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Hypertension Among Yoga Practitioners: A Cross-Sectional Study at I Gusti Bagus Sugriwa State Hindu University, Denpasar

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ABSTARCT

Introduction: Hypertension, or high blood pressure, can lead to severe illnesses and death. Yoga has been identified as a method to lower blood pressure by improving blood circulation and heart function. This study evaluates the benefits of yoga in managing hypertension and identifies contributing factors.
Methods: An analytical observational method with a cross-sectional approach was used. The study included 103 yoga practitioners selected via probability sampling. Blood pressure was measured using digital and aneroid sphygmomanometers. Dependent variables included body mass index (BMI), age, and physical activity measured through the IPAQ questionnaire.
Results: Yoga practitioners aged 18-39, predominantly females without a family history of hypertension and with normal BMI and high physical activity levels, generally had normal blood pressure. Fewer hypertension cases were observed in these groups. Those without a family history of hypertension had fewer cases compared to those with a history. Respondents with normal BMI mostly had normal blood pressure, but slight increases in hypertension were noted among overweight and obese individuals. No clear pattern was observed between coffee consumption and blood pressure. High physical activity levels were associated with normal blood pressure.
Conclusion: Age, gender, family history, BMI, coffee intake, physical activity, smoking, and medication adherence impact grade 1 hypertension. Yoga effectively lowers blood pressure and manages stress. Integrating yoga into educational hypertension programs can enhance public awareness and management skills. Promoting yoga as part of a healthy lifestyle could significantly reduce hypertension prevalence and its societal health burden, fostering healthier communities resilient against hypertension risks.

Keywords: overview, hypertension, yoga

INTRODUCTION

The tourism sector is experiencing rapid expansion, increasing domestic and international travel. Various factors, including advancements in health technology, rising living standards, increased mobile lifestyles, and individual aspirations for self-care, influence this growth. These factors enhance travel's appeal for recreational purposes and fulfil broader needs such as maintaining health. Indonesia, particularly Bali, has emerged as a popular health tourism destination, offering various health activities such as yoga, ashrams, spiritual retreats, luxury spa resorts and hotels.

Yoga, rooted in the Sanskrit language, symbolizes unity with nature and the Creator. In Hindu philosophy, yoga is seen as a discipline emphasizing meditation practices. Several popular variants of yoga exist in Indonesia, such as vinyasa, ashtanga, Iyengar, and yoga asana. According to Prabhakaran et al. (2020), yoga is claimed to have calming effects that can improve blood circulation throughout the body, with good blood circulation being an indicator of optimal heart health. Therefore, yoga is recommended for lowering blood pressure in patients. However, further research is still needed to understand the most effective type of yoga and its impact on blood pressure reduction.[1]

Yoga can influence blood pressure through various integrated mechanisms encompassing physical exercise, breathing techniques, meditation, and stretching. Firstly, yoga's breathing techniques, or pranayama, induce mind and body relaxation. Slow, deep breathing reduces available oxygen to the brain, mitigating panic responses, lowering heart rate, and decreasing blood pressure. Pranayama also reduces adrenaline production, contributing to blood pressure reduction. Secondly, meditation in yoga calms and focuses the mind, creating profound relaxation. Meditation stimulates alpha waves in the brain, which are associated with deep relaxation and mental alertness, thus lowering blood pressure.[2]

Additionally, yoga's stretching exercises strengthen the heart muscles, enhance blood pump capacity with minimal effort, and reduce cardiac workload, consequently lowering blood pressure. Stretching also boosts fat metabolism by decreasing LDL (low-density lipoprotein) levels and increasing HDL (high-density lipoprotein) levels, reducing arterial wall obstruction and normalizing blood flow. Yoga also affects the autonomic nervous system and endocrine glands, regulating internal functions like heart rate and hormone production while stimulating the release of

endorphins, acting as a natural tranquilliser, inducing comfort and aiding blood pressure reduction. Lastly, yoga helps reset baroreceptors—body systems controlling blood pressure—to lower, healthier levels, assisting in maintaining blood pressure at lower values. Thus, yoga aids in lowering blood pressure through physiological mechanisms and stress management and enhances mental and emotional conditions.[2]

Hypertension, also known as high blood pressure, is a leading cause of death with high incidence rates and is associated with increased morbidity. More than 1 billion people are estimated to suffer from hypertension, a severe public health issue causing 13% of deaths, 64 million years of disability-adjusted life, and 7 million premature deaths annually.[3] Based on data from the Basic Health Research (Riskesdas) in 2018, the prevalence of hypertension in Indonesia reached 34.1%, with higher prevalence among older age groups, exceeding 50% in individuals aged 65 years and above. In Bali Province, hypertension ranked as the fourth most common diagnosis in healthcare facilities in 2018, with Gianyar Regency having the highest prevalence, with 284,744 individuals diagnosed with hypertension. A study in Gianyar in 2019 showed a significant association between dyslipidemia and hypertension occurrence, with high total cholesterol and LDL levels significantly associated with hypertension, while HDL and triglycerides did not show a considerable association.[4] Williams et al. (2018) define hypertension as an elevation in blood pressure within the systemic arterial circulation measurable by a sphygmomanometer, with systolic values exceeding 140 mmHg and diastolic values of 90 mmHg. Approximately 80-90% of cases are essential (attributed to lifestyle or genetics), idiopathic hypertension (without a clear cause), while 10-20% of cases are secondary hypertension (arising due to other medical conditions).[5]

