ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue VI, June 2026

Implementation of Ethno-Ergonomics through the Synergy of *Dewata Nawa Sanga* Manifestations to Improve Physiological Stability and Health

Made Sutajaya [1*] , Desak Made Citrawathi [1], Moh Jafron Syah[2], Ni Putu Sri Arnita[3], and Ni Luh Putu Mia Lestari Devi [4]

[1,2]Biology Education Study Program, Department of Marine Biology and Fisheries, Faculty of Mathematics and Natural Sciences, Ganesha University of Education, Singaraja-Bali-Indonesia

[3,4]Biomedical Engineering Study Program, Faculty of Technology and Health Sciences, Bali Dwipa University, Denpasar-Bali-Indonesia

DOI: https://doi.org/10.51583/IJLTEMAS.2026.150600145

Received: 01 July 2026; Accepted: 06 July 2026; Published: 17 July 2026

ABSTRACT

Ethno-ergonomics is a branch of health science that discusses the physiology of work that considers human abilities, capabilities, and limitations and their implementation according to certain community groups. *Dewata Nawa Sanga* are nine Gods with their respective characteristics. The characteristics of the nine Gods are synergized with the anatomical and physiological conditions of humans related to their health. The method used is through a quasi-experimental. The research design uses a randomized pre and post test group design involving 32 subjects. The research process is: identification of problems, prioritization of problems, and formulation of an action plan. The independent variable, the implementation of ethno-ergonomics through the synergy of the manifestation of *Dewata Nawa Sanga* and the dependent variables: (1) understanding and caring attitude towards the management of physiological conditions and (2) health quality seen from musculoskeletal complaints, fatigue, and stress due to work. The data obtained were analyzed descriptively by looking for the percentage of change and continued with a paired t-test at a significance level of 5%. The results showed an increase in: (a) physiological stability as seen from a 27.87% decrease in musculoskeletal complaints, a 24.88% decrease in fatigue, and a 28.42% decrease in work-related stress; (2) an increase in understanding of health governance by 17.77%; and (3) an increase in caring attitudes toward health governance by 23.93%. The conclusion is that the implementation of ethno-ergonomics through the synergy of *Dewata Nawa Sanga* manifestations can improve physiological stability, understanding, and the community's caring attitudes toward health governance.

Keywords: Ethno-ergonomics, Governance, and Health.

INTRODUCTION

Ethnoergonomics is a branch of health science that examines the physiology of work, considering human capabilities, abilities, and limitations, and their implementation within specific social groups. The *Dewata Nawa Sanga* are nine gods, each with their own unique characteristics. These characteristics are synergized with human anatomy and physiology, relevant to human health.

The relationship between *Dewata Nawa Sanga* and the anatomy and physiology of the human body is: (1) *Chakra*, the weapon of Lord Vishnu synergized with the diaphyseal and epiphyseal discs in the joints in general and the vertebral column, (2) *Trisula*, the weapon of Lord Sambhu synergized with the triangular shape of the bones which functions for strength and flexibility of movement, (3) *Bajra (Genta)*, the weapon of Lord Iswara synergized with the brain which is protected in the skull, (4) *Dupa*, the weapon of Lord Mahesora synergized with the thorax which is equipped with 12 pairs of ribs as protectors of the lungs, (5) *Gada*, the weapon of Lord Brahma synergized with the lower arm and lower leg as extremities in humans, (6) *Moksala*, the weapon of Lord

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Rudra synergized with the upper leg and upper arm, (7) *Nagapasa*, the weapon of Lord Mahadewa synergized with the radius ulna bone with the ends in the form of the wrist (carpal) and palm (metacarpal) as well as the fingers, (8) *Angkus*, the weapon of the God Sangkara, synergizes with the tibia and fibula bones, the ends of which are the ankles and soles of the feet and toes, and (9) *Padma*, the weapon of the God Shiva, synergizes with the combination of all body organs that form an organ system with the manifestation of the five senses (Sutajaya et al., 2022; Sutajaya et al., 2025; Sutajaya, 2018; Sutajaya, 2019).

