education*, Vol. 54 No. 3, pp. 356-369, doi: [10.1111/ejed.12345](https://doi.org/10.1111/ejed.12345).
- Capone, V. and Petrillo, G. (2020), "Mental health in teachers: relationships with job satisfaction, efficacy beliefs, burnout and depression", *Current Psychology*, Vol. 39 No. 5, pp. 1757-1766, doi: [10.1007/s12144-018-9878-7](https://doi.org/10.1007/s12144-018-9878-7).

- Cheng, C., Beauchamp, A., Elsworth, G.R. and Osborne, R.H. (2020), "Applying the electronic health literacy lens: systematic review of electronic health interventions targeted at socially disadvantaged groups", *Journal of Medical Internet Research*, Vol. 22 No. 8, e18476, doi: [10.2196/18476](https://doi.org/10.2196/18476).
- Coman, C., Țiru, L.G., Meseșan-Schmitz, L., Stanciu, C. and Bularca, M.C. (2020), "Online teaching and learning in higher education during the coronavirus pandemic: students' perspective", *Sustainability*, Vol. 12 No. 24, 10367, doi: [10.3390/su122410367](https://doi.org/10.3390/su122410367).
- Countdown, N.C.D., Msemburi, W.T., Pickersgill, S.J., Kawakatsu, Y., Gheorghe, A., Dain, K., Johansson, K.A., Said, S., Renshaw, N., Tolla, M.T., Twea, P.D., Varghese, C., Chalkidou, K., Ezzati, M. and Norheim, O.F. (2022), "NCD Countdown 2030: efficient pathways and strategic investments to accelerate progress towards the Sustainable Development Goal target 3.4 in low-income and middle-income countries", *Lancet*, Vol. 399, 10331, pp. 1266-1278, doi: [10.1016/S0140-6736\(21\)02347-3](https://doi.org/10.1016/S0140-6736(21)02347-3).
- Dadaczynski, K. and Hering, T. (2021), "Health promoting schools in Germany. Mapping the implementation of holistic strategies to tackle NCDs and promote health", *International Journal of Environmental Research and Public Health*, Vol. 18 No. 5, p. 2623, doi: [10.3390/ijerph18052623](https://doi.org/10.3390/ijerph18052623).
- DiPietro, L., Al-Ansari, S.S., Biddle, S.J., Borodulin, K., Bull, F.C., Buman, M.P., Cardon, G., Carty, C., Chaput, J.P., Chastin, S., Chou, R., Dempsey, P.C., Ekelund, U., Firth, J., Friedenreich, C.M., Garcia, L., Gichu, M., Jago, R., Katzmarzyk, P.T., Lambert, E., Leitzmann, M., Milton, K., Ortega, F.B., Ranasinghe, C., Stamatakis, E., Tiedemann, A., Troiano, R.P., van der Ploeg, H.P. and Willumsen, J.F. (2020), "Advancing the global physical activity agenda: recommendations for future research by the 2020 WHO physical activity and sedentary behavior guidelines development group", *International Journal of Behavioral Nutrition and Physical Activity*, Vol. 17 No. 1, pp. 1-11, doi: [10.1186/s12966-020-01042-2](https://doi.org/10.1186/s12966-020-01042-2).
- Duan, Y., Shang, B., Liang, W., Du, G., Yang, M. and Rhodes, R.E. (2021), "Effects of eHealth-based multiple health behavior change interventions on physical activity, healthy diet, and weight in people with noncommunicable diseases: systematic review and meta-analysis", *Journal of Medical Internet Research*, Vol. 23 No. 2, e23786, doi: [10.2196/23786](https://doi.org/10.2196/23786).
- Dunn, P. and Hazzard, E. (2019), "Technology approaches to digital health literacy", *International Journal of Cardiology*, Vol. 293, pp. 294-296, doi: [10.1016/j.ijcard.2019.06.039](https://doi.org/10.1016/j.ijcard.2019.06.039).