Several risk factors for hypertension include age, gender, genetic history, obesity, coffee intake, physical activity, and cigarette use. Both the hemodynamic function of the body and organ function decline with age, with hypertension more commonly occurring between the ages of 45-54. Additionally, gender plays a significant role, with men generally having higher blood pressure than women. Family history is also substantial, as adolescents from families with a history of hypertension are more likely to develop hypertension compared to those from families without such a history.[6] The hypothesis of this study posits that yoga practitioners have a lower prevalence of grade 1 hypertension compared to the general population and that variables such as age, gender, family history, and body mass index significantly correlate with blood pressure.

Based on the above exposition, it can be concluded that hypertension is a significant health issue in Indonesia, yet research on its risk factors remains limited. Therefore, researchers are interested in further exploration through the thesis titled "Overview of Grade 1 Hypertension among Yoga Practitioners at I Gusti Bagus Sugriwa State Hindu University Denpasar." This study aims to identify the prevalence of grade 1 hypertension among yoga practitioners at the university, analyze the relationship between factors such as age, gender, family history, and body mass index with the occurrence of grade 1 hypertension, and evaluate the impact of physical activity levels and coffee consumption on blood pressure. The data from this research is expected to provide deeper insights into the risk factors of grade 1 hypertension among yoga practitioners, serving as a foundation for further research and preventive efforts in the community. This study involves all yoga practitioners at I Gusti Bagus Sugriwa State Hindu University Denpasar to provide a comprehensive overview of grade 1 hypertension, which will be valuable to the literature on this condition.

METHOD

This study utilized an observational research design with a cross-sectional approach involving data collection at a single point in time. The research methodology was chosen to assess the prevalence of hypertension and obtain an overall picture of grade 1 hypertension among yoga practitioners at I Gusti Bagus Sugriwa State Hindu University Denpasar on April 13 and 14, 2024. Total random sampling was employed as the sampling technique. The data used were obtained directly (primary data). The sample size calculation in this study was based on several important factors, including the target population, confidence level, margin of error, and population variability. The target population in this study was all yoga practitioners affiliated with I Gusti Bagus Sugriwa State Hindu University Denpasar, totalling 103 individuals.

A confidence level of 95% was used, with a margin of error of 10% (0.1). To calculate the sample size, the Slovin formula was used: ($n = N / (1 + N.d^2)$), where N is the population size and d is the margin of error. Using this formula, a sample size of approximately 51 individuals was obtained. However, to anticipate possible dropouts or participants who only completed part of the research process, the sample size was increased by 10%, resulting in a final sample size of approximately 56 individuals. In practice, the researcher decided to involve all 103 yoga practitioners to ensure broader coverage and enhance the statistical power of the research findings. Including the entire population as the sample provided advantages regarding representativeness, statistical power, and reduced selection bias.

By involving the entire population, the research results became more representative, enabling the detection of finer relationships between variables and reducing the likelihood of selection bias. Therefore, the justification for the selected number of participants was to ensure maximum representativeness and validity of the research findings, considering the entire population of yoga practitioners at I Gusti Bagus Sugriwa State Hindu University Denpasar was 103 individuals. This research involved subjects who met the inclusion criteria, namely those willing to participate by providing informed consent and being yoga practitioners at I Gusti Bagus Sugriwa State Hindu University Denpasar.

Respondents who did not complete the questionnaire adequately were excluded from the study to maintain the accuracy and consistency of the collected data. This study did not establish specific dropout criteria, with the expectation that all respondents meeting the inclusion criteria and not falling under the exclusion criteria would complete all stages of the research. The researcher took several additional steps to control external variables that could affect the research results.

First, respondents' diets were controlled by instructing them to follow a consistent dietary pattern during the study period. Respondents were asked to record their food intake in a daily journal and avoid foods high in salt, fat, and

caffeine, which could affect blood pressure. Second, stress was managed by instructing respondents to practice relaxation and stress management techniques such as meditation or breathing exercises, which are part of yoga practice. Third, coffee consumption and smoking habits were meticulously recorded using a questionnaire measuring the frequency and amount of consumption, as both factors can significantly affect blood pressure. Fourth, respondents with other medical conditions that could affect blood pressure, such as diabetes or heart disease, were excluded from the study to ensure more accurate results. Fifth, respondents' physical activity levels were closely monitored using the IPAQ questionnaire, and only those regularly practising yoga were included in this study. Lastly, blood pressure measurements were taken under the same conditions for all respondents, i.e., in a quiet and comfortable environment in the auditorium of I Gusti Bagus Sugriwa State Hindu University Denpasar, to minimise variability caused by environmental factors. These steps ensured that external variables affecting the research results were well controlled, thus obtaining more accurate and reliable results.

The research began with completing the ethics clearance, obtaining permission to conduct the study, and communicating with the yoga supervisor at I Gusti Bagus Sugriwa State Hindu University Denpasar. The research was conducted with the assistance of a physiotherapist, who conducted the anamnesis, interviews, and blood pressure data collection.

