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Relationship Blood Pressure and Exercise with Vitamin D Levels in Employees

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ABSTRACT

In Indonesia prevalence of vitamin D deficiency is 63%, so although Indonesia is tropical country on the equator, but it doesn't guarantee the vitamin D levels. Vitamin D deficiency can cause bone deformitas and increase the risk of various chronic diseases such as diabetes, autoimun diseases, arthritis, cancer, obese, distraction of lipid profile, metabolic syndrome, hypertension and cardiovascular diseases. Increases blood pressure in global still remains the leading caused of death. In Indonesia, hypertension prevalence reach out 47.8% with 70% of them suffer undiagnosed hypertension. About 50-90% vitamin D is mainly synthesized in the skin after exposure to UVB whereas only a minor part is derived from dietary sources. Exercise in the morning can help synthesized of vitamin D. Because of that, the aim of this study is to researching relationship blood pressure and exercise with vitamin D levels. The study was conducted on 63 employees with range aged 19-60 years in February 2021 at USAKTI Faculty of Medicine, East Jakarta. The research design used in this study was an observational analytic with cross-sectional approach and analysed by chi-square test. This research presents significant relationship between blood pressure with vitamin D levels (p=0.044), meanwhile for exercise doesn't have any significant relationship with vitamin D levels (p=0.565). This study shown vitamin D can impact blood pressure, while vitamin D source not only fron sun-exposure but can be take from food or supplements.

Key words: blood preasure, exercise, vitamin D levels

INTRODUCTION

Over 1 billion world population are suffering vitamin D deficiency with 50% from population suffering vitamin D insufficiency.(1) Based on data from WUS, the prevalence of vitamin D deficiency in various contries in Europe, America, and Asia including Malaysia, Singapura, Thailand, Vietnam, India, Japan and Hongkong are varies from 42% to 90%.(2) Data in Indonesia showed that vitamin D deficiency around 63%, so it can be said that although Indonesia is a tropical islands in equator line, but it can't guarantee the status of vitamin D levels.(2,3)

Human can make vitamin D3 naturally in response to sun exposure, especially UVB radiation so it can becomes an endocrine hormones precusor. Along with parathyroid hormone, vitamin D have a role in calcium-phosphate homeostatis and cofactor for enzyms like lipase and ATPase.(4) Vitamin D plays an important role in absorption of calcium, magnesium, phosphate, bone metabolism and helps to mantains neuromuscular function.(5,6) Although bone, small intestine and kidneys are the main organs that has response to vitamin D, but there are still many vitamin D effects in the body through vitamin D receptor (VDR). VDR is steroid hormone receptor which can bind 1,25(OH)D with high affinity and mediates the regulation of gene transcription. Some of VDR located in heart, smooth muscle blood vessels, endothel, abdomen, brain, skin, gonad and various cells for the immune system.(5) Recently, some studies showed that VDR plays a role in renin angiotensin aldosterone system (RAAS), so it can affect

od pressure regulation. Vitamin D deficiency can caused bone abnormalities and increased the risk of various chronic diseases, such as diabetes mellitus, cardiovascular diseases due to hypertension, obese, lipid profie disorder, cancer, autoimun disease and metabolic syndrome.[2,5,7]

Globally, increased blood pressure still remains the leading cause of death. In 2014, around 1.39 billion people suffered hypertension and 10.4 million deaths per year due to hypertension.[8] In Indonesia, the prevalence of hypertension reaches 47.8% with 70% of them suffering undiagnosed hypertension. Even now, it seems that many young people are suffering hypertension, although most of them are still suffered by elderly.[9] *Institute for Health Metrics and Evaluation* (IHME) (2017) said that 23.7% of the 1.7 million deaths in 2016 were caused by hypertension and based on Riskesdas data (2018), it showed that hypertension prevalence rate in the population over 18 years old is 34.11%.[10]

Regular exercise in the morning can increase vitamin D levels. Around 50% to 90%, vitamin D is obtained through absorption by skin that exposed to sunlight and only 10% is obtained from foods. Direct sunlight exposure to the skin with an exposed area about 40% in 20 minutes n prevent vitamin D deficiency. Morning exercise around 07.00 am to 10 am can help the vitamin D forming. Vitamin D is produced from 7-dehydrocholesterol which it found in the skin or from food sources such as fish, milk, butter, egg yolks, meat, etc. Through the help of UVB from sunlight with 290-3 0nm wavelength will convert provitamin D3 into active vitamin D. Vitamin D deficiency can be caused by various factors, such as increasing 25(OH)D degradation, low intake food or supplements cointaning vitamin D, malabsorption, celiac disease, gaster area operation, and less exposure to sunlight. [1,8,11,12,13]

The research conducted by Yosephin et.al. to fertile w men found that sunlight exposure and doing regular exercise in the morning for 30 minutes three times a week for 1 weeks can helped lowers blood pressure and improved vitamin D levels.[11] Stu that conducted by Hermawan et.al., showed that vitamin D intake had effect to lowering blood pressure in the elderly who suffer from hypertension.[14] Shu and Huang's research showed that vitamin D intake caused decrease blood pressure in Asia.[15] As well as research conducted by Farapti et.al, showed that decrease blood pressure in th elderly after taking vitamin D supplementation.[15] But, Forman et.al., study showed that there is no relationship between vitamin D intake from foods or supplements with hypertension and Bahrami et.al., also said that only decreased diastolic pressure in adults patients with coronary artery disease.[15]

Various clinical trial results showed that vitamin D has inconsistent effects on blo pressure with various health condition across all ages. Based on that, the researchers intend to examine the relationship between blood pressure and exercise habits with vitamin D in employees.