- Erlina, N., Prayekti, P. and Wicaksono, I. (2022), "Atomic physics teaching materials in blended learning to improve self-directed learning skills in Distance learning", *Turkish Online Journal of Distance learning*, Vol. 23 No. 4, pp. 20-38.
- Erlina, N., Suparta, I.N. and Juniartina, P.P. (2023), "Deteksi dan penyuluhan penyakit tidak menular pada Guru SMP Negeri 6 Singaraja", *Proceeding Senadimas Undiksha*, Vol. 8, pp. 424-430, 2023.
- Ferri, F., Grifoni, P. and Guzzo, T. (2020), "Online learning and emergency remote teaching: Opportunities and challenges in emergency situations", *Societies*, Vol. 10 No. 4, p. 86, doi: [10.3390/soc10040086](https://doi.org/10.3390/soc10040086).
- Fidalgo, P., Thormann, J., Kulyk, O. and Lencastre, J.A. (2020), "Students' perceptions on Distance learning: a multinational research", *International journal of educational Technology in Higher Education*, Vol. 17 No. 1, pp. 1-18, doi: [10.1186/s41239-020-00194-2](https://doi.org/10.1186/s41239-020-00194-2).
- Fraenkel, J.R. and Wallen, N.E. (2009), *How to Design and Evaluate Research in Education*, McGraw-Hill Education, New York.
- Geerts, J.M., Kinnair, D., Taheri, P., Abraham, A., Ahn, J., Atun, R., Barberia, L., Best, N.J., Dandona, R., Dhahri, A.A., Emilsson, L., Free, J.R., Gardam, M., Geerts, W.H., Ihekweazu, C., Johnson, S., Kooijman, A., Lafontaine, A.T., Leshem, E., Lidstone-Jones, C., Loh, E., Lyons, O., Neel, K.A.F., Nyasulu, P.S., Razum, O., Sabourin, H., Schleifer Taylor, J., Sharifi, H., Stergiopoulos, V., Sutton, B., Wu, Z. and Bilodeau, M. (2021), "Guidance for health care Leaders during the Recovery stage of the COVID-19 pandemic: a consensus Statement", *JAMA Network Open*, Vol. 4 No. 7, e2120295, doi: [10.1001/jamanetworkopen.2021.20295](https://doi.org/10.1001/jamanetworkopen.2021.20295).

- Gericke, N. and Torbjörnsson, T. (2022), "Identifying Capital for school improvement: recommendations for a Whole school approach to ESD implementation", *Environmental Education Research*, Vol. 28 No. 6, pp. 803-825, doi: [10.1080/13504622.2022.2045256](https://doi.org/10.1080/13504622.2022.2045256).
- Gong, E., Sun, L., Long, Q., Xu, H., Gu, W., Bettger, J.P., Tan, J., Ma, J., Jafar, T.H., Oldenburg, B. and Yan, L.L. (2021), "The implementation of a primary care-based integrated mobile health intervention for stroke management in rural China: mixed-methods process evaluation", *Frontiers in Public Health*, Vol. 9, 774907, doi: [10.3389/fpubh.2021.774907](https://doi.org/10.3389/fpubh.2021.774907).
- Haleem, A., Javaid, M., Qadri, M.A. and Suman, R. (2022), "Understanding the role of digital technologies in education: a review", *Sustainable Operations and Computers*, Vol. 3, pp. 275-285, doi: [10.1016/j.susoc.2022.05.004](https://doi.org/10.1016/j.susoc.2022.05.004).
- Hashemzadeh, M., Rahimi, A., Zare-Farashbandi, F., Alavi-Naeini, A.M. and Daei, A. (2019), "Trans theoretical model of health behavioral change: a systematic review", *Iranian Journal of Nursing and Midwifery Research*, Vol. 24 No. 2, pp. 83-90, doi: [10.4103/ijnmr.IJNMR_94_17](https://doi.org/10.4103/ijnmr.IJNMR_94_17).