Several steps were taken to control and identify potential biases in this study. Random sample selection was performed using the total random sampling technique to ensure that every yoga practitioner had an equal chance of being selected, reducing selection bias. Consent from respondents was obtained through informed consent, ensuring voluntary and informed participation—using valid and reliable instruments, such as a digital sphygmomanometer, for measuring blood pressure. The blood pressure measurement tool, which uses a digital sphygmomanometer, has been calibrated by PT. Adi Multi Kalibrasi Laboratorium Kalibrasi dan Uji, Yogyakarta, with certificate numbers 3096/LK-LKU/VI/2017, 3098/LK-LKU/VI/2017, and 3099/LK-LKU/VI/2017.

The reliability of the digital sphygmomanometer was tested on three categories of probands: high blood pressure (systolic >160mmHg), normal blood pressure (systolic 120-140 mmHg), and low blood pressure (systolic <120mmHg). The reliability test results showed a coefficient of variation (CV) ≤5%, indicating that the tool is reliable. Thus, it can be concluded that the digital sphygmomanometer used in this study is valid and reliable for measuring blood pressure. Respondent's physical activity level was calculated using the IPAQ questionnaire, with validity test results showing a correlation coefficient (r) for the IPAQ questionnaire of 0.442, indicating that this instrument is valid as the r value is greater than the determined table r value. The reliability test showed that the coefficient of reliability (Cronbach's alpha) for the IPAQ questionnaire was 0.713. An instrument with a Cronbach's alpha value of more than 0.6 is considered reliable. Thus, the IPAQ questionnaire in Bahasa Indonesia is supposed to have good validity and reliability, making it suitable for accurately and consistently assessing physical activity in the Indonesian population.[7]

Controlling for external variables, such as ensuring consistent blood pressure measurement conditions, helps reduce situational bias. Proper data analysis using appropriate statistical methods ensures accurate evaluation of relationships between variables. With these steps, the research aims to minimise bias to produce more reliable and valid results.

This study's data analysis consists of descriptive and bivariate analyses using the non-parametric Spearman's rank correlation coefficient in IBM SPSS 25 software. The selection of Spearman's rank correlation method in this research is based on the continuous nature of the data and the potential non-normal distribution. Spearman's rank correlation is a non-parametric test suitable for measuring the strength and direction of the relationship between two ordinal or continuous variables. The ethics committee of Udayana University has reviewed and approved the ethical suitability of this research with number 1101/UN14.2.2.VII.14/LT/2024.

RESULTS

The research process began with preparing the research proposal and obtaining permission from relevant institutions. After receiving permission, the next step was to recruit participants from yoga practitioners at I Gusti Bagus Sugriwa State Hindu University Denpasar. Participants were provided with initial information about the research and asked to sign informed consent forms as an agreement to participate. Subsequently, demographic data such as age, gender, and family history of hypertension were collected, and measurements of participants' height and weight were taken. Participants' blood pressure was measured twice using both digital sphygmomanometers and aneroid gauges, and these measurements were carefully recorded.

Participants were then asked to complete the IPAQ physical activity questionnaire and provide information about coffee consumption and smoking habits. The collected data were then analysed, starting with univariate analysis to assess variable distribution, followed by bivariate analysis to examine the relationship between independent variables and blood pressure. The final step in the research process was to compile the research findings report and document the entire process and results. This documentation is essential to ensure the transparency and validity of the research findings. This process outlines the research flow from start to finish, ensuring all steps are carried out systematically and structured.

The reasons for nonparticipation in this study include several essential factors. Participation is voluntary, so participants are free to refuse or discontinue participation at any time without sanctions. Language barriers in filling out informed consent forms can also lead to nonparticipation, especially if participants need help understanding or completing the forms correctly. Discomfort or boredom while completing questionnaires could be another reason for some participants not to complete their participation. Additionally, some respondents may need to meet the inclusion and exclusion criteria set, thus unable to participate in the study. Considering these factors, this study involved all 103 yoga practitioners at I Gusti Bagus Sugriwa State Hindu University Denpasar to ensure maximum representativeness and validity of the research findings.

This study had all the data for the variables of interest. All 103 respondents provided complete data on age, gender, family history of hypertension, body mass index (BMI), coffee consumption, physical activity, smoking habits, and duration of yoga practice. Thus, comprehensive analysis could only be conducted with consideration of potential bias due to data incompleteness. The presence of complete data for all essential variables from all study participants ensures the results' validity and reliability. The Distribution of Characteristics of Research Respondents can be seen in Table 1.

