Acupuncture Therapy Study in Obesity Cases: Glycemic and Inflammatory Marker Patterns

Sumanto[1*], Suwaji Handaru W[1], Sholichan Badri[1]

[1] Acupuncture Department, Health Polytechnic of Health Ministry Surakarta, Surakarta, Indonesia.

Abstract: Obesity is a problem in various countries, not only in developed countries but also in developing countries. Central obesity occurs due to excessive fat accumulation in the upper body, especially in the abdomen, which is generally in men and is characterized by an increase in waist circumference. Central obesity occurs due to excessive adipocyte expansion which can cause hypoxia and oxidative stress, resulting in further inflammation. Obesity can cause coronary heart disease, hypertension, stroke, insulin resistance, Diabetes Mellitus (DM), hyperlipidemia and cancer. This study aims to determine glycemic and inflammatory markers and obtain acupuncture therapy models in obesity cases. This study was designed as a quasi-experiment using the Pre-Post Design with obesity cases. The study was conducted in 3 stages (three years). Each series of acupuncture therapy was carried out 8 times. This study was conducted in three series (for 3 years, each year 1 series of acupuncture therapy). Haematologic and lipid examinations were carried out 2 times before therapy and after the 8th therapy in the first year. Liver function tests, insulin hormone tests and HBA1C tests were performed twice before therapy and after the 8th therapy in the second year. Kidney function tests were performed twice before therapy and after the 8th therapy in the third year. Laboratory results were analyzed using SPPS 23 statistical software to see their significance. Laboratory values were used in mathematical modeling to obtain the right acupuncture therapy model for obesity cases.

Keywords: Acupuncture; Central obesity; Glycemic markers; HBA1C; Inflammation; Insulin; Liver function; Kidney function

Introduction

Obesity is a problem in various countries, not only in developed countries but also in developing countries. This case can also increase the burden of health care costs. Obesity is a pathological condition due to excessive accumulation of triacylglycerol in fat tissue due to excess energy intake compared to that needed for body function (its use) (Kim et al., 2020). WHO reported that obesity is an epidemic problem and estimates that more than 1 billion adults are overweight and 300 million of them are clinically obese, which is a major contributor to the global burden of chronic disease and disability. The prevalence of obesity in various countries around the world has always increased from year to year. The prevalence of obesity in Indonesia in 2016 was 20.7%, an increase from 15.4% in 2013, the prevalence rate for women was 41.6% and for men was 24. Obesity can increase the risk of various degenerative diseases such as diabetes mellitus, coronary heart disease and hypertension (Li et al., 2021).

Central obesity is obesity that occurs due to excessive fat accumulation in the upper body, especially in the abdomen, which is generally in men and is characterized by an increase in waist circumference. This type of obesity can increase the risk of degenerative

diseases, such as type 2 diabetes mellitus, dyslipidemia, coronary heart disease, hypertension, cancer and metabolic syndrome (Yu et al., 2024). Maria & Evagelia (Zhao et al., 2024) added that there is a close relationship between obesity and various endocrine disorders, the respiratory system and sleep disorders. Central obesity there is excessive adipocyte expansion which can cause hypoxia and oxidative stress, as a result of which the inflammatory process occurs. Beta cell damage in pancreatic cells will accelerate if there is increased inflammation in obesity. Mohamed et al. (2024) reported that insulin resistance and excessive pancreatic beta cell function occur in central obesity with pre-DM which progresses to DM.

Acupuncture is known as one of the complementary methods in curing diseases. Several non-communicable diseases such as pain can be reduced in severity through acupuncture (Sun et al., 2024), while obesity, which is also a type of non-communicable disease, has also been widely reported to be treated through acupuncture (Luo et al., 2024). However, until now there has been no report on glycemic markers and inflammatory images related to obesity cases that received acupuncture therapy. Based on the background that has been explained, the researcher intends to conduct research on the effects of acupuncture on obesity cases based on glycemic markers and inflammatory images. This research is expected to provide additional information benefits, especially acupuncture which is associated with the biochemistry and immune system of obesity (Xiong et al., 2023).