- Heine, M., Lategan, F., Erasmus, M., Lombaard, C.M., Mc Carthy, N., Olivier, J., van Niekerk, M. and Hanekom, S. (2021), "Health education interventions to promote health literacy in adults with selected non-communicable diseases living in low-to-middle income countries: a systematic review and meta-analysis", *Journal of Evaluation in Clinical Practice*, Vol. 27 No. 6, pp. 1417-1428, doi: [10.1111/jep.13554](https://doi.org/10.1111/jep.13554).
- Jung, S.O., Son, Y.H. and Choi, E. (2022), "E-health literacy in older adults: an evolutionary concept analysis", *BMC Medical Informatics and Decision Making*, Vol. 22 No. 1, p. 28, doi: [10.1186/s12911-022-01761-5](https://doi.org/10.1186/s12911-022-01761-5).
- Kumar, R., Rehman, S., Baloch, G.M., Vankwani, M., Somrongthong, R. and Pongpanich, S. (2022), "Effectiveness of health education intervention on diabetes mellitus among the teachers working in public sector schools of Pakistan", *BMC Endocrine Disorders*, Vol. 22 No. 1, pp. 1-6, doi: [10.1186/s12902-022-01110-7](https://doi.org/10.1186/s12902-022-01110-7).
- Kumar, C., Rangappa, K.B., Suchitra, S. and Gowda, H. (2024), "Digital distractions during blended learning and its negative repercussions: an empirical analysis", *Asian Association of Open Universities Journal*, Vol. 19 No. 1, pp. 1-18, doi: [10.1108/AAOUJ-02-2023-0024](https://doi.org/10.1108/AAOUJ-02-2023-0024).
- Lawana, N., Kapingura, F.M. and Tsegaye, A. (2023), "The impact of non-communicable diseases on employment status in South Africa", *Cogent Economics & Finance*, Vol. 11 No. 2, 2246005, doi: [10.1080/23322039.2023.2246005](https://doi.org/10.1080/23322039.2023.2246005).
- Li, Y., Lv, X., Liang, J., Dong, H. and Chen, C. (2022), "The development and progress of health literacy in China", *Frontiers in Public Health*, Vol. 10, 1034907, doi: [10.3389/fpubh.2022.1034907](https://doi.org/10.3389/fpubh.2022.1034907).
- Linardon, J., Shatte, A., Messer, M., Firth, J. and Fuller-Tyszkiewicz, M. (2020), "E-mental health interventions for the treatment and prevention of eating disorders: an updated systematic review and meta-analysis", *Journal of Consulting and Clinical Psychology*, Vol. 88 No. 11, pp. 994-1007, doi: [10.1037/ccp0000575](https://doi.org/10.1037/ccp0000575).
- Liu, C., Wang, D., Liu, C., Jiang, J., Wang, X., Chen, H., Ju, X. and Zhang, X. (2020), "What is the meaning of health literacy? A systematic review and qualitative synthesis", *Family Medicine and Community Health*, Vol. 8 No. 2, p. e000351, doi: [10.1136/fmch-2020-000351](https://doi.org/10.1136/fmch-2020-000351).
- Lopes, J. and Oliveira, C. (2020), "Teacher and school determinants of teacher job satisfaction: a multilevel analysis", *School Effectiveness and School Improvement*, Vol. 31 No. 4, pp. 641-659, doi: [10.1080/09243453.2020.1764593](https://doi.org/10.1080/09243453.2020.1764593).
- MacLeod, K.E., Ye, Z., Donald, B. and Wang, G. (2022), "A literature review of productivity loss associated with hypertension in the United States", *Population Health Management*, Vol. 25 No. 3, pp. 297-308, doi: [10.1089/pop.2021.0201](https://doi.org/10.1089/pop.2021.0201).