Human capabilities are largely determined by profile factors, physiological capacity, psychological capacity and biomechanical capacity, while task demands are influenced by the characteristics of the work material, the tasks to be performed, the organization and the environment in which the work is carried out (Sutajaya et al., 2020; Huang et al., 2021: 122-129; Chatzimichailidou et al., 2020: 114-118; Mewes & Ebert, 2021: 332-335, Yusuf et al., 2021: 184-206; Rasel & Kalfadellis, 2021: 88-108; Squires et al., 2021: 65-84; Teslenko et al., 2021: 109-126; Weckroth & Kemppainen, 2021: 207-227). The implementation of ergonomics can reduce the negative impacts of the use of science and technology, because with ergonomics various occupational diseases, accidents, pollution, poisoning, job dissatisfaction, human element errors, can be avoided or reduced to a minimum (Sutajaya et al., 2022; Sutajaya et al., 2025; Sutajaya, 2018; Sutajaya, 2019; Inceoglu et al., 2021: 459-465; Shoss, 2021: 259-260; Graham et al., 2020: 230-252; Bernerth et al., 2021: 564-581; Arnold et al., 2021: 1-24). Through a systemic, holistic, interdisciplinary and participatory (SHIP) approach, healthy, safe, and comfortable governance will be realized and physiologically will not cause musculoskeletal complaints, will not result in excessive workloads and can slow the onset of fatigue and increase job satisfaction (Sutajaya et al., 2022; Sutajaya et al., 2025; Sutajaya, 2018; Sutajaya, 2019; Rajabalinejad et al., 2020: 83-113; Ghosh & Richard, 2021 :130-142; Martin, 2021: 143-161). The application of ergonomics is something that is urgent to be implemented and implemented as soon as possible (Sutajaya et al., 2022; Sutajaya, 2018; Sutajaya, 2019; Morales & Laura, 2021: 54-64; Micek et al., 2021: 23-44; Kirwan et al., 2019: 200-217; Sattler et al., 2021: 328-331; Andel et al., 2021: 276-290; Grandey et al., 2021: 261-175).

Starting from the problem identification, the problem is formulated: (1) can the implementation of ethno-ergonomics through the synergy of the manifestations of dewata nawa sanga improve physiological stability as seen from musculoskeletal complaints?; (2) can the implementation of ethno-ergonomics through the synergy of the manifestations of dewata nawa sanga improve physiological stability as seen from fatigue?; (3) can the implementation of ethno-ergonomics through the synergy of the manifestations of dewata nawa sanga improve physiological stability as seen from work-related stress?; (4) can the implementation of ethno-ergonomics through the synergy of the manifestation of *Dewata Nawa Sanga* increase understanding of health? and (5) can the implementation of ethno-ergonomics through the synergy of the manifestation of *Dewata Nawa Sanga* increase caring attitudes towards health governance?

METHOD

This quasi-experimental study used a randomized pre- and post-test group design (treatment by subject design), as shown in Figure 1.

P ---- RS-------S-----(p_0)-----O1-------WOP----------(p_1)-------O2

Figure 1. Research Design Diagram

Description:

P is the population consisting of people who use various symbols of Dewata Nawa Sanga.

RS is a randomly selected sample.

O1 is the data collected before treatment (Period I).

O2 is the data collected after treatment (Period II).

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(p0) is the physiological stability, understanding, and caring attitude toward health management before treatment.

(p1) is the physiological stability, understanding, and caring attitude toward health management after treatment.

WOP is the washout period, or the process of eliminating the effects of the treatment, which is given for one week and is also an adaptation process.

The use of this type of quasi-experimental research aims to compare with itself, because the subjects before being given treatment act as the control group and after the treatment act as the experimental group. The advantage of the research design in the form of a treatment by subject design is that it has very high internal validity so that the masking effect can be minimized. The amount of random variance (error variance) is drastically reduced because each participant acts as a control for themselves. This makes this design much more sensitive to detect the effects of the treatment.