Obesity is known as an abnormal condition characterized by the accumulation of fat tissue that can cause health problems. Generally, fat and adipose tissue are considered the same thing, but in reality, adipose tissue in each different region of the body has its own function. Obesity is a problem that is starting to be found a lot, not only in urban areas with high socio-economic, but also in children who live in rural areas and even from lower middle socio-economic groups (Lan et al., 2024). For example, white fat and brown fat as well as visceral and subcutaneous fat (Susilawati et al., 2025). This accumulation is influenced by age, gender, ethnicity, genetics and environmental factor. Factors that influence the incidence of obesity include energy intake that exceeds the AKG, high fat and carbohydrate intake, fast food consumption, lack of physical activity, genetics, and even the habit of not eating breakfast can increase the risk of obesity by 5.24 times (Bai et al., 2024).

The risk of disease due to increased BMI is related to the amount of fat, especially if visceral fat is found. The impact varies based on obesity class I to class III. In many cases, obesity is often a risk factor for more dangerous diseases. Health problems that can occur due to obesity include the risk of developing type 2 diabetes

mellitus, cardiovascular disease, and various types of cancer. The incidence of death due to obesity is 5-15%, the incidence of cancer is 2-8%, cardiovascular disease is 7-44% and type 2 diabetes mellitus is 3-83%. The incidence of overweight and obesity in Indonesia from 2007 to 2018 has increased quite significantly. Overweight sufferers in 2007 were 8.6% and increased to 13.6% in 2018, while obesity sufferers in 2007 were 10.5% and increased to 21.8% in 2018. In addition, the incidence of central obesity in 2007 was 18.8% and increased to 31% in 2018. There is a relationship between marital status, obesity level and frequency of treatment on weight loss results in obesity sufferers (Shan et al., 2024).

Obesity therapy can be done in several ways, namely diet management, physical activity, pharmacological therapy, behavioral therapy and lifestyle modification. In addition, alternative therapy can be done in the form of acupuncture which is one of the traditional treatments from China. Acupuncture has been widely used by the Indonesian people for the prevention and therapy of several diseases, because of its benefits in the form of anti-inflammatory, anti-apoptotic and neurotrophic (Li & Fang, 2022).

Medical acupuncture for weight loss program. Acupuncture comes from the Latin word acus which means needle, and punctur which means to stab. So, acupuncture means "to stab with a needle". Acupuncture initially developed in China since 3000 years ago and developed into a standard practice alongside massage, diet and herbs. Medical acupuncture is the science of acupuncture that developed from classical acupuncture whose application includes neuro-endocrine-immunology elements in biomedical science (Deneen & Garstka, 2022). The concept of acupuncture application states that health problems in humans come from disturbances in the flow of qi which is a combination of yin and yang energy forces in the human body. Yin energy represents the cold, slow or passive aspects of humans, while yang energy represents the hot, spirit or active aspects. A healthy condition can be achieved when yin and yang energy are in balance (Chen et al., 2024).

Qi flows throughout the body through pathways called meridians. There are fourteen Meridians that run vertically up and down the surface of the body. In addition, there are twelve organ Meridians on each side of the body. There are also two unpaired Meridians on the midline of the body (Farahbod et al., 2024). Acupuncture points are specific locations where meridians are close to the surface of the skin. Stimulation is done by inserting needles into these points so that they affect the flow of qi in the function of certain organs. Healing of diseases is done by removing blockages in the flow of qi that can interfere with physical, emotional, mental and spiritual health, while also ensuring the

smooth flow of qi and the balance of yin and yang energy (Sezgin & Kaplan, 2021).

Scientists, researchers and practitioners have scientifically proven that this acupuncture practice has proven to work well. WHO has also accepted and recommended the acupuncture method as one of the methods of treatment. In countries such as Canada, Germany, Cuba and Eastern European countries, acupuncture has been included in the curriculum of the Faculty of Medicine. While in Romania, Czechoslovakia, Brazil and Indonesia, acupuncture therapy has become one of the medical specialties. Dr. Cipto Mangunkusumo Hospital (RSCM) is the first hospital in Indonesia to provide acupuncture services to the community since 1967. Its services continue to be developed by collaborating with the Faculty of Medicine, University of Indonesia. In 2011, FKUI ratified the curriculum of the Medical Acupuncture Study Program as one of the Specialist Doctor Education Programs which by the end of 2017 had graduated 169 Acupuncture Specialists. Acupuncture therapy can affect glucose metabolism and reduce body mass index so that it can prevent the emergence of dangerous chronic diseases in the future (Zhong et al., 2020).

