

The Influence of Ergonomic Aspects on Sleep Quality and Its Impact on the Quality of Life of Tourists in Homestay

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Abstract

This study aims to determine the effect of ergonomic aspects on sleep quality and its impact on the quality of life of tourists staying at homestays in Bali. Ergonomic aspects are limited to visual displays, anthropometry, posture or sleeping position and environmental conditions. This study is a quantitative study using a survey method. Purposive sampling was used with a total of 43 respondents. Data were processed using the Structural Equation Model (SEM) with the help of the SmartPLS 3.2.9 program. The results showed that visual displays had a positive and significant effect on sleep quality with a t value of 3.227 and p value of 0.001, posture had a positive and significant effect with a t value of 5.219 with a p value of 0.000, while anthropometry did not significantly affect tourists' sleep quality with a p value of 0.125. The same condition also showed that the environment did not significantly affect sleep quality with a p value of 0.517. The results of the study also showed that sleep quality had an effect on the quality of life of tourists who stayed at homestays with a t value of 44.198 and p value of 0.000.

Keywords: Ergonomics, Sleep Quality, Quality of Life, Tourists, Homestay

INTRODUCTION

According to the International Ergonomics Association (EIA) (2000) ergonomics is a scientific discipline concerned with understanding the interaction between humans and

other elements of a system, and a profession that applies theory, principles, data, and methods to design to optimize human well-being and overall system performance. The goal of ergonomics is to eliminate discomfort and the risk of injury from works or activities by designing or modifying works or activities to suit humans, not vice versa, so that a better quality of life is achieved (IEA, 2000; Kroemer, 2017).

Until now, researches on the effect of ergonomics application on quality of life have been widely conducted, including the effect of sleep quality on human quality of life. However, researches on the effect of ergonomic aspects on sleep quality and quality of life of tourists in tourist villages have never been conducted because sleeping and staying in hotels play a crucial role as the main element in the tourist travel experience. One of the expectations of guests staying in a hotel is to be able to enjoy a good night sleep in a comfortable room with adequate bedding (Robbin, et al, 2021; Hon et al, 2019). Several studies have found that supporting facilities such as beds, mattresses, pillows, visualization, lighting settings, and temperature can affect the quality of tourists' sleep. (Bai et al, 2025; Jacobson et al., 2009) in his research found out that the condition of the bed surface could affect sleep quality, and a mattress that was adjusted to the sleeping position could reduce discomfort in the skeletal muscles and could improve sleep quality. An inappropriate bed can also cause centralized pressure and discomfort to the skeletal muscle system which is the main cause of sleep disorders (Hong et al, 2022; Meerlo et al., 2008 & (Palermo et al., 2011). (Zhang et al 2022; Haex, 2004) found that sleep quality was influenced by ergonomically designed beds by measuring individual anthropometry and sleeping position. Ergonomic body position during sleep will reduce pressure, thus reducing the risk of muscle and spinal injuries. (Zhang et al., 2022). Utilizing room facilities such as ergonomic pillows can improve optimal spinal alignment, thereby improving sleep quality and duration (Radwan et al., 2021). Visualization in the room such as color, layout or interior design in several studies is said to affect sleep quality. (Emmitt, 2023; Gao, 2015) found a relationship between room color and sleep quality. Temperature and lighting settings that are part of ergonomic studies help improve sleep quality by increasing body comfort to adapt to the natural sleep cycle (Cao et al., 2021). In tourism industry, sleep quality has a positive and significant effect on travel experience (Yang et al., 2021), while inadequate sleep quality is significantly associated with poor quality of life (Lee et al., 2021). Insufficient sleep can cause fatigue, lack of energy, and difficulty in focusing and enjoying activities during the trip. In addition, sleep disorders can also affect the physical and mental health of tourists. According

to (Cohrdes et al., 2018); (Matsui et al., 2021) in their research showed that sleep quality affected various aspects of quality of life.

Hotels generally provide facilities and environments specifically designed to create optimal sleep quality, such as comfortable beds, controlled lighting and quiet from noise disturbances, making hotels one of the dominant forms of accommodation chosen by tourists. But in recent years, the trend of tourism travel has changed. Hotels are no longer the main destination for tourists to stay. Tourists tend to visit tourist villages and stay in home stays to absorb local culture and participate in more authentic experiences offered by the local community. Hotels are different from home stays, where the use of space is partly rented to guests for a longer period of time and the facilities and forms of services provided are not yet standardized like hotels in general.