Table 1. Distribution of Characteristics of Research Respondents

Variable	Frequency (n	Percentage (%)
Age		
18-28 Years	39	37,9
29-39 Years	43	41,7
40-50 Years	12	11.7
Above 50 Years	9	8,7
Total	**103**	**100**
Gender		
Male	48	46,6
Female	55	53,4
Total	**103**	**100**
Family History of Hypertension		
Yes	22	21,4
No	81	78,6
Total	**103**	**100**
BMI		
Underweight	26	25,2
Normal	55	53,4
Overweight	15	14,6
Obese	7	6,8
Total	**103**	**100**
History of Coffee Consumption		
Never Consumed Coffee	33	32
Previously Consumed Coffee	40	38,8
Frequently Consumed Coffee	30	29,1
Total	**103**	**100**
History of Physical Activity		
Low	3	2,9
Moderate	18	17,5
High	82	79,6
Total	**103**	**100**
History of Smoking		
Never Smoked	103	100
Previously Smoked	0	0
Currently Smoke	0	0
Total	**103**	**100**
Years Practicing Yoga		
1 Year	5	4,9
2 Years	22	21,4
3 Years	41	39,8
4 Years	27	26,2
5 Years	8	7,8
Total	**103**	**100**
Blood Pressure		
Normal	99	96,1
Grade 1 Hypertension	2	1,9
Grade 2 Hypertension	2	1,9
Total	**103**	**100**
History of Hypertension Medication Consumption		
Yes	2	1,9
No	101	98.1
Total	**103**	**100**

The majority of respondents were aged between 29 and 39 years old (41.7%), with nearly equal gender composition between males (46.6%) and females (53.4%). Most respondents had a normal BMI (52.5%), while 25.7% were underweight, 14.9% were overweight, and 6.9% were obese. Regarding coffee consumption, 38.8% of respondents had tried it at least once, and 29.1% consumed it frequently. Moderate and high levels of physical activity were reported by 17.5% of respondents each, and 79.6% were non-smokers. Most respondents had practised yoga for three years (39.8%). About 96.1% had normal blood pressure, with only 1.9% having received treatment for hypertension. These data provide a general overview of the respondents' demographic profile, health habits, and nutritional status. The distribution of Hypertension Levels Based on Risk Factors can be seen in Table 2.

Table 2. Distribution of Hypertension Levels Based on Risk Factors

Variable	Normal	Hypertension Level 1	Hypertension Level 2
Age			
18-28 Years	37	0	2
29-39 Years	42	1	0
40-50 Years	11	1	0
<50 Years	9	0	0
Total	**99**	**2**	**2**
Gender			
Female	52	1	2
Male	47	1	0
Total	**99**	**2**	**2**
Family History of Hypertension			
Yes	22	0	0
No	77	2	2
Total	**99**	**2**	**2**
BMI			
Underweight	26	0	0
Normal	51	2	2
Overweight	15	0	0
Obese	7	0	0
Total	**99**	**2**	**2**
History of Coffee Consumption			
Never Consumed Coffee	32	0	1
Ever Consumed Coffee	38	1	1
Frequently Consumed Coffee	29	1	0
Total	**99**	**2**	**2**
History of Physical Activity			
Low	29	1	0
Moderate	3	0	0
High	18	0	0
Total	**99**	**2**	**2**
History of Smoking			
Never Smoked	99	2	2
Ever Smoked	0	0	0
Frequently Smoked	0	0	0
Total	**99**	**2**	**2**
Duration of Yoga Practice			
1 Year	5	0	0
2 Years	21	0	1
3 Years	40	1	0
4 Years	25	1	1
5 Years	8	0	0
Total	**99**	**2**	**2**
History of Hypertension Medication Consumption			
Yes	2	0	0
No	97	2	2
Total	**99**	**2**	**2**

Based on Table 2, respondents with a family history of hypertension tend to have fewer cases of hypertension compared to those without a family history. Based on Body Mass Index (BMI), most respondents with a normal BMI have normal blood pressure, with a slight increase in hypertension cases among those who are overweight and obese. In contrast, respondents with underweight BMI all have normal blood pressure. There is no clear pattern regarding coffee consumption and blood pressure, with the number of respondents with normal blood pressure tending to remain stable across all coffee consumption groups. High levels of physical activity correlate with normal blood pressure, while low physical activity does not show a clear pattern. Respondents who have never smoked all have normal blood pressure, and there are no respondents with a history of smoking who have normal blood pressure or hypertension. Most respondents who practice yoga have normal blood pressure, with some cases of hypertension among those who have practised for more extended periods. Respondents who have used hypertension medication mostly have normal blood pressure, while most of those who have never used hypertension medication also have normal blood pressure. Several factors, such as age, gender, family history, BMI, physical activity, smoking, and hypertension medication use,

correlate with blood pressure. Still, the relationship between coffee consumption and the duration of yoga practice with blood pressure may not be as evident from the provided data.

DISCUSSION

This research was conducted at the State University of I Gusti Bagus Sugriwa Denpasar, focusing on students and migrant guests participating in yoga classes. Initially, the target sample size was 103 respondents, considering a projected dropout rate of 10%, resulting in an expected 56 respondents. However, after collecting respondent data, 103 participants met the criteria assessed based on specific inclusion and exclusion criteria.

Among respondents aged 18-28 years old, 37 individuals had normal blood pressure, none experienced stage 1 hypertension, and two had stage 2 hypertension. In the age group of 29-39 years old, 42 respondents had normal blood pressure, one individual had stage 1 hypertension, and none had stage 2 hypertension. For the age group of 40-50, there were 11 individuals with normal blood pressure, 1 with stage 1 hypertension, and none with stage 2 hypertension. In the age group above 50, 9 individuals had normal blood pressure, and none experienced hypertension.