METHODS

This research was analytic observational study with crossectional design. The aim was to find the relationship between blood pressure and exercise with vitamin D levels in employees, which held on February 2021. The research subjects was calculated using an infinite-finite population formula with the prevalence in Indonesia was 63% with the accuracy level was 0.05. Based on this calculation, we ot 63 subjects. The subjects were collected by consecutive nonrandom sampling meth d. The inclusion criteria were men and women aged 19-60 years old, willing to participate and signed informed consent. Exclusion criteria were consuming

alcohol, hypertension drugs or antioxidants, having history of malignancy, smoking, liver or kidney disfunction, history of hospitalization in the last 1 month.

Data was collected by filling out a questionnaire, which before filling out, the subjects was given an explanation beforehand. The questionnaire contains information that includes identity (name, age, gender, ethnicity and regular exercise habits). Exercise habits are asked to do at least walking in the morning for at least 30 minutes, 3 times a week.[17] The subjects blood preassure were measured using digital sphygmomanometer which already calibrated. Measurements were taken in a calm situation, sitting position and the measurements were taken three times and then the average was taken. The results are declared hypertension if the systolic blood pressure is ≥ 140 mmHg and /or diastolic blood pressure is ≥ 90 mmHg.[8]

Two milli litre of blood samples was collected in plain vial, asceptically for vitamin D levels examination using ELISA method. The levels of vitamin D 30-100 ng/ml was indicate sufficient/normal, whereas below that there was a deficiency.[12] This research obtained ethical clearance from the Research Ethics Commision of the Faculty of Medicine, Trisakti University under no. 170/KER/FK/XII/2020.

RESULTS

The univariate analysis was used to determine the distribution of subjects characteristicas in the form of gender, age, ethnicity, morning routine exercise habits for at least 30 minutes, blood pressure and vitamin D levels. Data table 1 shows that from 63 subjects, 26 (41.3%) subjects were male and thirty-seven subjects (58.7%) were female. The mean patients aged 42.14 ± 8.78 years. The majority 39 (61.91%) weren't do the morning routine exercise. On blood pressure examination, it was found that 16 (25.40%) had hypertension. The mean vitamin D levels was 16.5 ± 6.68 with 53 (84.13%) were below the normal value.

Table 1. Distribution of features characteristics of the subjects (n=63)

Characteristic	n (%)	Mean±SD
Sex		
Male	26 (41.3 %)	
Female	37 (58.7 %)	
Age (years)		42.14 ± 8.78
Morning routine exercise		
< 3 x/week	39 (61.91 %)	
≥ 3 x/week	24 (38.09 %)	
Blood pressure		
< 140/90 mmHg	47 (74.60 %)	
≥ 140/90 mmHg	16 (25.40 %)	
Vitamin D 25-OH levels		16.5 ± 6.68
≥ 30ng/dl	11 (17.46 %)	
< 30ng/dl	52 (82.54 %)	

Statistical analysis was used chi-square test to determine the relationship blood pressure and exercise with vitamin D levels. Based on table 2, there was a positive significant relationship between blood pressure with vitamin D levels (p = 0.044). Meanwhile, the relationship between morning routine exercise with vitamin D levels wasn't found in this study (p = 0.565)

Table 2. Relationship between blood pressure, exercise and vitamin D level

Characteristic	Vitamin D Levels		p value
	≥30 ng/dl	<30 ng/dl	
	n	n	
Blood pressure			
≥140/90mmHg	10 (21.3%)	37 (78.7%)	0.044€
<140/90mmHg	1 (6.3%)	15 (93.7%)	
Morning routine exercise			
≥3x/mgg	3 (3.8%)	21 (20.2%)	0.565€
<3x/mgg	7 (6.2%)	32 (32.8%)	