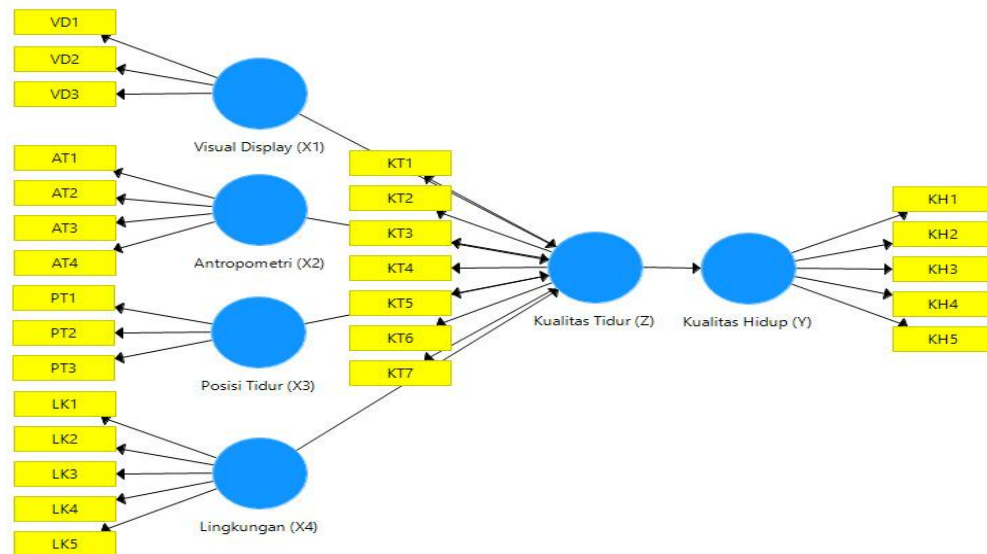
Based on this background, this study was conducted to determine the effect of ergonomic aspects on the quality of tourists' sleep and its impact on the quality of life during their stay at a homestay in Bali. The ergonomic aspects in this study were limited to physical ergonomic aspects including visual displays, anthropometry, posture and environmental aspects including lighting, humidity, temperature and noise. Therefore, the problem formulations in this study are: Do ergonomic factors from the visual display aspect, anthropometry, posture or sleeping position, and environmental conditions affect sleep quality; and does sleep quality affect the quality of life of tourists during their stay at a homestay in a Tourism Village in Bali?

METHOD

Research Model

The following is the research model framework that can be described based on the description of the variables that would be studied in this research:

Figure 1 Framework Study



Source: Researcher Data (2023)

Measurement of Research Variables

The instrument used in this study was a questionnaire. The questionnaire was developed based on a literature review. The questionnaire was divided into two parts. The first part of the questionnaire consisted of demographic questions. The second section examined respondents' perceptions on the visual appearance, anthropometrics, posture, environmental ergonomics and sleep quality of tourists during their stay at the homestay . Respondents' perceptions were measured using 26 indicators . Visual display indicators were adopted from Sanders, Mark S.; McCormick, EJ; Ernest, 1993 , (Freivalds, A., Niebel, 2013) and (Kroemer, 2017) . Anthropometric indicators were adopted from (Panero, J & Zelnik, 2003) . Environmental ergonomic indicators were adopted from (Sanders, Mark S.; McCormick, EJ; Ernest, 1993) and (Kroemer & Grandjean, 1997) . While sleep quality indicators were based on the sleep quality questionnaire (KKT) from (Karota, 2018) which was combined with *the Pittsburg Sleep Quality Index* (PSQI) Questionnaire (Buysse et al., 1989) by compiling the KKT based on 7 (seven) modified sleep components, including: (1) total hours of sleep at night, (2) time to start sleeping, (3) frequency of waking up, (4) feeling fresh when waking up in the morning, (5) depth of sleep, (6) satisfaction with sleep at night,

(7) feeling tired/sleepy during the day. Meanwhile, the quality of life was adopted from Peadmont & Friedman (2012). The measurement is presented in Table 1.