Hypertension represents a significant health issue in Indonesia, with the highest prevalence in South Kalimantan at 44%, followed by West Java at 39.60%. The elderly population is the most affected group by hypertension, with approximately 45.32% of individuals aged 45-54 years, 55.23% aged 55-64 years, 63.22% aged 65-74 years, and 69.53% aged over 75 years suffering from this disease. Hypertension is diagnosed when systolic pressure exceeds 140 mmHg, and diastolic pressure exceeds 90 mmHg. According to the Ministry of Health of the Republic of Indonesia (2013), hypertension ranks as the third leading cause of death in Indonesia across all age groups, accounting for 6.83% of mortality rates.[8]

Gender indeed plays a significant role in influencing blood pressure, as evidenced by a study showing that women generally have a higher prevalence of hypertension compared to men. The research findings indicate that among female respondents, 52 individuals had normal blood pressure, with one person experiencing stage 1 hypertension and two individuals with stage 2 hypertension. Meanwhile, male respondents had 47 individuals with normal blood pressure, one person with stage 1 hypertension, and none with stage 2 hypertension.

The transition to menopause in women becomes one contributing factor to this trend, as studies indicate that women face an increased risk of hypertension after reaching menopause, typically after the age of 45. Postmenopausal women experience decreased estrogen levels, which usually contributes to the increase in High-Density Lipoprotein (HDL), which is crucial for maintaining vascular health. Reduced estrogen levels can lower HDL levels if not balanced with a healthy lifestyle. Consequently, respondents in this study may experience repeated decreases in estrogen levels, including a reduction in HDL levels. When HDL is low and Low-Density Lipoprotein (LDL) is high, the development of atherosclerosis can lead to an increase in blood pressure.

In addition to hormonal influences, women are also vulnerable to hypertension due to obesity. This is supported by research observations that women tend to have higher obesity rates, contributing to hypertension affecting 24% of adult women compared to 14.9% of men. Furthermore, there is a correlation between hypertension and overweight, with a higher prevalence in individuals with obesity. Therefore, obesity emerges as a characteristic of communities vulnerable to hypertension.

Based on respondents with a family history of hypertension, 22 individuals without hypertension had normal blood pressure. In comparison, those without a family history showed 77 individuals with normal blood pressure, two individuals with stage 1 hypertension, and two individuals with stage 2 hypertension. These findings are consistent with the study by Raihan and Dewi in the Puskesmas Rumbai Pesisir area, which showed a significant relationship between smoking habits and the causes of hypertension, with a p-value of 0.000.

Looking at family history and genetic factors, adolescents from hypertensive families have a higher risk of developing hypertension compared to adolescents from non-hypertensive families. Offspring parents with hypertension, especially if both suffer from hypertension, have a significantly increased risk of hypertension, ranging from 4 to 15 times higher compared to offspring with parents with normal blood pressure. If both parents suffer from essential hypertension, almost 45% of their children are likely to suffer from hypertension. If only one parent has hypertension, about 12.8% of their descendants may suffer from hypertension. The manifestation of hypertension in individuals appears to be influenced by genetic changes. Research has shown that blood pressure and regulating various systems, such as the renin-angiotensin-aldosterone and sympathetic nervous systems, are genetically determined. Advances in biomolecular techniques have facilitated the exploration of genes related to the occurrence of hypertension.[9]

Based on respondents categorized by BMI, individuals with underweight BMI had normal blood pressure, totalling 26 individuals without hypertension cases. Among those with normal BMI, there were 51 individuals with normal blood pressure, 2 with stage 1 hypertension, and 2 with stage 2 hypertension. Respondents with overweight and obese BMI had normal blood pressure, with 15 and 7 individuals, respectively, without hypertension cases. These findings align with research indicating that excess body fat can lead to weight gain, affect BMI, and increase the risk of various degenerative conditions such as diabetes mellitus, high blood pressure, coronary heart disease, and stroke.[10]

Hypertension associated with obesity stems from increased blood volume and cardiac output, persistent peripheral resistance, heightened sympathetic nervous system activity, and insulin resistance. Obesity induces resistance to insulin-stimulated glucose uptake, leading to hyperinsulinemia. Weight loss has been shown to improve insulin sensitivity, although the exact mechanisms linking insulin resistance or hyperinsulinemia to hypertension remain unclear. It is hypothesized that insulin may have a natriuretic effect, increase sympathetic nervous system activity, enhance vasoconstriction in response to norepinephrine and angiotensin, disrupt endothelium-dependent vasodilation, and promote smooth muscle cell growth in blood vessels.[11]

The coffee consumption history shows that respondents who have never consumed coffee have 32 individuals with normal blood pressure, without cases of stage 1 hypertension, and one individual with stage 2 hypertension.

Respondents who have ever consumed coffee have 38 individuals with normal blood pressure, one individual with stage 1 hypertension, and one individual with stage 2 hypertension. Meanwhile, those who frequently consume coffee have 29 individuals with normal blood pressure, one individual with stage 1 hypertension, without cases of stage 2 hypertension.

According to Sheps, as cited by Septian et al. (2018), caffeine intake can increase blood pressure. However, the long-term impact of caffeine on blood pressure is minimal, and it is recommended to limit consumption to two cups per day. Various studies have shown that caffeine can inhibit hormones responsible for arterial dilation, leading to increased adrenaline levels and a drastic increase in blood pressure. With a digestion absorption rate of 99% and reaching peak bloodstream levels within 45-60 minutes, caffeine has a rapid and varied effect on the body. Each cup of coffee typically contains 60.4-80.1 mg of caffeine, which primarily affects blood pressure, especially in hypertensive individuals.