The research subjects were the traditional village community members in Peliatan Traditional Village, Ubud, Gianyar, Bali, who use various symbols of the *Dewata Nawa Sanga*. The research objects included the facilities and infrastructure supporting physiological stability, understanding, and caring attitudes toward health management.

The target population was all members of the traditional village community members in Peliatan Traditional Village. The accessible population consisted of 43 people who used various symbols of the *Dewata Nawa Sanga* and met the inclusion criteria. The research sample consisted of traditional village community members involved in the use of various symbols of the *Dewata Nawa Sanga*. They were selected to determine the sample size and fully participated in the study.

The sample size was 32 subjects, selected using a stratified random sampling method. The technique is: (1) from 12 banjars in Peliatan Traditional Village, two *banjars* were selected that were ready to be involved as subjects, (2) referring to the accessible population of 43 people spread across the two selected *banjars*, a list of their names was made, (3) from the list of names, a proportion was made according to the number of residents involved in the use of various symbols of the *Dewata Nawa Sanga* in the two selected banjars, and (4) a selection was carried out using a simple random technique by drawing lots and selecting 32 samples as research subjects. Research variables: (a) independent variable: implementation of ethno-ergonomics through the synergy of *Dewata Nawa Sanga* manifestations; (b) dependent variables: (1) physiological stability, (2) community understanding of health, and (3) community concern for health governance, and (c) control variables: social and economic conditions.

The research procedures are: (1) identification of problems faced by the community involved in the use of various symbols of dewata nawa sanga using ethno-ergonomic references in its implementation, (2) research outputs in the form of physiological stability were recorded using: (a) Nordic Body Map to record musculoskeletal complaints, (b) fatigue questionnaire, and (c) work-related stress questionnaire, (3) community understanding of health was recorded using questionnaires in Periods I and II, and (4) community attitudes of concern for health governance were recorded using questionnaires in Periods I and II.

The data analysis strategy is: (1) data on physiological stability, understanding, and attitudes of concern for health governance before and after treatment were analyzed descriptively by finding the mean and standard deviation and analyzing the percentage of change and (2) data on physiological stability, understanding, and attitudes of concern for health governance before and after treatment were analyzed using paired t-test at a significance level of 5%.

RESULTS

The results of the descriptive analysis of: (a) physiological stability as seen from musculoskeletal complaints, (b) physiological stability as seen from fatigue, (c) physiological stability as seen from work-related stress, (d)

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community understanding of health governance, and (e) community concern for health governance between Period I (before the implementation of ethno-ergonomics through the synergy of *Dewata Nawa Sanga* manifestations) and Period II (after the implementation of ethno-ergonomics through the synergy of *Dewata Nawa Sanga* manifestations) can be seen in Table 1.

Table 1. Results of Descriptive Analysis between Before and After Implementation

Variable	Before Implementation		After Implementation		Information
	Mean	SD	Mean	SD	
Musculoskeletal complaints	56.84	1.743	41.00	1.704	Decrease 27.87%
Fatigue	66.31	1.749	49.81	1.401	Decrease 24.88%
Work-related stress	68.19	1.533	48.81	1.203	Decrease 28.42%
Understanding of health governance	84.56	3.162	99.59	1.757	Increase 17.77%
Attitude of concern towards health governance	56.03	2.389	69.44	1.480	Increase 23.93%

Based on the analysis results in Table 1, it can be stated that there was (a) an increase in physiological stability seen from a decrease in musculoskeletal complaints by 27.87%, fatigue by 24.88 and work-related stress by 28.42%, (b) an increase in public understanding of health governance by 17.77%, and (c) an increase in public concern for health governance by 23.93% between before and after the implementation of ethno-ergonomics through the synergy of *Dewata Nawa Sanga* manifestations.