Table 1. Variables, Indicators and Statement Items

Variables	Indicator	Statement Items
Visual display (size, color, contrast)	Room color (color composition)	The color design of the bedroom is not disturbing
	Typography and font size	Signage can be easily read
	Visual activities	Allows you to see the object view clearly
Anthropometry	Room size	The room is not cramped
	Bed size	The bed in this homestay fits my body dimensions (body size)/not too narrow for me
	Condition of the mattress or bed	The mattress I used in this homestay did not cause any lower back pain.
	Pillow condition	The pillow I used in this home stay did not cause pain in the back of my neck.
Posture	Supine sleeping position	The supine sleeping position is the best sleeping position.
	Prone sleeping position	The prone sleeping position does not disturb my sleep.
	Side sleeping position	The side sleeping position is the best choice.
Environmental Conditions	Lighting	The lighting in this homestay room is sufficient to maintain comfort.
	Humidity	The humidity in this homestay room is sufficient for a good and comfortable sleep throughout the night.
	Noise	This homestay room provides a quiet environment and is free from noise that disturbs my stay experience.
	Temperature or temperature	The temperature in the homestay room overall provides comfort during sleep.

	Vibration	This homestay room is quiet and free from vibrations that disturb my sleep quality.
Sleep Quality	Total hours of sleep at night	I get enough sleep to restore my body's energy.
	Time to start sleeping	I can easily fall asleep at any desired time.
	Frequency of waking up	I rarely wake up in the middle of the night
	Feeling fresh when you wake up in the morning	I wake up in the morning feeling refreshed and energized
	Depth of sleep	I feel like I slept pretty well
	Satisfaction of night sleep	I am satisfied with the quality of my night's sleep.
	Feeling tired/sleepy during the day	I rarely feel tired or sleepy during the day.
Quality of Life	Physical Health	I have the ability to do physical activities without getting tired quickly.
	Psychological Health/emotional well-being	I feel happy
	Social Relations	I have strong and meaningful interpersonal relationships.
	Relationship with the Environment	I can adapt to the physical environment around me

Sources : Sanders, Mark S.; McCormick, EJ; Ernest, 1993 , (Freivalds, A., Niebel, 2013) (Kroemer, 2017) , (Panero, J & Zelnik, 2003, (Sanders, Mark S.; McCormick, EJ; Ernest, 1993) , (Karota, 2018) (Buysse et al., 1989)

Samples and Data Collection

The population in this study was all tourists who stayed at homestays in the Tourism Village in Bali. The sampling technique used purposive sampling, namely sampling based on criteria set by the researcher. The criteria were; 1) foreign tourists, 2) have stayed, 3) minimum length of stay of 1 week. The sample was 43 respondents.

Data analysis

This research was explanatory research, which is a type of research that aims to explain the relationship between the variables studied and to identify the influence between one variable and another. In this study, the researcher used an explanatory method to test the proposed hypothesis. The goal was to provide a deeper understanding of the relationship and influence between the independent and dependent variables in the hypothesis. The

sampling method used purposive sampling, which was a sampling technique based on certain criteria (Sugiyono, 2021) .

In this study, Structural Equation Model (SEM) was used as an analysis tool and Smart PLS 3.2.9 was used as data processing software. In PLS-SEM there are two measurement models, namely Outer Model and Inner Model.

FINDING AND DISCUSSION

The description of the tourists' characteristics who stayed in tourist villages in Bali is presented in table 2.

Table 2. Descriptive Analysis Results

No	Items	Answer Categories	Amount	Percentage (%)
1	Gender	Woman	18	18.00
		Man	25	53.00
2	Age	20-25 Years	9	20.93
		26-30 Years	17	39.53
		31-35 Years	7	16.28
		36-40 Years	5	11.63
		41-45 Years	5	11.63
3	Education	SENIOR HIGH SCHOOL	2	4.65
		Diploma	7	16.28
		Bachelor	25	58.14
		Master	9	20.93
4	Visit	Less than 2 times	21	48.84
		More than 2 times	22	51.16
5	Origin	Asia	10	23.26
		Australia	5	11.63
		Europe	18	41.86
		American	10	23.26

Source: Researcher data, 2023

Based on the data above, it appears that tourists visiting tourist villages are dominated by male tourists. In terms of age between 26-30 years, with the most education status being high school education, and visiting tourist villages more than 2 times as much as 51.16%. And from the data collected, European tourists mostly stay in tourist villages.

Perception of the environment affects sleep quality. Thus, this is a special attraction for European tourists to visit and stay in tourist villages.

