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Implementation of Bali Elderly Care Model to Increase Melatonin Levels in Elderly Community

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bali elderly care;
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elderly;
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Abstract

The importance of melatonin in the life of the elderly makes us aware of the importance of non-medical alternatives that can increase melatonin levels. The aims of this study to determine the effect of implementing the Bali Elderly Care model on increasing levels of Melatonin in the elderly population in Tabanan Regency, Bali. This is an experimental study conducted in the community (community trial) using a randomized pretest and posttest control group design. The grouping of subjects was conducted by randomization and divided into two groups. An independent t-test was conducted to determine the difference in mean levels of melatonin between the control and treatment groups. The mean melatonin levels after 3 months of observation, the control group experienced a decrease in the mean melatonin levels by 0.17 ± 2.60, but this result was not statistically significant. In the treatment group that received the Bali Elderly Care model intervention, the mean increase in melatonin levels was -1.84 ± 1.65 and it was statistically significant (p = 0.000). The implementation of the Bali Elderly Care Model increases Melatonin levels in the elderly better than conventional nursing care.

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1 Introduction

By 2050, globally, the population of elderly people aged over 60 years is estimated to reach 2 billion, an increase from 900 million in 2015 (World Health Organization, 2018). The term 'elderly' is applied to individuals aged 60 and over, representing some of the fastest-growing populations worldwide (Amarya et al., 2018; Salvà et al., 2004). As we age, the body also undergoes various visible changes and this aging process is often accompanied by a decrease in bodily functions. However, a decrease in bodily functions is different from a loss of function due to disease. Aging changes occur in all body cells, tissues, and organs and these changes affect the functioning of all body systems (Chalise, 2019; Hausdorff et al., 1997). Insomnia is a symptom that most often occurs in the elderly which is a major cause of physical and mental health disorders (Most et al., 2010; Mant et al., 2007). Nearly 30-40% of the elderly population suffer from mild to severe insomnia (Cardinali et al., 2012). Previous research has shown an age-related decrease in melatonin levels (Ganesan et al., 2019; Stepnowsky & Ancoli-Israel, 2008) especially in elderly insomniacs (Grad & Rozencwaig, 1993).

Altered melatonin secretion in the elderly has been associated with a significant reduction in sleep efficiency and continuity that is typical in elderly individuals (Stepnowsky & Ancoli-Israel, 2008). Several studies have shown that aging is a syndrome due to melatonin deficiency (Grad & Rozencwaig, 1993; Karasek, 2004). Research from the Massachusetts Institute of Technology (MIT) has also linked decreased melatonin levels in the elderly with poor sleep quality. Administration of prolonged-released melatonin orally for the treatment of primary insomnia in the appropriate dosage range can increase the level of nocturnal melatonin to improve sleep patterns (Wade & Downie, 2008; Lajoie & Gallagher, 2004). However, a randomized, placebo-controlled trial involving 37 subjects who were given prolonged daily melatonin (0.15-12 mg, for 4-29 weeks) for the treatment of primary and secondary sleep disorders obtained results, namely a side effect of melatonin which most frequently reported were daytime sleepiness (1.66%), dizziness (0.74%), headache (0.74%), other sleep-related side effects (0.74%), and hypothermia (0.62%). There were very few serious or clinically significant side effects, including agitation, palpitations, nightmares, mood swings, fatigue, and skin irritation. Most of these effects resolved spontaneously within days without adjustment for melatonin, or immediately after discontinuation of treatment (Besag et al., 2019; Silakarma et al., 2021). The importance of melatonin in the life of the elderly makes us aware of the importance of non-medical alternatives that can increase melatonin levels. Non- medical management that may be given to the elderly is in the form of an integrated service program according to the needs of the elderly.

Based on the aforementioned problems, the author has conducted a preliminary study entitled "Physiological and Psychosocial Changes and the Need for a Health Intervention Model for the Elderly in Tabanan Regency, Bali Province". Based on this preliminary study, the researchers made an innovation in the nursing care model for the elderly which is packaged in the framework of the Bali Elderly Care (BEC) model which consists of health education, physical activity activities in the form of yoga, and relaxation massage. Researchers want to conduct further research to determine the effect of implementing the BEC model on increasing levels of Melatonin in the elderly population in Tabanan Regency, Bali.