- Madani, R.A. (2019), "Analysis of educational quality, a goal of education for all policy", *Higher Education Studies*, Vol. 9 No. 1, pp. 100-109, doi: [10.5539/hes.v9n1p100](https://doi.org/10.5539/hes.v9n1p100).
- Mansyur, M., Sagitarsi, R., Wangge, G., Sulistomo, A.B. and Kekalih, A. (2021), "Long working hours, poor sleep quality, and work-family conflict: determinant factors of fatigue among Indonesian tugboat crewmembers", *BMC Public Health*, Vol. 21, pp. 1-7, doi: [10.1186/s12889-021-11883-6](https://doi.org/10.1186/s12889-021-11883-6).

- McGill, E., Er, V., Penney, T., Egan, M., White, M., Meier, P., Whitehead, M., Lock, K., Anderson de Cuevas, R., Smith, R., Savona, N., Rutter, H., Marks, D., de Vocht, F., Cummins, S., Popay, J. and Petticrew, M. (2021), "Evaluation of public health interventions from a complex systems perspective: a research methods review", *Social Science & Medicine*, Vol. 272, 113697, doi: [10.1016/j.socscimed.2021.113697](https://doi.org/10.1016/j.socscimed.2021.113697).
- Meherali, S., Punjani, N.S. and Mevawala, A. (2020), "Health literacy interventions to improve health outcomes in low-and middle-income countries", *HLRP: Health Literacy Research and Practice*, Vol. 4 No. 4, pp. e251-e266, doi: [10.3928/24748307-20201118-01](https://doi.org/10.3928/24748307-20201118-01).
- Mills, K.T., Stefanescu, A. and He, J. (2020), "The global epidemiology of hypertension", *Nature Reviews Nephrology*, Vol. 16 No. 4, pp. 223-237, doi: [10.1038/s41581-019-0244-2](https://doi.org/10.1038/s41581-019-0244-2).
- Mini, G.K., Sarma, P.S. and Thankappan, K.R. (2019), "Cluster randomised controlled trial of behavioural intervention program: a research protocol for control of hypertension among teachers in schools in Kerala (CHATS-K), India", *BMC Public Health*, Vol. 19, pp. 1-7, doi: [10.1186/s12889-019-8082-5](https://doi.org/10.1186/s12889-019-8082-5).
- Mohamed, S.M. and Ghalab, A.M. (2022), "Effect of physical activity and health behavior on staff Nurses' job performance", *International Egyptian Journal of Nursing Sciences and Research*, Vol. 2 No. 2, pp. 118-132, doi: [10.21608/ejnsr.2022.212309](https://doi.org/10.21608/ejnsr.2022.212309).
- Monaco, A., Palmer, K., Holm Ravn Faber, N., Kohler, I., Silva, M., Vatland, A., van Griensven, J., Votta, M., Walsh, D., Clay, V., Yazicioglu, M.C., Ducinskiene, D. and Donde, S. (2021), "Digital health tools for managing noncommunicable diseases during and after the COVID-19 pandemic: perspectives of patients and caregivers", *Journal of Medical Internet Research*, Vol. 23 No. 1, e25652, doi: [10.2196/25652](https://doi.org/10.2196/25652).
- Muhsin, M.R., Indartono, S. and Astuti, S.I. (2020), "The role of school culture in teacher professionalism improvement", *International Conference on Progressive Education (ICOPE 2019)*, Atlantis Press, pp. 158-162, doi: [10.2991/assehr.k.200323.111](https://doi.org/10.2991/assehr.k.200323.111).
- Ndejjo, R., Musinguzi, G., Nuwaha, F., Bastiaens, H. and Wanyenze, R.K. (2022), "Understanding factors influencing uptake of healthy lifestyle practices among adults following a community cardiovascular disease prevention programme in Mukono and Buikwe districts in Uganda: a qualitative research", *PLoS One*, Vol. 17 No. 2, e0263867, doi: [10.1371/journal.pone.0263867](https://doi.org/10.1371/journal.pone.0263867).