The results of the hypothesis tests on: (a) physiological stability as seen from musculoskeletal complaints, (b) physiological stability as seen from fatigue, (c) physiological stability as seen from work-related stress, (d) public understanding of health governance, and (e) public concern for health governance between Period I (before the implementation of ethno-ergonomics through the synergy of Dewata Nawa Sanga manifestations) and Period II (after the implementation of ethno-ergonomics through the synergy of *Dewata Nawa Sanga* manifestations) can be seen in Table 2.

Table 2. Results of Hypothesis Tests on Physiological Stability of Public Understanding and Concern for Health between Periods I and II

Variable	t Value	p Value	Decision Rule
Musculoskeletal complaints	34.919	0.0001	Significant
Fatigue	39,.173	0.0001	Significant
Work-related stress	52.424	0.0001	Significant
Understanding of health governance	25.489	0.0001	Significant
Attitude of concern towards health governance	24.638	0.0001	Significant

Based on the results of the hypothesis test in Table 2, it can be stated that all variables differ significantly between before and after the implementation of ethno-ergonomics through the synergy of *Dewata Nawa Sanga* manifestations, because the p value <0.05 is obtained. This means that the implementation can improve: (a) physiological stability as seen from the decrease in musculoskeletal complaints, fatigue, and work-related stress, (b) understanding of health governance, and (c) caring attitudes towards health governance.

DISCUSSION

The implementation of ethno-ergonomics through the synergy of *Dewata Nawa Sanga* manifestations has been shown to improve physiological stability, as evidenced by a significant 27.87% decrease in musculoskeletal

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complaints ($p<0.05$). This finding is due to the community's increasing understanding and concern for their physiological condition, particularly as it relates to the musculoskeletal system. This understanding and concern for muscle health, as the human body's movement system, has implications for muscle health. Public awareness of the importance of maintaining muscle health has led them to regularly exercise through sports such as walking, jogging, aerobics, and yoga, as well as games such as soccer, volleyball, table tennis, and basketball. Furthermore, a group of people belonging to a nature lover group enjoys exploring nature and hiking. The temple's leaders also frequently engage in communal cleaning activities, providing opportunities for physical activity.

Tripego activities (Peliatan *Ngogo*, Peliatan *Gotong Royong*, and Peliatan Go Green) also have the potential to involve body movements when realizing the three activities carried out by the Peliatan Traditional Village community. Pego I (Peliatan *Ngogo*) is carried out in the water area when cleaning up trash so that the water (of Lord Vishnu) is not polluted. Pego II (Peliatan *gotong royong*) is carried out in a very sacred cemetery area, because it is the place where Goddess Durga (the power of Lord Shiva) resides as a realization of the concept of melting (eradicating or recycling) which is a manifestation of Lord Shiva. Pego III (Peliatan go green) is carried out through planting various ceremonial plants, rare plants, and medicinal plants. This activity is a realization of the manifestation of Lord Sangkara as the protector god of plants and vegetation (Sutajaya et al., 2025).

Body movements performed by people through various activities can trigger the blood circulation system that supplies blood to the muscles. If this occurs, the lactic acid accumulated in some local muscles, which acts as a cause of musculoskeletal complaints and muscle fatigue, can be overcome by oxygen supply to the muscles as a result of improved blood circulation. This condition will change anaerobic respiration to aerobic, which can overcome the accumulation of lactic acid in the muscles used for daily work. This change in the respiratory mechanism in the muscles can overcome musculoskeletal complaints and fatigue (Sutajaya et al., 2025). This condition is in synergy with the findings: (1) Arnita et.al.(2020) states that improvements in ergonomically oriented work mechanisms reduce musculoskeletal complaints of workers making ceremonial devices by 44.45%, (2) Apriantini et al. (2022) states that there is a significant difference in musculoskeletal complaints, where the complaints are 22.28% lighter in the experimental group with loads that are upheld in accordance with ergonomic principles compared to the control group with loads that are upheld beyond the capacity of workers (not ergonomic), (3) Sutajaya et al. (2021) states that training and implementation of local wisdom nyangling oriented Socio-Cultural Ergonomic improves the quality of public health as seen from a decrease in musculoskeletal complaints by 24.5%, and (4) Sutajaya & Citrawathi (2023) states that biotanggul oriented socio-cultural ergonomic improves the quality of health as seen from a decrease in musculoskeletal complaints of the public by 21.9%.