This increase in blood pressure is caused by biological mechanisms such as caffeine binding to adenosine receptors, activating the sympathetic nervous system by increasing plasma catecholamine levels and stimulating the adrenal glands to increase cortisol production. These processes result in vasoconstriction, an increase in total peripheral resistance, and, ultimately, an increase in blood pressure. The caffeine content in coffee can vary based on factors such as coffee type, origin, climate, and processing method.[12,13]

Low physical activity indicates three individuals with normal blood pressure without cases of hypertension. Moderate physical activity shows 18 individuals with normal blood pressure without instances of hypertension. High physical activity shows 78 individuals with normal blood pressure, two individuals with stage 1 hypertension, and two individuals with stage 2 hypertension. Lack of physical activity increases the risk of obesity, which is known to be the precursor of hypertension and other degenerative diseases. Engaging in regular exercise reduces peripheral resistance, thereby lowering blood pressure. Additionally, consistent exercise conditions the heart muscles to increase workload, effectively reducing heart rate frequency and arterial pressure. Systolic blood pressure increases during exercise, while diastolic blood pressure is primarily unaffected by exercise intensity. However, systolic blood pressure gradually decreases with continued exercise due to arteriolar dilation in active muscles. Regular exercise improves the efficiency of heart function, ultimately reducing heart rate and blood pressure.[14]

Respondents who have never smoked have 99 individuals with normal blood pressure, two individuals with stage 1 hypertension, and two individuals with stage 2 hypertension. There are no respondents with a history of smoking who have normal blood pressure or hypertension. Smoking, defined as the act of inhaling tobacco wrapped in paper, is an expected behaviour. The findings of this research are consistent with studies in the Puskesmas Rumbai Pesisir community, which show a significant relationship between smoking habits and the causes of hypertension, with a p-value of 0.006.[15] Specifically, there is a trend of increasing triggers for hypertension over time, likely due to changes in lifestyle patterns. Smoking, once a significant activity among adults, is now prevalent among adolescents as well. The adverse effects of smoking on hypertension stem from nicotine and carbon monoxide present in cigarettes. Nicotine contributes to increased fatty acids, platelet activation, atherosclerosis, and narrowing of blood vessels.[16] At the same time, carbon monoxide damages haemoglobin, causing it to accumulate in the capillary membrane and subsequently thicken the blood vessel walls.[17]

Based on the data, among respondents who have used hypertension medication, two individuals have normal blood pressure, and none suffer from stage 1 or stage 2 hypertension. Conversely, among 97 respondents with no history of hypertension medication, all have normal blood pressure, and two individuals have stage 1 or stage 2 hypertension. Commitment to drugs is crucial for maintaining the health of hypertension patients. Adherence to hypertension medication is vital for effective control, with the most significant potential for improving hypertension control in enhancing patient behaviour. Conversely, patient non-adherence to antihypertensive medication is a significant contributing factor to therapeutic failure.[18]

Based on findings from individuals who practised yoga over different periods, the results show a positive impact on blood pressure levels. Over five years, there has been a trend towards normalization of blood pressure among participants. Specifically, Wolff et al.'s study in 2017 highlighted the positive experiences of patients using yoga as a treatment for hypertension, stating that they prefer yoga over medication and vigorous exercise.[19] Similarly, Pal et al.'s research findings collectively emphasise the potential of yoga as a holistic approach to managing hypertension, particularly in cases of stage 1 hypertension, as evidenced by the research efforts mentioned above.[20]

The implications of this research finding extend to a broader context, particularly in public health practice. The study was conducted on yoga practitioners at the I Gusti Bagus Sugriwa Denpasar State Hindu University, who possess unique characteristics such as a high level of physical activity and healthier lifestyle patterns compared to the general population. The environmental conditions in Bali, with its exceptional climate and culture, may also influence the research outcomes. Yoga practices as part of daily life in Bali may be more readily accepted and routinely practised compared to elsewhere, potentially leading to varying levels of participation and benefits compared to populations with different cultural backgrounds. To enhance the generalizability of the findings, further research is needed on more diverse populations with varying demographic, geographic, and cultural backgrounds. By considering these factors, researchers can provide a more comprehensive view of the extent to which their findings can be applied to broader populations and how specific contextual factors may affect this generalizability.

The findings indicate that yoga practice positively impacts managing blood pressure and can be utilized as a preventive and management strategy for grade 1 hypertension. Therefore, promoting community engagement in physical activities like yoga can help reduce the prevalence of hypertension. Education programs and health promotion emphasizing the benefits of yoga and other physical activities should be strengthened to increase public awareness and participation. For interventions or policies, developing affordable and easily accessible community yoga programs, particularly in areas with high hypertension prevalence, is highly recommended. Public health campaigns educating the

public on the importance of physical activity, healthy eating patterns, and stress management can contribute to hypertension prevention and management. Integrating yoga and other forms of physical exercise into primary health care programs can also help alleviate the burden of hypertension in society.