Inflammation has been reported to be associated with poor dietary habits, generally high-fat and/or high-sugar foods. The preference and consumption of palatable foods - including sugar - are biologically controlled (Doyan et al., 2025b). The ChREBP protein in the liver that aims to regulate the amount of fibroblast hepatokine 21 (FGF21) in vitro in response to high carbohydrates and regulates carbohydrate intake by suppressing the consumption of simple sugars, but not complex carbohydrates, proteins, or lipids. Low FGF21 in mice increases sucrose consumption, while excessive FGF21 actually suppresses the intake of sugar and non-caloric sweeteners via neurons in the hypothalamus that produce endocrine satiety signals to suppress sugar intake (Lu et al., 2022).

The body that consumes sugar can experience positive effects in the short term and negative effects in the long term. This negative effect is proven by Dwinijanti & Japaries (2021) that there is an increase in CRP as an inflammatory parameter. Sugar also has a positive effect, namely the results found in the form of an insignificant increase in immune parameters. The increase in immune cells is a response to increased stress and inflammation. The higher the exposure to stress and inflammation, the higher the production of immune cells in the body (Doyan et al., 2025a).

Obesity is the beginning of chronic inflammation and contributes greatly to related metabolic complications, especially insulin resistance, which is initiated by dysfunction of adipose tissue and the body's immune system by damaging immune function,

changing the number of leukocytes and cell-mediated immune responses (T cells, B cells, macrophages). This is evidenced by the research of Rosales-gómez et al. (2018) whose results showed an increase in immunity after consuming monosaccharides. This is a "forced" body response as a form of preventing inflammation. This inflammatory state is caused by increased levels of circulating pro-inflammatory cytokines, and occurs in every age group (Chen et al., 2020).

Method

Place and Time of Research

This research was conducted at Griya Sehat Dewandaru Klaten, Prima Diagnostika Klaten Main Clinical Laboratory and Redy Mojosongo Laboratory, Jebres Surakarta. This research is planned to be carried out in three stages (years). The first year of research was carried out from March to November 2024, then continued in the second year and the third year.

Research Design

This research related to acupuncture therapy follows a quasi-experimental research flow using the Pre-Post Group Design (two treatment groups), while the analysis of glycemic markers and inflammatory images in the blood follows a qualitative research flow (Cai et al., 2019).

Population and Research Sample

Male and female patients with obesity (waist circumference > 90 cm) aged around 30-50 years totaling 30 people (each treatment totaling fifteen people). Acupuncture therapy was carried out in each series (each year) eight times using local acupuncture points. Laboratory data collection in the form of haematologic profiles and lipid profiles was carried out twice, namely before the start of acupuncture therapy, and after the eighth therapy in the first year. Further laboratory data collection in the form of liver function, insulin hormone and HBA1C twice in the second year. Furthermore, laboratory data collection in the form of kidney function twice in the third year (Liu et al., 2022).

Data Collection Procedure
Data Type

The type of research data is primary data taken directly by researchers from research subjects, namely before acupuncture therapy and after 8X acupuncture therapy. The data taken is a picture of inflammation in the blood (Wulandari et al., 2024).

How to Collect Data

Managing Permits, Managing permits is done after the research proposal is approved by the Research Unit

of the Directorate of Surakarta Health Polytechnic. Researchers will submit a permit to the ethics committee related to ethical clearance; Preparation Stage; Subjects of the study., Subjects of the study who will be studied related to obesity, then given acupuncture therapy are required to sign an informed consent after receiving an explanation from the researcher. The provision of therapy to the research subjects will be carried out 8 times with a schedule of 2 times per week; and Implementation Stage

Results and Discussion

Results

Based on data collection that has been carried out from August to September 2024 with acupuncture intervention and laboratory examination on 30 respondents. Therapy was given to the research subjects 8 times with a schedule of 2 times per week. The data obtained with the following results (Holmer et al., 2021).