The implementation of ethno-ergonomics through the synergy of *Dewata Nawa Sanga* manifestations can apparently increase physiological stability as seen from a significant decrease in fatigue by 24.88% ($p<0.05$). The actions taken related to this implementation are through socialization about the manifestation of gods associated with fatigue such as: (a) Lord Vishnu who manifests as a maintainer, explained that in the human body organs there are various enzymes and hormones that act as tissue maintainers and can function optimally and maximally if the body is not too tired as a result of excessive workload, (b) Lord Brahma who manifests as a creator, explained that the metabolic process that occurs in the body's tissues will create substances that are beneficial to the body, if the body does not experience excessive fatigue, both local fatigue and absolute fatigue, (c) Lord Shiva who manifests as a smelter, explained that the function of the immune system (smelter of foreign objects, bacteria, fungi, viruses, parasites, and microorganisms and other substances) in the body will work well if the human body does not experience a level of fatigue that exceeds the threshold value. The physiological stability of the body as seen based on fatigue parameters is equivalent to the findings: (1) Apriantini et al. (2022) states that there is a significant difference in fatigue of porters at Badung market, where the fatigue is 15.16% lighter in the experimental group with loads supported according to ergonomic principles compared to the control group with loads supported beyond the worker's capacity (not ergonomic), (2) Sutajaya & Citrawathi (2023) states that socio-cultural ergonomic-oriented biotanggul improves health quality as seen from a decrease in fatigue by 21.5%, (3) Devi et al. (2022) states that providing snacks and active breaks reduces fatigue of workers making gipang snacks by 27.27%, (4) Devi et al. (2023) states that community empowerment through ergo-entrepreneurship reduces fatigue of workers making sengait snacks by 24.62%, and (5) Sutajaya & Warpala

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(2018) states that community empowerment through ergo-entrepreneurship training can improve health quality significantly ($p<0.05$) seen from the decrease in sculptor fatigue by 20.73%.

The implementation of ethno-ergonomics through the synergy of *Dewata Nawa Sanga* manifestations can apparently increase physiological stability as seen from a significant decrease in work-related stress of 28.42% ($p<0.05$). The actions taken in relation to the implementation are through socialization about the manifestation of gods associated with work-related stress such as: (a) Lord Vishnu who manifests as a leader god with wisdom, more emphasis is placed on wise ways to manage work-related stress through wise body maintenance, (b) Lord Sambhu who manifests as the god who guards the balance of the universe and is often worshipped to ask for enlightenment and energy balance, more emphasis is placed on the use of energy during activities with the concept that if you are hungry you must eat, if you are thirsty you must drink and do not delay so that hypoglycemia does not occur as a result of energy imbalance, (c) Lord Iswara who manifests as the god of beauty and spiritual inspiration, which is more focused on the use of ornamental plants (floriculture) which can influence psychological elements and can help spiritual activities inspired by the beauty and fragrance of ornamental plants, (d) Lord Maheswara who manifests as a dispeler of inner darkness (ignorance), a giver of compassion, solidarity, and emotional humanity, more emphasis is placed on managing emotions so that stress does not arise at work because it is based on compassion and solidarity, (e) Lord Brahma who manifests as the creator of the universe and its contents, emphasizing gratitude for his creations that can be utilized wisely, (f) Lord Rudra who manifests as a melter (*pralina*), ruler of storms, winds, and hunting that symbolizes cosmic anger to restore balance, more emphasis is placed on the mechanism of maintaining the body's physiological balance (homeostatic) so that there is no accumulation of metabolic toxins due to prolonged stress that must be dissolved as soon as possible so as not to damage tissues, organs, and organ systems, (g) Lord Mahadewa who manifests as a god who is worshipped to ask for balance and peace, more emphasis is placed on ways to obtain inner peace through stress management so that physiological stability occurs, (h) Lord Sangkara who manifests as the god who rules plants, fertility, and prosperity of the universe, more emphasis is placed on the use of plants as medicinal plants, especially stress-relieving plants such as: dapdap leaves and bark, moringa leaves and fruit, berry fruit, pegagan leaves (*piduh/apah iduh*), orange fruit, pineapple, and mango, and (i) Lord Shiva who manifesting as the God of arts with the title *Siwa Natya Raja* (King of the arts) describes that various artistic activities such as: dance, percussion, painting, sculpture, carving, literary arts, weaving, drama, and vocal arts are blessed with health, peace, happiness, prosperity, and harmony by Lord Siwa which can be achieved through overcoming stress due to work.