- Nomura, S., Sakamoto, H., Ghaznavi, C. and Inoue, M. (2022), "Toward a third term of Health Japan 21—implications from the rise in non-communicable disease burden and highly preventable risk factors", *The Lancet Regional Health—Western Pacific*, Vol. 21, 100377, doi: [10.1016/j.lanwpc.2021.100377](https://doi.org/10.1016/j.lanwpc.2021.100377).
- Nutbeam, D. and Lloyd, J.E. (2021), "Understanding and responding to health literacy as a social determinant of health", *Annual Review of Public Health*, Vol. 42 No. 1, pp. 159-173, doi: [10.1146/annurev-publhealth-090419-102529](https://doi.org/10.1146/annurev-publhealth-090419-102529).
- On, J.Y., Ong, S.K. and Abdul Rahman, H. (2021), "Assessing association of waist-height ratio (WHtR) and body mass index (BMI) with non-communicable disease risk factors", *Journal of Public Health*, Vol. 29 No. 4, pp. 921-929, doi: [10.1007/s10389-020-01196-0](https://doi.org/10.1007/s10389-020-01196-0).
- Opara, C.J. and Maduka, O. (2020), "An evaluation of obesity and hypertension among Prima-ry school teachers in an Urban region of South-South Nigeria", *Journal of Hypertension and Management*, Vol. 6 No. 2, p. 050, doi: [10.23937/2474-3690/1510050](https://doi.org/10.23937/2474-3690/1510050).
- Ortan, F., Simut, C. and Simut, R. (2021), "Self-efficacy, job satisfaction and teacher well-being in the K-12 educational system", *International Journal of Environmental Research and Public Health*, Vol. 18 No. 23, 12763, doi: [10.3390/ijerph182312763](https://doi.org/10.3390/ijerph182312763).
- Paakkari, L. and Okan, O. (2020), "COVID-19: health literacy is an underestimated problem", *The Lancet Public Health*, Vol. 5 No. 5, pp. e249-e250, doi: [10.1016/S2468-2667\(20\)30086-4](https://doi.org/10.1016/S2468-2667(20)30086-4).
- Peramunugamage, A., Ratnayake, U.W., Karunanayaka, S.P. and Jayawardena, C.L. (2024), "Design of Moodle-based collaborative learning activities to enhance student interactions", *Asian Association of Open Universities Journal*, Vol. 19 No. 1, pp. 37-54, doi: [10.1108/AAOUJ-06-2023-0079](https://doi.org/10.1108/AAOUJ-06-2023-0079).

- Podolsky, A., Kini, T. and Darling-Hammond, L. (2019), "Does teaching experience increase teacher effectiveness? A review of US research", *Journal of Professional Capital and Community*, Vol. 4 No. 4, pp. 286-308, doi: [10.1108/JPCC-12-2018-0032](https://doi.org/10.1108/JPCC-12-2018-0032).
- Pozo-Rico, T., Gilar-Corbí, R., Izquierdo, A. and Castejón, J.L. (2020), "Teacher training can make a difference: tools to overcome the impact of COVID-19 on primary schools. An experimental research", *International Journal of Environmental Research and Public Health*, Vol. 17 No. 22, p. 8633, doi: [10.3390/ijerph17228633](https://doi.org/10.3390/ijerph17228633).
- Rakhmatullaev, M. (2023), Advantages and disadvantages of distance learning. Lessons from the Covid 19 pandemic. *Society Integration Education: Proceedings of the International Scientific Conference*, Vol. I, pp. 264-274, doi: [10.17770/sie2023vol1.7124](https://doi.org/10.17770/sie2023vol1.7124).
