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Research Study *Medical research*

Effectiveness of combination hydrotherapy and inhalation aromatherapy on cortisol levels and blood pressure

(Study on Pregnant Women with Hypertension in Region Cirebon Regency)

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ABSTRACT

Pregnancy hypertension is the second leading cause of maternal mortality, with 44% of pregnant in Cirebon Regency having hypertension in 2019. Handling hypertension through complementary administration, which is considered safer, has minimal side effects, namely a combination intervention through physical (hydrotherapy) and psychosocial (inhaled aromatherapy). The aim was to determine effectiveness of combination Hydrotherapy and Inhaled Aromatherapy on Cortisol and Blood Pressure of Pregnant with Hypertension. The research design is pretest-posttest randomized control group. A sample of 40 pregnant with hypertension was selected by simple random sampling, there were 3 treatment and 1 control group. Measurement of blood pressure (sphygmomanometer), serum cortisol levels (ELISA KIT). Bivariate and multivariate data analysis. Result of research showed the combination group with delta mean of cortisol levels decreased by 27.30 ng/ml, systolic 25.2 mmHg and diastolic blood pressure 14.9 mmHg. Cortisol levels hydrotherapy group increased by 7.90 ng/ml, decreased systolic by 15 mmHg and diastolic blood pressure 9.1 mmHg. The cortisol levels aromatherapy group decreased by 21.7 ng/ml, systolic 13.1 mmHg and diastolic blood pressure 8.0 mmHg. The control group increased cortisol levels by 0.6 ng/ml, decreased systolic by 4.4 mmHg and diastolic blood pressure 3.2 mmHg. Cortisol levels between four groups did not have a significant difference p=0.217, while systolic and diastolic blood pressure had a significant difference p=0.000. The combination of hydrotherapy, inhaled aromatherapy, antihypertensive drugs and standard ANC care was the most effective treatment among the other groups, with the highest mean delta value in lowering cortisol, systolic and diastolic blood pressure.

Keywords: Hydrotherapy, Aromatherapy, Blood Pressure, Cortisol Levels.

INTRODUCTION

Background

Maternal mortality in Indonesia is dominated by several causes, one of which is Hypertension in Pregnancy. The prevalence of hypertension among pregnant women in Indonesia in 2015 was 6.18%.[2] According to a preliminary study in Cirebon Regency, the leading cause of maternal death in 2019 was Pregnancy Hypertension, which climbed 44% from the previous year, specifically in 2017 there were 1278 cases, and in 2018, there were 2410 cases, while in 2019, there were 2231 cases.

Pregnancy is prone to anxiety; 10% of pregnant women suffer from anxiety disorders, which leads to rise in blood pressure (hypertension).[3] Anxiety, if not addressed immediately, is stressful for a person and will stimulate the hypothalamus (anterior pituitary pituitary) to increase the hormone cortisol, as well as the sympathetic nerves in triggering the heart's work as a cause of vasoconstriction in peripheral blood vessels, thereby raising blood pressure.[4] The risks of pregency hypertension are premature birth,

stunted fetal growth, and Intra Uterine Growth Gestriction (IUGR).[5]

Treatment of pregnant hypertension is typically done in two ways: pharmacological and non-pharmacological. Pharmacological methods according to service standards are given antihypertensive drugs and given ANC standard nursing care. Pharmacological treatment in gestational hypertension is helpful, although it can produce adverse effects at first, and antihypertensive medications taken consistently can cause headaches, shortness of breath, and nausea.[6] So that it may be used with non-pharmacological obstetric therapy, which is regarded safer, more pleasant, has less side effects, and is the best option because it can be performed independently.[7]

Non-pharmacological treatment methods to help treat hypertension are using complementary therapy or Complementary and Alternative Medicine (CAM) such as applying relaxation techniques.[8] Relaxation techniques for treating hypertension and controlling anxiety are using physical and psychosocial approaches. The application of interventions with a physical approach, one of which is hydrotherapy and a psychosocial or psychological approach, is aromatherapy.[9-10] Non-pharmacological combination interventions can provide more effective effects in enhancing the brain's capacity to control bodily processes and alleviate muscular tension, resulting in lower anxiety and blood pressure.