In understanding health governance, it was found that there was a significant increase, namely from an average score of 84.56 to 99.59 or a significant increase of 17.77% ($p <0.05$). This could happen because through the socialization of the meaning of the manifestation of *Dewata Nawa Sanga* which is associated with ethno-ergonomics and physiological stability and is associated with health governance, the community is increasingly aware that the manifestation of *Dewata Nawa Sanga* is full of educational meaning and if implemented sustainably and seriously will have implications for health. The same thing was also found in the public's caring attitude towards health governance which also increased significantly, namely from an average score of 56.03 to 69.44, or an increase of 23.93% ($p <0.05$). The increase in public understanding of health governance, accompanied by an increase in their caring attitude, has implications for improving the quality of health, which is indicated by a significant decrease in musculoskeletal complaints by 27.87%, fatigue by 24.88%, and work-related stress by 28.42%. This fact can be explained based on the concept of ergonomics which emphasizes that an activity carried out with feelings of joy and happiness accompanied by dynamic movements will be able to increase the production of the happiness hormone in the form of endogenous morphine and will suppress the production of the hormone cortisol as a cause of stress which will have an impact on muscle complaints, fatigue, and the emergence of work-related stress (Sutajaya et al., 2025). This condition is in synergy with the findings: (1) Arnita et.al. (2020) states that improving ergonomically oriented work mechanisms reduces work-related stress in ceremonial device makers by 29.90%, (2) Sutajaya et al. (2021) states that training and implementation of local wisdom nyangling oriented Socio-Cultural Ergonomics improves the quality of public health as seen from a decrease in work-related stress by 28.8%, (3) Sutajaya & Citrawathi (2023) states that biotanggul oriented socio-cultural ergonomics improves the quality of health as seen from a decrease in community stress by 28.4%, and (4) Arnita et al. (2023) states that the implementation of participatory ergo-entrepreneurship reduces work-related stress in ceremonial device makers by 26.88%.

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CONCLUSIONS AND RECOMMENDATIONS

Based on the research results and discussions reviewed, based on data analysis and arguments, as well as synergy with relevant research, it can be concluded that the implementation of ethno-ergonomics through the synergy of the *Dewata Nawa Sanga* manifestations can improve: (1) physiological stability as seen from a decrease in: (a) musculoskeletal complaints by 27.87%, (b) fatigue by 24.88%, and (c) work-related stress by 28.42%, (2) understanding of health by 17.77%, and (3) caring attitudes toward health governance by 23.93%.

The suggestions narrated in this study as input to related parties are: (1) it is recommended that the community continue to pay attention to and utilize local wisdom in the form of *Dewata Nawa Sanga* manifestations, as it has been proven to improve health quality, and (2) it is recommended that other researchers continue this research with a more in-depth study, particularly regarding the physiological conditions of organs and organ systems that are influenced by the application or implementation of the various meanings of the *Dewata Nawa Sanga* manifestations as one of the ethno-ergonomic interventions.

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