Analysis Measurement Outer Model

Results analysis model in measurement study served in Table 3. The following:

Table 3. Measurement Outer Model

No	Variable	Indicators	Outer Loadings	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
1	Visual Display (X1)	X1.1 X1.2 X1.3	0.822 0.717 0.946	0.776	0.871	0.695
2	Anthropometry (X2)	X2.1 X2.2 X2.3 X2.4	0.921 0.88 0.874 0.878	0.911	0.937	0.79
3	Sleeping Position (X3)	X3.1 X3.2 X3.3	0.757 0.789 0.843	0.712	0.839	0.635
4	Environment (X4)	X4.1 X4.2 X4.3 X4.4 X4.5	0.985 0.721 0.852 0.896	0.915	0.924	0.754
4	Sleep Quality (Z)	Z1.1 Z2.2 Z3.3 Z3.4 Z3.5 Z3.6 Z3.7	0.945 0.732 0.946 0.812 0.934 0.903 0.948	0.956	0.964	0.796
5	Quality of Life (Y)	Y1.1 Y1.2 Y1.3 Y1.4	0.929 0.79 0.874 0.808	0.914	0.936	0.746

		Y1.5	0.909			
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Based on table 3, the outer loading above all construct indicators have a rule of thumb value of 0.7. In the reliability test of indicators using the Composite Reliability parameter, the generally accepted value is above 0.70. If the factor loading value is > 0.70, then the construct indicator is considered valid. In addition, according to Ghazali and Latan (2015), the Average Variance Extracted (AVE) value above 0.50 is considered to meet the reliability requirements. In addition, the Composite Reliability and Cronbach's Alpha values above 0.70 are considered reliable or meet the reliability requirements.

In this study, the Fornell-Larcker Criterion values are presented in Table 4.

Table 4. Fornell-Larcker Criterion (Discriminant Validity)

No	Variable	Visual Display (X1)	Anthropometry (X2)	Sleeping Position (X3)	Environment (X4)	Sleep Quality (Z)	Quality of Life (Y)
1	Visual Display (X1)	0.834					
2	Anthropometry (X2)	0.217	0.889				
3	Sleeping Position (X3)	0.792	0.066	0.797			
4	Environment (X4)	0.103	0.129	0.017	0.868		
5	Sleep Quality (Z)	0.798	0.254	0.0828	0.276	0.892	
6	Quality of Life (Y)	0.792	0.19	0.0905	0.083	0.0944	0.864

From the table, it can be seen that each construct has the highest Fornell-Larcker Criterion value when tested with other latent variables, this indicates that the latent variables can predict indicators better than other variables. Thus, it can be concluded that all constructs meet the criteria for discriminant validity.

Path analysis (inner model) and hypothesis testing

The results of the hypothesis testing are shown in Table 5, as follows:

Table 5. Path Coefficient for Hypothesis Testing

No	Path Hypothesis	Standardized Beta	T Statistics	P Value	Hypothesis Test Results
1	H1 X1 -> Z	0.381	3,227	0.001	Accepted

2	H2 X2 -> Z	0.126	1,536	0.125	Rejected
3	H3 X3 -> Z	0.554	5,219	0,000	Accepted
4	H 4 X 4 -> Z	0.065	0.649	0.517	Rejected
5	H5 Z -> Y	0.276	44,198	0,000	Accepted

As shown in table 5, the visual display aspect has a positive effect on the quality of tourists' sleep (H1), posture or sleeping position affects the quality of sleep (H3), and sleep quality affects the quality of life of tourists (H5) with a significance value of $p \text{ value} < 0.05$. While the anthropometric and environmental aspects do not have a significant effect on the quality of tourists' sleep, as shown by the $p \text{ value} > 0.05$.

Analysis of the Influence of Visual Display Aspects on Tourist Sleep Quality

The hypothesis regarding the influence of visual display with indicators of color composition, typology and font size, and visual activity on the quality of sleep of tourists in home stays is accepted. This means that the results of the study provide sufficient evidence to state that these variables have a significant influence on the quality of sleep of tourists who are staying in homestays. This finding indicates that visual display design, color composition, typology and font size, and visual activity play important roles in shaping the sleep experience of tourists in homestay environment. The outer loadings factors value shows that of the three visual display indicators, visual activity (vd3) with the statement that allows viewing the object display clearly is the indicator that best explains the visual display variable with an *outer loading value* of 0.946.

This confirms that the homestays have met the homestay assessment standards stated in the Regulation of the Minister of Tourism and Creative Economy of the Republic of Indonesia No. 9 of 2014 concerning Homestay Standardization (Noor et al., 2021) . This standard includes a nameplate facility with clearly legible writing and installed in a visible place (displaying the Homestay Name, address, and telephone/mobile number). In addition, the arrangement and maintenance of rooms that meet the standards according to regulations also support the comfort of tourists, ensuring that they can enjoy a clean and complete room atmosphere.