Hydrotherapy or immersing the feet using warm air is a medical treatment that relies on the body's response to air and is a low-tech approach.[11] Hydrotherapy can improve blood circulation in a person's body and is good for dilatation of blood vessels, which can reduce blood pressure.[12] While someone who inhaling aromatherapy can shift the autonomic balance towards the parasympathetic system's dominance, producing a calming effect and lowering anxiety and blood pressure in those with hypertension.[13] The type of aromatherapy that is safe and has high active ingredients in reducing blood pressure and anxiety in pregnant women is Lavender (Lavadula Angustifolia).[14-15] Lavender's active chemical components, linalool, linalyl acetate, and esters, help relax smooth muscles and the neurological system, making it effective for reducing blood pressure.

Research conducted by Hartinah, et al. shows that the results have not been effective. Hydrotherapy treatment was given for 5 consecutive days with a duration of ± 15 minutes and a temperature of 32-35ºC. The results of systolic and diastolic blood pressure decreased but did not reach normal blood pressure, namely before treatment it was 165/101 mmHg to 151/92 mmHg.[16] Another study conducted by Maisi et al with lavender aromatherapy intervention and not given standard ANC care. The treatment was given for 1 time with a duration of 20 minutes. The results of the analysis test obtained p-value <0.05, meaning that it was significant for the decrease in systolic blood pressure after being given aromatherapy intervention.[7]

Based on an explanation of the problem of pregnancy hypertension, which is still prevalent and contributes to AKI, the researchers wanted to conduct a study on the effectiveness of combination hydrotherapy and aromatherapy inhalation on cortisol levels and blood pressure of pregnant women with gestational hypertension.

Methods

The type of research used is quantitative through an analytical observational survey approach (quasy experiment) as well as a pre test post test design with a control group. This research was conducted after obtaining a letter from the Ethics Committee of the Sultan Agung Islamic University Semarang regarding ethical feasibility. Result of ethical clearance number No. 71/III/2021/Commission on Bioethics. Researchers will keep respondent data confidential and use informed consent to obtain respondent's consent. The research was conducted different operating locations in Cirebon District Health Center (Puskesmas Astanajapura, Sindanglaut Health Center, Pangenan Health Center, Mundu Health Center and Sidamulya Health Center) from March to May 2021.

The sample in this study was collected by simple random sampling, with a minimum sample size of 10 people per group or as many as 40 pregnant women with hypertension. The samples were separated into four groups: group 1 (hydrotherapy and aromatherapy combined treatment), group 2 (hydrotherapy treatment), group 3 (inhalation aromatherapy treatment), and group 4 (control). The inclusion criteria in this study were mothers with gestational hypertension, gestational age >20 weeks, taking antihypertensive drugs, pregnant women receiving standard ANC care, receiving lavender aroma, pregnant women who did not smoke and did not drink alcohol. Foot soak therapy with warm water and a temperature of 37-40^{o}C is administered for 7 days in a row, with each session lasting 20 minutes. While the aromatherapy treatment involves dissolving 5 drops of lavender essential oil in 20 ml of water and placing it in a diffuser, inhaling through the nose for 20 minutes on a daily basis for 7 days. In the combination treatment by giving warm water foot soak treatment and lavender aromatherapy inhalation simultaneously for 20 minutes each session for 7 consecutive days. The control group was given antihypertensive drugs and standard ANC care.

Digital sphygmomanometer with Omron brand to measure blood pressure (before and after the intervention) and Serum cortisol levels were measured using the ELISA method using the ELISA KIT reagent at the GAKI Laboratory, Diponegoro University. This study used the Parametric Paired Samples T-Test test (normal data) for the combination, aromatherapy and control groups, while the hydrotherapy group because the data was not normal, the Wilcoxon non-parametric test was used. Another parametric test to analyze the effectiveness between groups of combination, hydrotherapy, inhaled aromatherapy and control of cortisol levels using the Kruskal Wallis test. Testing changes in systolic and diastolic blood pressure of pregnant women with hypertension before and after being given treatment. Because this study fulfilled the criteria, the data were evaluated using general linear models repeated measure ANOVA (normal data) and post hoc bonferori tests.

Results

Forty pregnant women in the four study groups with 10 people each per group. There were no pregnant that dropped out until the end of the treatment.