- Rosak-Szyrocka, J., Żywiołek, J., Zaborski, A., Chowdhury, S. and Hu, Y.C. (2022), "Digitalization of higher education around the Globe during covid-19", *IEEE Access*, Vol. 10, pp. 59782-59791, doi: [10.1109/ACCESS.2022.3178711](https://doi.org/10.1109/ACCESS.2022.3178711).
- Sadeghi, M. (2019), "A shift from classroom to distance learning: advantages and limitations", *International Journal of Research in English Education*, Vol. 4 No. 1, pp. 80-88, doi: [10.29252/ijree.4.1.80](https://doi.org/10.29252/ijree.4.1.80).
- Salas-Salvadó, J., Díaz-López, A., Ruiz-Canela, M., Basora, J., Fitó, M., Corella, D., . . . Martinez-Gonzalez, M.A. (2019), "Effect of a lifestyle intervention program with energy-restricted Mediterranean diet and exercise on weight loss and cardiovascular risk factors: one-year results of the PREDIMED-Plus trial", *Diabetes Care*, Vol. 42 No. 5, pp. 777-788, doi: [10.2337/dc18-0836](https://doi.org/10.2337/dc18-0836).
- Sollid, S.J., Dieckman, P., Aase, K., Søreide, E., Ringsted, C. and Østergaard, D. (2019), "Five topics Consensus Process can address to improve patient safety: results from a consensus process", *Journal of Patient Safety*, Vol. 15 No. 2, pp. 111-120, doi: [10.1097/pts.0000000000000254](https://doi.org/10.1097/pts.0000000000000254).
- Stellefson, M., Paige, S.R., Chaney, B.H. and Chaney, J.D. (2020), "Evolving role of social media in health promotion: updated responsibilities for health education specialists", *International Journal of Environmental Research and Public Health*, Vol. 17 No. 4, p. 1153, doi: [10.3390/ijerph17041153](https://doi.org/10.3390/ijerph17041153).
- Strøm, B. and Falch, T. (2020), "Chapter 22: The role of teacher quality in education production", *The Economics of Education*, pp. 307-319, doi: [10.1016/B978-0-12-815391-8.00022-7](https://doi.org/10.1016/B978-0-12-815391-8.00022-7).
- Sukmayadi, V. and Yahya, A. (2020), "Indonesian education landscape and the 21st century challenges", *Journal of Social Studies Education Research*, Vol. 11 No. 4, pp. 219-234, available at: <https://www.learntechlib.org/p/218538/>.
- Szymkowiak, A., Melović, B., Dabić, M., Jeganathan, K. and Kundi, G.S. (2021), "Information technology and Gen Z: the role of teachers, the internet, and technology in the education of young people", *Technology in Society*, Vol. 65, 101565, doi: [10.1016/j.techsoc.2021.101565](https://doi.org/10.1016/j.techsoc.2021.101565).
- Walker, D. (2023), "Physical exercise as a preventive strategy for non-communicable diseases among secondary school teachers in Bayelsa State", *African Journal of Human Kinetics, Recreation and Health Studies*, Vol. 1 No. 1, pp. 9-32, doi: [10.31920/2976-7784/2023/v1n1a1](https://doi.org/10.31920/2976-7784/2023/v1n1a1), available at: https://hdl.handle.net/10520/ejc-aa_ajhkrhs_v1_n1_a2
- White, V., Linardon, J., Stone, J.E., Holmes-Truscott, E., Olive, L., Mikocka-Walus, A., Hendrieckx, C., Evans, S. and Speight, J. (2022), "Online psychological interventions to reduce symptoms of depression, anxiety, and general distress in those with chronic health conditions: a systematic review and meta-analysis of randomized controlled trials", *Psychological Medicine*, Vol. 52 No. 3, pp. 548-573, doi: [10.1017/S0033291720002251](https://doi.org/10.1017/S0033291720002251).