2 Materials and Methods

Research type and design

This research is an experimental study conducted in the community (community trial) using a randomized pretest and posttest control group design. The grouping of subjects was conducted by randomization and

divided into two groups, which was the group I (one) was the treatment group that implemented the Bali Elderly Care model with a frequency of 2 times a week for 105 minutes, in the form of health education activities, yoga training, and practical training in relaxing massage or reflexology massage. The intervention program was conducted by a team of experts in their field and monitored by researchers. Group II (two) was a control group that carried out conventional community nursing care, which was the elderly Posyandu (integrated service post) program and elderly gymnastics. This activity was carried out by elderly cadres and village midwives in charge of the area (Bemelmans et al., 2012; Stolt et al., 2011; Ningsih et al., 2021).

Research samples

The sample in this study was determined using inclusion and exclusion criteria. The sample inclusion criteria were men or women who were in the age range of 60-74 years; residing in Selemadeg Sub-District and West Selemadeg Sub-District, Tabanan Regency; willing to be a research sample until the completion of the research by signing an agreement letter of willingness as a sample; and able to communicate well. The sample exclusion criteria consisted of elderly people who needed assistance in carrying out their daily activities; had a major depressive disorder; experiencing clinical problems (suffering from certain diseases such as asthma, heart disease, kidney failure) that interfere with the ability to perform physical activity. The number of samples for each group was 34.1 and rounded to 35 per group, so the total sample was 70 people. This research was received ethical clearance from Udayana University/Sanglah General Hospital with the number 2964/UN14.2.2.VII.14/LP/2019.

Research analysis

In this study, a descriptive analysis was carried out using frequencies and percentages for the variables of gender, age, nutritional status, systolic blood pressure, diastolic blood pressure, and pulse rate. An independent t-test was conducted to determine the difference in mean levels of melatonin between the control and treatment groups. The t-paired test was conducted to determine the difference in the mean value between before and after intervention on melatonin levels. The level of confidence in this study was 95% (α = 0.05). Data analysis was performed using SPSS software (Shapey et al., 2008; Westermann et al., 2014).

3 Results and Discussions

Based on the results of the study, it was found that the characteristics of the treatment group were mostly female (77.1%), while the control group was male (61.8%). In the treatment and control groups, most were in the age group of 60-64 years, respectively 57.2% and 44.1%. From the nutritional status, the results were both the treatment and control groups had samples, most of which had normal nutritional status, respectively 62.9% and 61.8%. The results of the bivariate analysis test between the sample characteristics variables with levels of melatonin, insomnia, depression, and physical fitness can be seen in Table 2. The results of this test indicate a significant relationship between gender variables with insomnia, depression, and physical fitness with p values of 0.048, 0.002, and 0.002, respectively.

Based on Table 3, it was found that the mean level of melatonin in the treatment group before the intervention was 12.90 ± 2.39 and the mean level of melatonin in the control group was 13.62 ± 2.67. Meanwhile, after the intervention, the mean level of melatonin in the treatment group was 14.74 ± 2.95 and in the control group was 13.62 ± 2.4. Then, the analysis was conducted using an independent t-test for inter-group difference test and paired t-test to test the improvement in each group between before and after the intervention (Hale, 1991; Lestari et al., 2016; Rubeis, 2020). Based on the results of the analysis, there was no difference in the mean level of melatonin between groups before and after the intervention was given (p = 0.123 and p 0.105). In the treatment group, there was an increase in the mean level of melatonin significantly (p <0.001), while in the control group there was no increase (p = 0.695).

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Table 1
Characteristics of research subjects

Variables	Categories	Observation group			
		Control		Treatment	
		N	%	N	%
Sex	Male	21	61.8	8	22.9
	Female	13	38.2	27	77.1
Age (years)	60-64	15	44.1	20	57.2
	65-69	14	41.2	9	25.7
	70-74	5	14.7	6	17.1
Nutritional status	Underweight	2	5.8	2	5.7
	Normal	21	61.8	22	62.9
	Overweight	11	32.4	11	31.4
Total sample		34	100.0	35	100.0

Table 2
Relationship between variables of research subject characteristics and melatonin levels