Table 1 Analysis of differences in cortisol levels before and after treatment in each group

Groups	Cortisol Levels		P
	Pre	*Post*	
	Mean±SD	Mean±SD	
Combinations	136,2±51,21	108,9±39,40	0,021*
Hydrotherapy	101,0±33,27	108,9±49,76	0,799**
Aromatherapy	116,6±40,75	94,9±40,25	0,138*
Control	115,2±34,43	115,8±29,97	0,955*

**Paired samples t-test* ***Wilcoxon*

Table 1. The results of test showed that average pretest and post-test cortisol levels in combined hydrotherapy and aromatherapy treatment group and aromatherapy group experienced a decrease in average cortisol level, while hydrotherapy treatment group and control group experienced average increase in cortisol levels. In groups combination have a significant value of p = 0.021 which means there is a significant difference in average before and after the combination treatment, while the other three groups have a p > 0.05 which means there is no significant difference in average before and after treatment of three groups.

Table 2 Analysis of differences in cortisol levels between treatment and control groups

Groups	Cortisol Levels	
	ΔMean±SD	*p
Combinations	27,3±31,05	0,217
Hydrotherapy	-7,9±54,80	
Aromatherapy	21,7±42,10	
Control	-0,6±32,70	

**Kruskal wallis*

Table 2. Showed the variable cortisol levels with p = 0.217 between four groups, which means that average decrease in cortisol levels before and after treatment in four groups did not have a significant difference.

Table 3 Descriptive results of systolic blood pressure in each group

Variable	*Pre/Post*	Groups							
		Combination		Hydrotherapy		Aromatherapy		Control	
		Mean± SD	Min-Max	Mean± SD	Min-Max	Mean± SD	Min-Max	Mean± SD	Min-Max
Systolic blood pressure	*Pre*	156,5± 11,50	145-180	153,6± 7,91	145-170	150,9± 8,39	140-166	155,2± 10,16	140-171
	Post ke 1	151.5±1 6,29	129-189	147,3±5 ,83	140-156	144,2±7 ,89	134-160	153,2±10, 36	142-170
	Post ke 2	142,4± 12,76	121-170	143,0± 7,39	135-159	144,0± 11,05	121-163	154,1± 12,36	127-170
	Post ke 3	141,6± 8,82	130-160	138,1± 8,43	127-151	141,9± 12,87	120-159	153,9± 9,57	136-164
	Post ke 4	139,0± 13,80	120-166	136,0± 5,88	124-142	140,6± 10,95	126-160	150,4± 12,24	132-166
	Post ke 5	136,5± 12,98	120-161	136,8± 9,09	120-149	141,7± 13,49	113-161	149,3± 12,01	135-171
	Post ke 6	132,1± 8,59	120-142	139,6± 8,36	128-154	138,2± 12,62	120-154	151,6± 11,32	139-168
	Post ke 7	131,3± 623	122-143	138,0± 8,19	122-151	137,8± 12,04	122-161	150,8± 9,05	141-165

The results in table 3 show that average change in systolic blood pressure in pretest and posttest treatments. The pretest results in combination group were 156.5 mmHg, hydrotherapy group was 153.6 mmHg, aromatherapy group was 150.9 mmHg and control group was 155.2 mmHg. The average results of posttest day 7 systolic blood pressure in combination group consistently decreased to 131.3 mmHg, hydrotherapy group to 138.0 mmHg, aromatherapy group to 137.8 mmHg. While, control group did not reached the normal limit, average value of drop was 150.8 mmHg.

Table 4 Descriptive results of diastolic blood pressure in each group

Variable	*Pre/Post*	Groups							
		Combination		Hydrotherapy		Aromatherapy		Control	
		Mean± SD	Min-Max	Mean± SD	Min-Max	Mean± SD	Min-Max	Mean± SD	Min-Max
Diastolic blood pressure	*Pre*	102,7± 5,20	96-110	99,1± 4,74	93-109	98,7± 8,08	90-113	100,1± 3,92	95-109
	Post ke 1	99,8± 5,35	89-108	94,6± 3,68	90-101	95,7± 6,61	88-108	98,8± 5,05	91-109
	Post ke 2	96,5± 7,47	82-108	91,7± 3,46	87-99	93,2± 6,87	82-102	97,8± 5,71	90-108
	Post ke 3	93,9± 5,78	85-103	92,9± 4,90	85-102	91,3± 5,85	84-104	96,2± 4,68	90-106
	Post ke 4	92,0± 5,69	85-101	90,3± 6,00	80-97	91,5± 8,11	80-101	96,4± 4,94	91-107
	Post ke 5	90,2± 5,11	85-99	90,6± 5,03	81-100	91,0± 6,86	80-102	98,3± 5,25	91-109
	Post ke 6	88,7± 3,86	81-94	90,5± 4,83	82-98	92,5± 6,45	80-101	97,4± 6,65	89-107
	Post ke 7	87,8± 2,97	83-92	90,0± 3,26	84-95	90,7± 7,49	81-104	96,9± 4,48	90-102