Research suggests that visual stimuli in the bedroom can have a significant impact on sleep quality. (Beattie et al., 2017) found that individuals with insomnia symptoms fixated on the bedside area in natural scenes, suggesting a potential link between visual attention and sleep disturbance. Optimal exposure to sunlight and scenery has been associated with longer sleep duration and improved cognitive performance (Boubekri et al., 2020) . However,

(Liao et al., 2022) and (Xiong et al., 2020) highlighted the importance of other factors such as the position of open windows and bedroom temperature and ventilation in influencing sleep quality. These studies collectively suggest that visual stimuli in the bedside area and exposure to natural light may play a role in improving sleep quality.

Analysis of the Influence of Anthropometric Aspects on Tourist Sleep Quality

The hypothesis regarding the influence of anthropometric aspects on sleep quality with indicators of room size, bed size, mattress size, and pillow size is rejected with a value of $p > 0.05$. This means that there is not enough statistical evidence to reject the null hypothesis, which states that there is no significant influence of anthropometric aspects on the quality of sleep of tourists in homestays.

The rejection of this hypothesis could be due to the complexity of the interaction between variables or the presence of other unidentified factors that influence the relationship between anthropometric aspects and sleep quality. Another possibility is the large anthropometric variation among tourists staying in homestays, including racial differences, which can cause inconsistent results or it can be said that physical characteristics, body size or body dimensions can vary based on ethnicity, such as the height and body size of Europeans are larger than Asians. This can affect the design of different spaces and objects, thus affecting comfort and accessibility for all individuals. For example, the dimensions of furniture and the placement of equipment such as the placement of paintings, or other objects need to be adjusted based on the anthropometric data of tourists. Several studies have shown that there is a significant relationship between anthropometric measurements and sleep quality. Researches on bed design using anthropometric data have produced several important findings. (Verhaert et al., 2011) found that body dimension preferences play an important role in the relationship between beds and sleep quality. If the design of a product, facility, and tool is in accordance with the anthropometric data of its users, then the user can carry out their activities comfortably for a long time (Panero, J & Zelnik, 2003) . A bed that is in accordance with anthropometric data greatly contributes to sleep quality.

Analysis of Sleeping Posture or Position on Tourists' Sleep Quality

The hypothesis regarding the influence of posture aspects on sleep quality by considering the indicators of prone sleeping position, supine sleeping position, and side sleeping position is accepted with a value of $p > 0.05$. This means that the results of the study provide sufficient evidence to support the hypothesis that variations in prone, supine, and side sleeping positions can have significant effects on sleep quality.

From the outer loading factors value, *it shows that of the* three indicators of posture or sleeping position, the side sleeping position (p3) with the statement that the side sleeping position is the best choice is the most explanatory indicator of the sleep position variable with an outer loading value of 0.843. The results of this study are reinforced by the results of research by (Zhang et al., 2022) that showed that the most crucial factors influencing sleep quality are sleep posture preferences *and* frequency of turning. Data analysis reveals that subjects with a preference of lying on the right side and turning less have better sleep quality. The results of this study are in line with (Verhaert et al., 2011) which found that the spine affected sleep in healthy subjects, and found that the relationship between bed and sleep quality was influenced by individual anthropometry and sleeping posture. In several studies, the side sleeping position can also reduce pressure on the spine, especially on the back and neck, so that it can reduce the potential for discomfort that impacts sleep quality.

Researches also consistently show that sleep posture can significantly affect sleep quality. (Chen et al., 2013) found that mattress characteristics and sleep behavior, including posture, were closely related to sleep quality. This is further supported by (Liu et al., 2014) , who developed a method to recognize and monitor sleep posture, and found that recognizing posture significantly improved sleep quality. Nicholson (1987) and Koninck (1983) both found that certain postures, such as lying at a 40° angle and avoiding sleeping on the back, were associated with better sleep quality. These studies collectively indicate that sleep posture plays an important role in determining sleep quality.

Analysis of Environmental Influence on Tourist Sleep Quality

The hypothesis regarding the influence of environmental aspects on the quality of sleep of tourists in homestays or houses by considering indicators of temperature, lighting, noise, and humidity is rejected with a significance value of $p > 0.05$. There is insufficient evidence to support the statement that these environmental variables have a significant influence on the quality of sleep of tourists in homestays or houses. This may be due to the characteristics of the homestays or houses studied, such as geographical location, type of building, or infrastructure conditions, external environmental temperature so that the results can differ significantly. These differences can produce inconsistent results. In addition, tourists' preferences for environmental sleeping conditions, such as the considered comfortable temperature or desired lighting levels, can vary greatly. Some tourists may be more tolerant of differences in environmental conditions than others.