Directions for future research include longitudinal studies involving a more significant number of participants to provide a deeper understanding of the long-term effects of yoga on blood pressure and cardiovascular health in general. Studies involving a more comprehensive population variation, including various age groups, ethnicities, and socioeconomic backgrounds, can help understand the effectiveness of yoga in different contexts. Furthermore, researching the combination of yoga with other interventions, such as specific diets or medical therapies, can provide insights into holistic approaches to hypertension management. Considering the findings of this research in a broader context is expected to significantly contribute to efforts to improve public health, develop better health policies, and pave the way for further research in this field.

This research has several limitations that need to be considered before interpreting its results. The study design employed a cross-sectional approach that only measured variables at one point, thus unable to determine cause-and-effect relationships, only correlational relationships definitively. Additionally, the research sample consisted of yoga practitioners at the I Gusti Bagus Sugriwa Denpasar State Hindu University, which may need to be more generalizable to a broader population, especially those who do not practice yoga or have different lifestyles.

There is a possibility of respondent bias in completing the questionnaire regarding family history, coffee consumption, and physical activity, which could lead to inaccurate or incomplete information. Although adjustments were made for some confounding variables such as age, gender, family history, BMI, and physical activity, there is still a possibility that other unmeasured or uncontrolled variables could affect the results. Blood pressure measurements were taken at one point, so variations in measurements due to factors such as stress or physical activity before measurement can only partially be eliminated. Data collected through questionnaires have limitations in accuracy and precision; for example, coffee consumption and physical activity assessments are based on self-reporting, which can be influenced by subject memory and perception.

Potential biases in this study include selection bias, where the sample consisted only of yoga practitioners at one university, so those who chose to participate may have different characteristics compared to the general population. Information bias may also occur due to respondents' errors in completing the questionnaire, which can result in inaccurate information. Uncertainties in this study include individual variations in response to yoga exercises and other factors such as diet and genetics that may influence outcomes, as well as external factors such as environment, stress levels, and lifestyle not measured in this study. Considering these limitations, the research results need to be interpreted with caution. Further studies with longitudinal designs and broader samples are required to confirm the findings and clarify cause-and-effect relationships.

CONCLUSION

Based on the research findings at the I Gusti Bagus Sugriwa Denpasar State Hindu University, it can be concluded that age is a significant factor influencing blood pressure levels, with hypertension prevalence increasing with age. Additionally, gender plays an important role, with women tending to have higher hypertension rates than men, especially after menopause. A family history of hypertension increases an individual's risk of hypertension, indicating the significant role of genetic factors. Body mass index (BMI) and obesity correlate with an increased risk of hypertension as obesity raises insulin resistance and sympathetic nervous system activity. Excessive coffee consumption can lead to increased blood pressure. Sufficient physical activity can help reduce the risk of hypertension by improving insulin sensitivity and cardiovascular function. Smoking also increases the risk of hypertension due to the adverse effects of nicotine and carbon monoxide on blood vessels. Compliance with medication is crucial to controlling blood pressure and preventing complications. Yoga has been proven to impact lowering blood pressure positively and can serve as a holistic approach to managing hypertension.

Recommendations for health organizations and services include using these findings to shape better healthcare services for hypertension patients. In the educational field, this research can serve as a source of information for curricula and educational programs on hypertension prevention and management. Healthcare practitioners are advised to integrate yoga into hypertension management programs and raise awareness of the importance of physical activity and weight control. The public is encouraged to be more aware of hypertension risk factors and the importance of a healthy lifestyle to reduce hypertension prevalence and improve quality of life.

REFERENCES

1. Prabhakaran D., Chandrasekaran A. M., Singh K., Mohan B., Chattopadhyay K., Chadha D. S., et al. Rehabilitasi Jantung Berbasis Yoga Setelah Infark Miokard Akut: Sebuah Uji Coba Acak. J Am Coll Cardiol. 2020 Apr 7;75(13):1551–61.
2. Dinata W. W. Menurunkan Tekanan Darah Pada Lansia Melalui Senam Yoga. Jurnal Olahraga Prestasi. 2015 Jul;11(2):77–90.
3. Herawati A. T., Manaf H, Kusumawati E. P. Pengetahuan Tentang Penanganan Penyakit Hipertensi Pada Penderita Hipertensi. JIKP Jurnal Ilmiah Kesehatan PENCERAH. 2021;10(2).
4. Putri M. P. D., Suyasa I. P. G. E. A., Budiapsari P. I. Hubungan antara Dislipidemia dengan Kejadian Hipertensi di Bali Tahun 2019. Aesculapius Medical Journal |. 2021 Oct;1(1):8–12.
5. Fadila E., Solihah E. S. Literature Review Pengaruh Senam Lansia Terhadap Penurunan Tekanan Darah Pada Penderita Hipertensi. Malahayati Nursing Journal. 2022 Feb 2;5(2):462–74.
6. Agustina H., Reni, Kes M, Nabila F., Lestari R., Rahma T. S., et al. Gaya Hidup Terhadap Resiko Hipertensi Pada Lansia. 2021.