Variables	Melatonin	
	R value	P value
Age	-0.039	0.753
Sex	0.112	0.359
Weight	0.082	0.503
Height	0.026	0.835
Body mass index	0.078	0.524

Table 3
The effect of BEC model implementation on increased melatonin levels in the treatment group

Groups	Before treatment Mean±SD	After treatment Mean±SD	Increase level of melatonin	P value**
Treatment	12.90±2.39	14.74±2.95	1.84±1.65	<0.001
Control	13.80±2.42	13.62±2.67	-0.18±2.60	0.695
P value*	0.123	0.105	<0.001	

Note: * t-independent test; **t-paired test

Discussion

The rate of aging of the population worldwide is increasing dramatically. The number of elderly populations in developing countries is projected to increase by 140 percent compared with an increase of 51 percent in developed countries (National Institute on Aging, 2007). Indonesia is a developing country that is entering an aging structured population era because the number of people aged 60 years and over has exceeded 7% (Yusharmen, 2013). Based on gender, most of the treatment group were female (77.1%), while in the control group most of them were male (61.8%). Women tend to live longer than men, were at the global level in 2010-2015, women's life expectancy at birth was higher than men, which was 4.6 years. Globally, in 2010-2015, women aged 60 years survived longer than men aged 60 years with an average lifespan of 2.9 years. The consequence of higher female longevity is a predominantly female elderly population, wherein 2017, women accounted for 54 percent of the global population aged 60 years or over and 61 percent of all elderly aged 80 years or over (National Institute on Aging, 2007)

In the subjects of this study, most of the elderly in the control group and the treatment group had a systolic blood pressure of 120-139 mmHg which indicated the direction of pre-hypertension. The increasing prevalence of age-related hypertension is due to changes in the structure and function of the arteries during

the aging process (Aronow et al., 2011). The aging process is associated with a progressive increase in aortic stiffness, which is largely due to increased collagen cross-linking and degradation of elastin fibers. As a result, systolic blood pressure will increase gradually throughout life, while diastolic blood pressure will peak and plateau at the end of middle age, then decrease slightly thereafter (Aronow et al., 2011).

In this study, testing was conducted on the initial melatonin levels of research subjects in the control and treatment groups. The mean initial melatonin levels in the control group were 13.80 ± 2.41 and in the treatment group 12.89 ± 2.38. Each group received a different intervention for 3 months. The control group was given an intervention by implementing conventional government programs. Whereas in the treatment group, the Bali Elderly Care (BEC) model was applied which consists of three aspects, namely health education, yoga practice, and relaxation massage (Bressler & Bahl, 2003; Prince et al., 1997).

Melatonin (N-acetyl-5-methoxytryptamine) is the main hormone of the pineal gland and is secreted exclusively at night. The circulating amino acid Ltryptophan is a precursor to melatonin. In the cells in the pineal gland, it is converted to serotonin through a two-step process catalyzed by tryptophan hydroxylase and 5- hydroxytryptophan decarboxylase. This process involves serotonin-N-cetylation, which is catalyzed by N-acetyltransferase, and methylation by hydroxyindole-O- methyltransferase to produce melatonin. Hormones are released directly into the bloodstream and cerebrospinal fluid when synthesized and, because of their fat-soluble nature, they can access every cell of the body. Regular activation of the pineal gland is determined by periodic signals from the suprachiasmatic nuclei (SCN), which is the main biological "clock". The suprachiasmatic nuclei are active during the day and slow down at night. The gradual reduction of nighttime SCN activity promotes nighttime melatonin production. The sudden application of bright light at night activates the SCN and suppresses melatonin secretion. However, exposure to darkness during the day does not cause melatonin production. The temporal pattern of melatonin production by the pineal gland correlates with human sleep time. The onset of nighttime melatonin secretion begins approximately 2 hours before the individual's habitual bedtime and correlates with the onset of nighttime sleepiness (Zhdanova & Tucci, 2003).