- Yuksel, H.S., Şahin, F.N., Maksimovic, N., Drid, P. and Bianco, A. (2020), "School-based intervention programs for preventing obesity and promoting physical activity and fitness: a systematic review", *International Journal of Environmental Research and Public Health*, Vol. 17 No. 1, p. 347, doi: [10.3390/ijerph17010347](https://doi.org/10.3390/ijerph17010347).
- Zafar, M.I., Mills, K.E., Zheng, J., Peng, M.M., Ye, X. and Chen, L.L. (2019), "Low glycaemic index diets as an intervention for obesity: a systematic review and meta-analysis", *Obesity Reviews*, Vol. 20 No. 2, pp. 290-315, doi: [10.1111/obr.12791](https://doi.org/10.1111/obr.12791).

Table A1. Wilcoxon test and *T*-test

School	Component	N	Wilcoxon test Differences			T-test				
			Negative	Positive	Ties	p	Mean	t	df	SD
Health parameters										
Northern	Blood pressure (ST/DT)	7	2/1	Two-fourths	3/2	0.705/0.408				
Southern		11	5/1	2/2	4/8	0.121/0.785				
Western		16	9/2	2/2	5/12	0.016/0.605				
Northern	Fasting blood sugar	7	3	3	1	0.674				
Southern		11	7	4	0	0.119				
Western		16	14	2	0	0.007				
Northern	Uric acid	7	4	3	0	0.396				
Southern		11	6	3	2	0.084				
Western		16					1.15625	3.188	15	1.45096
Northern	MMSE	7				−0.143	−1.000	6	0.378	0.356
Southern		11				−0.54545	−2.206	10	0.82020	0.052
Western		16	0	5	11	0.039				
Northern	BMI	7				−0.22000	−0.533	6	1.09296	0.613
Southern		11				0.35091	1.640	10	0.70980	0.132
Western		16				0.29875	1.672	15	0.71471	0.115
Northern	WHR	7				−0.00429	−0.411	6	0.02760	0.695
Southern		11				−0.03091	−1.554	10	0.06595	0.151
Western		16				0.00562	0.510	15	0.04412	0.617
Northern	WHtR	7				0.00273	−0.493	6	0.02299	0.639
Southern		11				0.01437	0.305	10	0.02970	0.767
Western		16				0.00273	2.743	15	0.02097	0.015
Performance indicators										
Northern	Knowledge	7				5.42857	0.988	6	14.53567	0.361
Southern		11	0	11	0	0.003				
Western		16				−52.50000	−13.024	15	16.12452	0.000
Northern	Performance observation	7	0	7	0	0.018				
Southern		11				−42.76909	−13.568	10	10.45472	0.000
Western		16				−38.87353	−25.599	16	6.26125	0.000
Northern	Self-satisfaction and expectation response	7	0	7	0	0.018				
Southern		11				−20.80909	−9.942	10	6.94182	0.000
Western		16	0	16	0	0.000				

Source(s): The authors

Table A2. Kruskal–Wallis Test and one-way ANOVA test

Component	N	Kruskal–Wallis test			One-way ANOVA test			
		Chi-square	df	p	Sum of squares	df	F	p
Blood pressure (ST/DT)	7	2.809/	2/	0.245/				
	11	5.250	2	0.072				
	16							
Fasting blood sugar	7	6.720	2	0.035				
	11							
	16							
Uric acid	7	1.190	2	0.942				
	11							
	16							
MMSE	7				13.498	2	2.411	0.106
	11							
	16							
BMI	7				56.405	2	2.021	0.150
	11							
	16							
WHR	7				0.027	2	3.319	0.049
	11							
	16							
WHtR	7				0.024	2	2.382	0.109
	11							
	16							
Knowledge	7				45.135	2	0.469	0.630
	11							
	16							
Performance observation	7				56.038	2	2.356	0.112
	11							
	16							
Self-satisfaction and expectation response	7	0.120	2	0.942				
	11							
	16							

Source(s): The authors

Corresponding author

Nia Erlina can be contacted at: niaerlina@undiksha.ac.id