€ = *chi-square test*;p < 0.05

DISCUSSION

In this study shown that vitamin D has been able to reduce blood pressure. Vitamin D can reduce blood pressure through various mechanisms, these include inhibiting the expression of the renin gene, maintaining parathyroid hormone levels and calcium homeostasis, dilation of blood vessels and also decreased sympathetic nerve activity.[15] Vitamin D can reduce blood pressure through vascular resistance and the RAAS. Increased vitamin D levels can lead to a decrease vascular resistance in overall when the skin goes extensive vasodilatation, resulting in an increase nitric oxide in the skin's blood vessels.[11,12,15] The effect of vitamin D through RAAS is by suppressing renin activity. Vitamin D receptor (VDR) is found in various body tissues, which can modulates various genes, such as inhibits renin synthesis. Vitamin D can inhibit the expression of COX-2 in the macula densa cells in the kidneys, which this enzyme plays a very important role in the process of converting arachidonic acid into prostaglandins. In the absence of prostaglandins in macula cells that will be produce, will cause the absence of prostaglandins that should be capture by prostaglandin receptors in the juxtaglomerular cells, so the impact was renin can't be produced, ultimately the RAAS can't be activated and can't increase blood pressure. However, if a person is deficient in VDR or hyper-reninemia can caused increasing blood pressure.[11,12,14,18,19]

One of the vitamin D function is to maintain blood calcium homeostatis, so when there is a deficiency of vitamin D, it will cause changes in blood calcium levels, which will increase parathyroid hormone. Increased levels of parathyroid hormone will cause RAAS disorders, atherosclerosis, increased heart contractility which can increase the risk of cardiovascular disease.[14,15,19] There is an effect in blood vessels by the high levels of parathyroid hormone through angiotensin II release which can cause vasocontriction, so that the pheriperal resistance will increase. Also, increase parathyroid hormone levels can caused increase of endothelin-1 levels and IL-6, so the endothelium becomes inflamed and atheriosclerosis occurs through vascular endothelial growth factor (VEGF).[20,21] Besides that, it had sclerotic effect to smooth muscle cells.[22]

Other effects of vitamin D can regulated GuanylylCylase (GC)A in vascular smooth musclecells, stimulated production of cGMP so that can caused vasodilatation which it can lower blood pressure.[23,24] Vitamin D can also suppressed T-efector cells activity so it can decreased the activity of the sympathetic system which can lower blood pressure.[24]

Vitamin D has an effect on various organs in the body. Other than small intestine, kidneys, parathyroid glands, it also has effects on certain tissues and organs such as cardiovascular, skeletal muscle, the immune system which has a response to vitamin D, blood vessels's smooth mucle, endothel and immune cells, including CD-4^{+}T cells through VDR. VDR can tightly bound to vitamin D3 becomes active and interacts with retinoid X receptor (RXR) which wll

regulate gene transcription so that it can regulate calcium homeostasis, blood pressure, cardiovascular and skeletal muscle function.[24]

Research by Pike and Meyer concluded VDR had an active mechanism on target genes through the activation of VDR which is activated by $1,25(OH)_2D_3$ so that can modulates genes expression (transcription) at single gene locus and also at the tissue level.[5] Chen et.al, stated that there is a gene that is responsible for causing hypertension induced bt vitamin D deficiency. Each gene with a genomic position binds to an active VDR or indirectly regulated by vitamin D3 or VDR signals that lead to an increase or decrease transcription involved in the regulation of blood pressure can be affected by vitamin D deficiency causing hypertension.[24]

A study conducted by Hermawan, al. who gave vitamin D preparations to the elderly with hypertensi showed that decrease blood pressure in the elderly.[14] Another study by Qi et.al.,said that vitamin D deficiency was associated with the risk of hypertension. A study in Asia by Shu and Huang showed blood pressure in peripheral decrease after vitamin D supplementation.[15]

There are no relationship between morning routine exercise with vitamin D levels (p=0.565). Although Indonesia is a tropical island where it is easily exposed to sunlight so humans are able to make vitamin D3 naturally by changing 7-dehydrocholesterol which can be found in the skin, it turns out that it doesn't always guarantee a person's vitamin D levels.[7] Lack of outdoor activities or longer periods of working indoors and the social lifestyle of Asian people who avoid being exposed to the sun such as the use of clothing materials that are difficult to absorb sunlight or wearing closed clothes, using body protection, such as hats, umbrellas, sunscreens cause lack of exposure to the sunlight so it causes a lack of natural vitamin D formation. Although food source such as fish, butter, egg yolks, meat, margarine, yogurt, cod liver oil, etc can become vitamin D, but apparently it isn't enough for a person.[2,7,11,12,25,26,27] Besides that, skin tone can impact the absorption of sunlight, which dark skin color makes a person take a longer time to form vitamin D.[12] Same results wa ptained by several studies which said that employees who work more in the room are at risk of developing vitamin D deficiency due to lack of sun exposure and lack of opportunities to do morning exercise. Besides that, the subject's majority are females (58.7%) and most of them are muslim with using hijab as a protection and wearing close dress which can cause lack of sun exposure.

CONCLUSIONS

Blood pressure and vitamin D levels was found positive significant relationship, where indicated the higher vitamin D levels can help to reduce high blood pressure. Meanwhile there wasn't found relationship between morning routine exercise with vitamin D levels.

CONFLICT OF INTEREST

The authors do not have any conflict of interest to declare.

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