Univariate Analysis

Table 1. Frequency distribution by gender and age

	Frequency	Percentage %
Groups Based on Gender		
Gender		
Man	15	50
Woman	15	50
Total	30	100
Groups Based on Age		
Age		
18	2	6.7
24	3	10
27	1	3.3
28	1	3.3
29	1	3.3
31	1	3.3
32	3	10
33	1	3.3
34	1	3.3
35	2	6.7
36	2	6.7
42	1	3.3
43	1	3.3
44	3	10
47	3	10
50	1	3.3

	Frequency	Percentage %
52	1	3.3
53	2	6.7
Total	30	100

The characteristics of the subjects of this study include age, gender. The data is presented in the form of a frequency distribution as follows (Table 1).

Based on Table 1, it can be seen that each respondent consists of 15 male (50%) and 15 female (50%). The youngest age who experienced obesity was 18 years old, 2 people (6.7%) and the oldest age who experienced obesity was 53 years old, 2 people (6.7%).

Bivariate Analysis
Data Normality Analysis

Before determining the statistical test technique used, it is necessary to conduct a data normality test to determine whether the data is normally distributed or not. The data normality test in this study uses the Shapiro-Wilk test analysis (Indragunawan, 2022).

Table 2. Data normality test by Shapiro-Wilk test

	Statistics	N	Sig
Body weight before acupuncture	0.911	30	0.016
Weight loss after acupuncture	0.952	30	0.191
Waist circumference before acupuncture	0.974	30	0.654
Waist circumference after acupuncture	0.956	30	0.238
Hemoglobin before acupuncture	0.933	30	0.059
Hemoglobin after acupuncture	0.902	30	0.009
Leukocytes before acupuncture	0.868	30	0.002
Leukocytes after acupuncture	0.663	30	0,000
Cholesterol before acupuncture	0.939	30	0.086
Cholesterol after acupuncture	0.968	30	0.481
HDL before acupuncture	0.974	30	0.660
HDL after acupuncture	0.972	30	0.597
LDL before acupuncture	0.971	30	0.566
LDL after acupuncture	0.943	30	0.111
Triglycerides before acupuncture	0.777	30	0.000
Triglycerides after acupuncture	0.763	30	0.000

Based on Table 2, the results of the Shapiro-Wilk test for leukocyte data before and after acupuncture and triglyceride data before and after acupuncture show that the data is not normally distributed.

Table 3. Hemoglobin laboratory results before and after acupuncture

Tests of Between-Subjects Effects					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	110.526a	3	36.842	37.819	.000
Intercept	11587.041	1	11587.041	1.189E4	.000
Time	.113	1	.113	.116	.735
Gender	109.891	1	109.891	112.805	.000
Time*Gender	.523	1	.523	.537	.467

Tests of Between-Subjects Effects					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Error	54.553	56	.974		
Total	11752.120	60			
Corrected Total	165.079	59			

a. R Squared = .670 (Adjusted R Squared = .652)

From Table 3, the results of the average value (mean) of the increase in Hemoglobin in the male group have a higher average value than women both before and after the intervention. The results of the two-way ANOVA test showed that the sig value > 0.05 (0.467) then there was no significant difference between the increase in hemoglobin in the male group and the hemoglobin in the female group before and after Acupuncture (Meng et al., 2020).

Table 4. Leukocyte laboratory results before and after acupuncture

	Gender	N	Mean Rank
Leukocyte Results Before and After Acupuncture	Man	15	13.03
	Woman	15	17.97
	Total	30	

From Table 4, the results of the average value (mean) of women tend to have higher leukocyte values than men. The results of the Kruskal Wallis Test showed that the sig value > 0.05 (0.942) then there was no significant difference between the decrease in leukocytes in the male group and the decrease in leukocytes in the female group before and after Acupuncture (Wagealla, 2018).

From the table, the results of the average value (mean) of cholesterol reduction in the male group have a higher average value compared to cholesterol reduction after acupuncture. The results of the two-way ANOVA test showed that the sig value < 0.05 (0.000) means there is a significant difference in cholesterol levels in both men and women before and after acupuncture. The sig value for gender > 0.005 (0.263) which means that gender does not have a significant effect on cholesterol levels. Conclusion Acupuncture intervention is effective in significantly reducing cholesterol levels, both in men and women (You, 2020).