These findings are in line with the concept of Environmental Ergonomics which investigates the relationship between humans and their limitations in the physical work

environment, including illumination (lighting), sound, climate, air circulation, and vibration. Environmental ergonomics affects human health, comfort, ability, and willingness to perform (Kroemer, 2017; (Sanders, Mark S.; McCormick, EJ; Ernest, 1993).

According to (Cao et al., 2021) the results of subjective sensations in the thermal environment showed a close relationship between thermal comfort and sleep quality. Previously, (Cao et al., 2021) conducted a comprehensive study on the effect of temperature, relative humidity, and light intensity on sleep quality, the results of the study recommended that environmental conditions that optimally affect sleep quality were at a temperature of 20°C, relative humidity of 55%, and light intensity before going to bed 150 lux and 30 lux before waking up

Analysis of the Influence of Sleep Quality on the Quality of Life of Tourists

The hypothesis of sleep quality aspects as represented by 7 indicators has a positive influence on the quality of life of tourists is accepted with a significance value of less than 0.05. The acceptance of this hypothesis indicates that there is sufficient evidence to support that sleep quality contributes positively to the quality of life of tourists. This finding also provides empirical support for the assumption that tourists' sleep quality can positively affect their quality of life during their stay at a homestay or resident's house.

Other studies have shown that sleep quality can have a significant impact on tourists' quality of life. Changes in the sleep environment, such as staying in a new place, can affect sleep health. Risk factors that can worsen sleep quality while traveling include unhealthy sleep habits, early waking habits, and short sleep duration. Changes in diet and physical activity can also play a role in sleep disturbances. Sleep deprivation during travel can result in decrease of performance for business travelers and athletes, reduce the enjoyment of the experience for those seeking entertainment, and can even become chronic for those who travel frequently or are at risk for long-term sleep deprivation and circadian disruption. However, concrete actions can be taken to improve sleep quality, both during travel and in transit (Yang et al., 2021a; (Xiong et al., 2020).

Researches also show that sleep quality is an important factor in determining the quality of life of travelers. Researches show that sleep quality significantly and positively affects traveler experiences, with better sleep increasing satisfaction and perceived value of the travel experience (Yang et al., 2021a). Sleep quality refers to how well a person sleeps regardless of the duration of sleep (Crain et al., 2018, 2018). In other words, this term reflects an individual's sleep experience based on their assessment of their sleep condition (Hon & Fung, 2019). Some methods used to measure sleep quality involve objective

approaches, such as monitoring the interbeat interval and counting the number of times a person wakes up (Harvey et al., 2008) . In addition, subjective methods are also often used, including evaluating a person's difficulty in initiating sleep and maintaining sleep throughout the night (Crain et al., 2018 ; Harvey et al., 2008) .

A population-based study conducted in Korea found that poor sleep quality was associated with impaired quality of life, particularly with the presence of anxiety or depression (Lee et al., 2021) . Another study of working adults in Abu Dhabi concluded that sleep quality impacted multiple aspects of quality of life, including health, physical and cognitive function, and psychological effects (Badri et al., 2023)

Several other studies have shown that sleep quality can have a significant impact on quality of life, including traveling. Studies have shown that lack of sleep while traveling can lead to fatigue and reduced enjoyment of travel, which affects both business and leisure travelers (Yang et al., 2021b) . As a result, the concept of "sleep tourism" has emerged, with more and more hotels and resorts offering sleep-focused experiences to help guests improve their sleep quality (Hardingham-Gill, 2022 ; Mikhail, 2024 ; Zwarensteyn, 2024) . Sleep experiences often include amenities, unique sleep environments, and guidance from sleep experts to improve sleep quality and overall well-being (Mikhail, 2024 ; Zwarensteyn, 2024) . Other studies have also shown that poor sleep quality can lead to fatigue, interfere with performance, and reduce travel enjoyment. Travel-related sleep disorders are usually short-term problems, but can become chronic for people who travel frequently or who are at risk for long-term sleep deprivation and circadian disruption. Conversely, good sleep quality can result in high customer satisfaction and better hotel reviews.

CONCLUSION

Based on the results of the analysis obtained, it can be concluded that there is a significant influence of visual display and posture or sleeping position on sleep quality and has an impact on the quality of life of tourists. Meanwhile, anthropometry and environmental conditions have not been proven to affect tourists who stay in homestays in tourist villages in Bali.

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