7. Ilmi A. F., Utari D. M. Faktor Dominan Premenstrual Syndrome Pada Mahasiswi (Studi Pada Mahasiswi Fakultas Kesehatan Masyarakat Dan Departemen Arsitektur Fakultas Teknik, Universitas Indonesia). Media Gizi Mikro Indonesia. 2018 Dec 30;10(1):39–50.
8. Raniya S. Faktor-Faktor Yang Berhubungan Dengan Kejadian Obesitas Pada Remaja Umur 13–15 Tahun Di Indonesia (Analisis Lanjut Data Riskesdas 2018). 2022;
9. Saing S., Johannes H. Hipertensi pada Remaja Hipertensi pada Remaja Hipertensi pada Remaja Hipertensi pada Remaja Hipertensi pada Remaja [Internet]. Vol. 6. 2016 [cited 2024 May 16]. Available from: https://saripediatri.org/index.php/sari-pediatri/article/download/873/807
10. Sabilu Y. Korelasi Usia dengan Kadar Kolesterol, Gula Darah Sewaktu (GDS) dan Asam Urat. Jurnal Kesehatan. 2023;6(2).
11. Ardiana M. Buku Referensi Spike Protein Sars-Cov-2 & Penyakit Kardiovaskular [Internet]. Airlangga University Press. 2023 [cited 2024 May 16]. p. 44–5. Available from: https://books.google.com/books?hl=id&lr=&id=oFWwEAAAQBAJ&oi=fnd&pg=PP1&dq=Dihipotesiskan+bahwa+insulin+mungkin+memiliki+efek+natriuretik,+meningkatkan+aktivitas+sistem+saraf+simpatis,+meningkatkan+vasokonstriksi+sebagai+respons+terhadap+norepinefrin+dan+angiotensin,+mengganggu+vasodilatasi+yang+bergantung+pada+endotel,+dan+mendorong+pertumbuhan+otot+polos+pembuluh+darah&ots=-2pOzQt85W&sig=bdsZWLkj1YJ-4L5s9713umDNers
12. Lestari F., Wirandoko., Ignatius H., Sanif M. E. Tunas Medika Jurnal Kedokteran & Kesehatan Pengaruh Kebiasaan Minum Kopi Terhadap Grade Hipertensi pada Laki-laki Usia Produktif di Wilayah Kerja Puskesmas Larangan Kota Cirebon [Internet]. 2020. Available from: http://jurnal.unswagati.ac.id/index.php/tumed
13. Santoso P., Puspitasari B., Darmayanti R. Pengaruh Konsumsi Kopi Terhadap Hipertensi. Jurnal Kebidanan [Internet]. 2023 [cited 2024 May 15];12(1). Available from: https://akbid-dharmahusada-kediri.e-journal.id/JKDH/article/view/275
14. Cahyo, Widodo S., Sayono. Hubungan Antara Gaya Hidup Dengan Kejadian Hipertensi Pada Remaja [Internet]. repository.unimus.ac.id. 2018 [cited 2024 May 15]. Available from: http://repository.unimus.ac.id/1061/
15. Dewi F. Hubungan Dukungan Keluarga Dengan Tingkat Kepatuhan Minum Obat Pada Pasien Lansia Dengan Hipertensi [Internet]. http://eprints.umpo.ac.id/. 2022 [cited 2024 May 15]. Available from: http://eprints.umpo.ac.id/10115/
16. Sumilah, Sumilah I., Faisal K., Umi A. Hubungan Keaktifan Dalam Posyandu Lansia Dengan Perilaku Pengendalian Hipertensi Pada Lansia Di Dusun Talunsudo Desa Gunungan Dawarblandong [Internet]. repositori.ubs-ppni.ac.id. 2022 [cited 2024 May 15]. Available from: https://repositori.ubs-ppni.ac.id/handle/123456789/2232
17. Sinarsari M. Yoga Gembira Bagi Lansia Hipertensi. Jurnalyoga Dan Kesehatan Jurusan Yoga Kesehatan Fakultas Brahma Widya Ihdn Denpasar [Internet]. 2019 Nov 10 [cited 2024 May 15];3. Available from: https://www.ejournal.ihdn.ac.id/index.php/jyk/article/view/1518
18. Wirakhmi I., Purnawan I. Hubungan Kepatuhan Minum Obat Dengan Tekanan Darah Pada Penderita Hipertensi [Internet]. Vol. 12, Jurnal Ilmu Keperawatan dan Kebidanan. 2021 [cited 2024 May 16]. Available from: https://ejr.umku.ac.id/index.php/jikk/article/view/1079
19. Wolff M., Brorsson A., Midlöv P., Sundquist K., Strandberg E. Yoga–Sebuah Cara Yang Melelahkan Menuju Kesejahteraan: Pengalaman Pasien Tentang Yoga Sebagai Pengobatan Untuk Hipertensi Di Perawatan Primer. Scand J Prim Health Care [Internet]. 2017 Oct 2 [cited 2024 May 16];35(4):360–8. Available from: https://www.tandfonline.com/doi/abs/10.1080/02813432.2017.1397318
20. Ruangthai R., Phoemsapthawee J. Latihan Kombinasi Meningkatkan Tekanan Darah dan Kapasitas Antioksidan pada Individu Lansia dengan Hipertensi. J Exerc Sci Fit. 2019 Jan 20;17(2):67–76.