From the table, the results of the average value (mean) of the increase in HDL levels in the male group have a higher average value compared to the increase in HDL in the female group after acupuncture. The results of the two-way ANOVA test showed that the sig value < 0.05 (0.000) means that there is a significant difference in HDL levels in both men and women before and after acupuncture. The sig value for gender > 0.005 (0.865) which means that gender does not have a significant effect on HDL levels. Conclusion Acupuncture intervention is effective in increasing HDL levels significantly, both in men and women (He et al., 2021).

Table 5. Low-Density Lipoprotein (LDL) laboratory results before and after acupuncture

Tests of Between-Subjects Effects					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	17544.144a	3	5848.048	6.442	.001
Intercept	1214587.448	1	1214587.448	1.338E3	.000
Time	16670.000	1	16670.000	18.363	.000
Gender	389.640	1	389.640	.429	.515
Time*Gender	484.504	1	484.504	.534	.468
Error	50836.057	56	907.787		
Total	1282967.650	60			
Corrected Total	68380.202	59			

a. R Squared = .257 (Adjusted R Squared = .217)

From the table, the results of the average value (mean) of the decrease in LDL levels in the male group have a higher average value compared to the decrease in LDL in the female group after acupuncture. The results of the two-way ANOVA test showed that the sig value < 0.05 (0.000) means that there is a significant difference in LDL levels in both men and women before and after acupuncture. The sig value for gender > 0.005 (0.515) which means that gender does not have a significant effect on LDL levels. Conclusion Acupuncture intervention is effective in significantly reducing LDL levels, both in men and women.

Table 6. Triglyceride laboratory results before and after acupuncture

	Gender	N	Mean Rank
Triglyceride Lab Results before and after Acupuncture	Man	15	13.97
	Woman	15	17.03
	Total	30	

From the results obtained from the average value (mean), women tend to have higher triglyceride values than men. The test results The Kruskal Wallis Test showed that the sig value > 0.05 (0.942) means there is no significant difference between the decrease in Triglycerides in the male group and the decrease in Triglycerides in the female group before and after Acupuncture.

Discussion

Obesity is an abnormal or excessive accumulation of fat that can interfere with health. Obesity is associated with many pathological changes including insulin resistance, fatty liver, hyperlipidemia and other obesity-related diseases. These comorbidities are a significant public health threat. Acupuncture treatment has been shown to be effective in treating obesity and obesity conditions and avoiding side effects (Jiang et al., 2024). The basis of diagnosis used for obesity is Body Mass Index (BMI) and waist circumference (WRH) which is included in the obesity category if the waist circumference for men is > 90 cm while for women the waist circumference is > 80 cm (Listiowati, 2004). Acupuncture can reduce weight by regulating the endocrine system, improving the digestive system, reducing oxidative stress, suppressing appetite, and increasing lipolytic activity (Shafira, 2022). The results of the study showed that there was a significant difference between the weight loss of the male group and the weight loss of the female group before and after acupuncture, there was a significant difference between the decrease in waist circumference of the male group and the decrease in waist circumference of the female group before and after acupuncture. The conclusion that the conclusion of acupuncture intervention significantly reduced weight and waist circumference in both men and women (Alpert et al., 2020).