The results in table 4. The average change in diastolic blood pressure between pretest and posttest treatments was 102.7 mmHg in combination group, 99.1 mmHg in hydrotherapy group, 98.7 mmHg in aromatherapy group, and 100.1 mmHg in control group. On the seventh day, the average posttest posttest diastolic blood pressure in the combination group steadily declined, reaching 87.8 mmHg, while the hydrotherapy group reached 90.0 mmHg, the group reached 90.7 mmHg, and the control group reached 96.9 mmHg.

Table 5 Analysis of difference in systolic blood pressure before and before in each group

Blood pressure	Measurement		Groups							
			Combination		Hydrotherapy		Aromatherapy		Control	
			Mean difference	*P	Mean difference	*P	Mean difference	*P	Mean difference	*P
Systolic	*Pre*	*Post 7*	25,200	0,000	15,600	0,001	13,100	0,041	4,400	0,243
Diastolic	*Pre*	*Post 7*	14,900	0,000	9,100	0,014	8,000	0,010	3,200	1,000

**Post hoc bonferroni-pairwise comparisons*

The results of analysis in table 5 showed significant differences in pretest and posttest systolic blood pressure on seventh day in combination treatment group, hydrotherapy group, and aromatherapy group with a significant value in lowering systolic blood pressure $p < 0.05$, while control group showed no significant difference in lowering blood pressure $p > 0.05$ for systolic blood pressure. Meanwhile, there was a difference in pretest and posttest diastolic blood pressure values on day 7 in combination treatment group, hydrotherapy group, and aromatherapy group with a significant value in lowering systolic blood pressure $p < 0.05$, while control group showed no significant difference in lowering diastolic blood pressure $p > 0.05$.

Table 6 Analysis of repeated measure ANOVA test (tests of between-subjects effects) on systolic and diastolic blood pressure between four groups

Source	*Type III Sum of Squares*	Df	*Mean Square*	F	P
Systolic	6673301,628	1	6673301,628	9661,27	0,000
Diastolic	2844842,450	1	2844842,450	16747,160	0,000

Table 6 shows the findings of the analysis. Based on the repeated measure ANOVA test from pretest to posttest systolic blood pressure variables between groups, there was a significant difference between combination treatment, hydrotherapy treatment, aromatherapy treatment and control group with $p = 0.000$.

Table 7 Analysis of *Post hoc* in comparing systolic and diastolic blood pressure between groups

Variable	Groups	Mean difference	*P
Systolic blood pressure	Combination vs Hydrotherapy	3,53	1,000
	Combination vs Aromatherapy	7,60	0,078
	Combination vs Control	14,00	0,000
	Hydrotherapy vs Aromatherapy	4,07	1,000
	Hydrotherapy vs Control	10,47	0,006
	Aromatherapy vs Control	6,40	0,205
Diastolic blood pressure	Combination vs Hydrotherapy	2,33	1,000
	Combination vs Aromatherapy	3,57	0,431
	Combination vs Control	7,30	0,003
	Hydrotherapy vs Aromatherapy	1,24	1,000
	Hydrotherapy vs Control	4,97	0,084
	Aromatherapy vs Control	3,73	0,364

**Analisis post hoc-pairwise comparisons*

The results in table 7. shows that there is a significant difference in systolic blood pressure between combination and control groups (p=0.000) and between hydrotherapy and control groups (0.006). Meanwhile, in diastolic blood pressure, there was a significant difference only between combination and control groups (p=0.003).

DISCUSSION

This study aims to determine the effectiveness of combination Hydrotherapy and Inhaled Aromatherapy on Cortisol Levels and Blood Pressure of Pregnant Women with Hypertension. The combination of hydrotherapy with aromatherapy inhalation is a relaxing method that entails sensations of peace or relaxation. This is consistent with the idea, which is relaxation therapy approaches aimed at reducing anxiety by relaxing the muscles in the body in order to produce a healthy mental state.[17] When a person's state is calm or relaxed, the coping mechanism and cortisol give negative feedback on the hypothalamic-pituitary axis, inhibiting ACTH and CRH production. Overproduction of ACTH can produce a rise in cortisol, therefore it is extremely beneficial under calm situations. It will also impact the hypothalamus for CRH production as well as reduce the capacity of cells in ACTH over CRH by direct action in the anterior pituitary. Emotional circumstances that have been stabilized or relaxed by relaxation techniques might result in a drop in cortisol levels.[18]