Melatonin is formed in various organs and cells, such as the digestive tract, bone marrow, leukocytes, membranous cochlea and, possibly, the skin and other areas of the central nervous system. Extra pineal melatonin is released either in small amounts into the circulation or for a short time (Hardeland, 2012). The increase in melatonin found with aging or post pinealectomy can cause changes in sleep/wake cycles. Melatonin levels in human plasma usually start to increase between 6:00 p.m. and 8:00 p.m., and peak between midnight and 5:00 a.m., followed by a rapid decline (Alamsyah et al., 2017; Kalsbeek & Fliers, 2013). The results in this study showed that the mean melatonin levels after 3 months of observation, the control group experienced a decrease in the mean melatonin levels by 0.17 ± 2.60, but this result was not statistically significant. In the treatment group that received the BEC model intervention, the mean increase in melatonin levels was -1.84 ± 1.65 and it was statistically significant (p = 0.000).

In the process of aging, peak levels of nocturnal melatonin usually decrease, although the variability between individuals is quite large. In some elderly individuals, the value of melatonin at night is almost indistinguishable from that obtained during the day. In individuals with very low levels of melatonin, usually during the day it also decreases (De Almeida et al., 2011). Age-dependent imbalances in melatonin formation are detected not only in plasma concentrations, but also in the human pineal gland,saliva, cerebrospinal fluid, and in the urine amount of the main metabolite, 6- sulfatoxymelatonin. Age-related decline in melatonin can have a variety of different causes, which are progressive deterioration (i) of the SCN or (ii) of nerve transmission to the pineal, reminiscent of the changes observed in neurodegenerative disorders, or (iii) pineal calcification (Hardeland, 2012). The systematic review, which included 19 studies on physiological melatonin levels in the elderly, showed a mean peak nocturnal melatonin concentration of 40.1 pg/ml-1. Melatonin levels reach their maximum concentration at 300 hours, and they decline thereafter. The daytime level is 8.9–11.4 pg/ml-1 (Kalsbeek & Fliers, 2013; Scholtens et al., 2016).

Yoga is an ancient cultural heritage of India which was later adopted into the fabric of people's lives and is said to provide ideal physical, mental, intellectual and spiritual health. Therefore, yoga is fast emerging as a new discipline for integrating mind and body into harmony (Field, 2011). Regular yoga practices have been shown to bring about improvements in cardio-respiration, thermoregulation, body flexibility, and psychological functions such as mental performance increased memory and creating feelings of well-being (Krishnakumar et al., 2015). Normal healthy subjects who practiced yoga for short periods have shown increased fat and carbohydrate metabolism, cardiorespiratory performance, and psychological function. The

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effects of this yoga practice are mediated through interactions between the autonomic nervous system and the endocrine system, in which pineal melatonin secretion may play an important role (Field, 2011). Melatonin is known not only to synchronize organisms to change the day and night cycle but has also been shown to induce relaxation during sleep, lower cholesterol levels, prevent platelet aggregation, stimulate the immune system, and is one of the most powerful antioxidant hormones (Harinath et al., 2004; Erland & Saxena, 2017). Yoga practice may affect pineal melatonin secretion, which is responsible for some of the effects of yoga and meditation. The implementation of yoga that was applied to the treatment group in this study consisted of nine movements guided by the instructor. The movements consist of sukhasana, kapalabhati pranayama, baddha konasana, dandasana, tadasana, vrksasana, virabhadrasana, utkasana, and padahastana.

Apart from yoga training, relaxing massage was also conducted in the treatment group. This relaxing massage for the elderly was conducted twice a week with a duration of 15 minutes for each meeting. Massage therapy can be an appropriate means of relaxation in releasing fatigue from daily activities. Massage for the elderly is a massage intended for elderly people, therefore, this application is certainly different from massage intended for younger individuals (Field, 2014). Moreover, massage therapists are also required to know about the physiological changes that occur in the human body. The massage technique for the elderly is different, where the pressure applied is different, there must be sensitivity in its application so that the massage is comfortable and effective for the elderly (Mustika, 2019).

4 Conclusion

In conclusion, the elderly health care program model with the name BEC model is a new finding based on local wisdom which is explored from the problems experienced by the elderly by taking into accounts the biological, psychological and social needs of the elderly. The BEC model integrates various components that work together to improve the quality of life of the elderly. The three components consist of health education, yoga and relaxation massage (Mendes et al., 2015; Hardeland et al., 2006). Those three components are conducted continuously and evaluated by measuring melatonin levels in the elderly. The implementation of the Bali Elderly Care Model increases Melatonin levels in the elderly better than conventional nursing care.

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