According to research on the application of foot soaks, diaphragmatic breathing, and lavender aromatherapy given for two weeks to five third trimester pregnant women, it was proven to reduce anxiety, specifically by scores before treatment (19-24 with mild and moderate anxiety criteria) and after treatment two weeks the score becomes 9 with no anxiety criteria.[19] Warm water foot baths have a positive physiological influence on the body and can increase performance and reduce anxiety in a person.[20] While aromatherapy has function to rise hormone production endorphins, encephalon, and serotonin, it also helps to lower the hormone cortisol and promote relaxation, which is the end reduces anxiety.[21]

The implementation of healty lifestyle for hypertension pregnant woman, Non-pharmacological methods can also be done by applying complementary therapy or Complementary and Alternative Medicine (CAM) such as applying relaxation techniques. Pregnant women who are relaxed, their bodies will create endorphins, which play a part in natural analgesics in a person's body (complaints felt by physical or mental). When a person's body is relaxed, it can also stimulate the parasympathetic nervous system, which helps to lower heart rate, respiratory rate, and blood pressure.

Non-pharmacological combination interventions can provide more effective results in increasing the brain's capacity to regulate body functions and relieve muscles so that it will lower blood pressure. Therapy that combines physical and psychosocial approaches has a positive impact on lowering blood pressure in someone with hypertension.[22] Therapy with a physical approach involves the body's role and has the same effect as exercise which makes blood circulation smoother, while the psychosocial approach is more focused on psychology which aims to calm the mind so as to relieve anxiety and lower blood pressure.[23] One of the physical or physical applications is hydrotherapy intervention and the psychosocial approach through psychology, including aromatherapy intervention.

In line with the theory of hydrotherapy, namely the type of foot soak with warm water, CAM therapy can improve blood circulation. Soaking the feet in warm water at a temperature of roughly 37-40^{0}C for around 20-30 minutes by conduction, soaking the feet in warm water can increase cell activity (molecules) and transfer energy by convection of the liquid medium.[20] The performance process of warm water will transmit heat to a person's body and cause vasodilation, or the expansion of blood vessels, resulting in a reduction in peripheral and muscular tension and, eventually, reduced blood pressure.[16,24]

The combination of several relaxation therapies can control and lower blood pressure, because it can relax the body so that blood pressure can decrease. Relaxation therapy is not to replace antihypertensive therapy that is being consumed by pregnant women with HDK, but to helps in lowering

blood pressure that is greater and controlled. The combination treatment of hydrotherapy and aromatherapy inhalation by receiving antihypertensive drugs and standard ANC care has no negative effects on the mechanisms in the body, but each component works in synergy to provide an effect on lowering blood pressure by vasodilation of the vasculature so that it can cause an effect on lowering blood pressure.

This study is also consistent with previous studies on the use of warm water foot soaks to lower blood pressure in pregnant women with hypertension. The treatment was given for 2 weeks with a duration of 15 minutes and statistically significant test results were obtained, namely p = 0.000. The results of the treatment also caused an average decrease in blood pressure of 11.67 mmHg (before treatment 146.00 mmHg to 134.33 mmHg).[25]

In this study, giving hydrotherapy and inhalation of aromatherapy did not act as a substitute for antihypertensive or standard ANC care but as complementary alternative therapies. This treatment is given simultaneously with giving antihypertensive and standard ANC care because it has the potential to have a greater effect in reducing anxiety. The combination treatment group also had the highest effect in reducing cortisol levels, systolic and diastolic blood pressure in pregnant women with hypertension compared to hydrotherapy or aromatherapy treatment, which was seen from the delta mean decrease. This is in accordance with the theory, someone who applies complementary therapy or Complementary and Alternative Medicine (CAM) such as applying some relaxation therapies can relax the body so that cortisol levels can be controlled and decreased.

CONCLUSION

Combination hydrotherapy, inhaled aromatherapy, antihypertensive, and standard ANC care for 7 consecutive days with a duration of 20 minutes was the best treatment compared to the other treatment groups, with the highest mean delta value in lowering cortisol levels, systolic and diastolic blood pressure has returned to normal levels.

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