Acupuncture therapy has various health benefits. In addition, there have been many studies that support the effectiveness of this therapy in treating diseases or maintaining health, one of which is lowering cholesterol (Salma, 2024). Hypercholesterolemia is a medical condition characterized by an increase in the lipid profile of any or all lipoproteins in the blood where total cholesterol levels exceed 200 mg/dl or above the normal threshold. Several factors that cause increased cholesterol levels in the body are genetic factors, dietary habits of saturated fat, obesity, age and gender, smoking and lack of exercise. In this case study of hypercholesterolemia, the patient received therapeutic treatment using acupuncture and herbal therapy methods. The points used for acupuncture therapy are ST-40 Fenglong, SP-6 Sanyinjiao, KI-3 Taixi and KI-7 Fuliu, as well as herbal therapy, namely with a decoction of rosella flower petals (*Hibiscus sabdarifa* Linn.). Acupuncture therapy was carried out 12 times, once every 2 days for 24 days. The results of therapy showed that total cholesterol levels as the main complaint decreased, namely before therapy 286 mg/dL and after therapy 261 mg/dL. Other complaints such as dizziness, heavy and sore legs, pain in the waist, and fatigue felt by patients also decreased (Mauliddya, 2020). A meta-analysis by Xue-Song et al. (2020) regarding acupuncture and other therapies for dyslipidemia, showed a decrease in total cholesterol, triglycerides, LDL, and increased HDL levels after 12 sessions of acupuncture therapy with the most widely used modality being thread implant acupuncture followed by manual acupuncture and electroacupuncture. Based on a study conducted by Cha & Park (2019) regarding the effects of ear acupressure on obesity, significant results were obtained in reducing total cholesterol and LDL levels, this is possible due to an increase in β-endorphin levels in blood plasma after ear acupressure. A clinical trial conducted by Taha et al. (2021), comparing the effects of electroacupuncture and sham electroacupuncture on hyperlipidemia in NAFLD patients showed that there was a decrease in total cholesterol, LDL and triglyceride levels in the electroacupuncture group that received therapy 3 times per week for 6 weeks. The points used were LR14, LR3, ST36 and GB34, using continuous waves, a frequency of 5 Hz, and an intensity adjusted to patient comfort for 20 minutes. The mechanism of action of acupuncture explained in the study is that electroacupuncture can improve liver function and reduce lipid levels in NAFLD patients. The results showed that acupuncture intervention was effective in significantly lowering cholesterol levels, both in men and women. Acupuncture intervention was effective in significantly increasing HDL levels, both in men and women. Acupuncture intervention was effective in significantly reducing LDL levels, both in men and women, but there was no significant difference between the decrease in triglycerides in the male group and the decrease in triglycerides in the female group before and after acupuncture.

Conclusion

Based on the results and discussion, it can be concluded that: two-way ANOVA test showed that the sig value < 0.05 (0.003) then there was a significant

difference between the weight loss of the male group and the weight loss of the female group before and after acupuncture. The conclusion is that acupuncture intervention significantly reduces weight in both men and women. the two-way ANOVA test showed that the sig value < 0.05 (0.002) means there is a significant difference between the decrease in waist circumference of the male group and the decrease in waist circumference of the female group before and after acupuncture. The conclusion is that acupuncture intervention significantly reduces waist circumference in both men and women. The two-way ANOVA test showed that the sig value > 0.05 (0.467) means there is no significant difference between the increase in hemoglobin in the male group and the hemoglobin in the female group before and after acupuncture. The results of the Kruskal Wallis Test showed that the sig value > 0.05 (0.942) means there is no significant difference between the decrease in leukocytes in the male group and the decrease in leukocytes in the female group before and after acupuncture. the two-way ANOVA test showed that the sig value < 0.05 (0.000) means there is a significant difference in cholesterol levels in both men and women before and after acupuncture. The sig value for gender > 0.005 (0.263) which means that gender does not have a significant effect on cholesterol levels. Conclusion Acupuncture intervention is effective in significantly lowering cholesterol levels, both in men and women. The two-way ANOVA test showed that the sig value < 0.05 (0.000) means there is a significant difference in HDL levels in both men and women before and after acupuncture. The sig value for gender > 0.005 (0.865) which means that gender does not have a significant effect on HDL levels. Conclusion Acupuncture intervention is effective in increasing HDL levels significantly, both in men and women. the two-way ANOVA test showed that the sig value < 0.05 (0.000) means there is a significant difference in LDL levels in both men and women before and after acupuncture. The sig value for gender > 0.005 (0.515) which means that gender does not have a significant effect on HDL levels. Conclusion Acupuncture intervention is effective in significantly reducing LDL levels, both in men and women. The results of the Kruskal Wallis Test showed that the sig value > 0.05 (0.942) means there is no significant difference between the decrease in Triglycerides in the male group and the decrease in Triglycerides in the female group before and after Acupuncture.

Author Contributions

This article was written by three people, namely S., S.H.W., and S.B., who have read and approved the published version of this manuscript. Designed the study and analyzed the data, while S. and S.B. carried out the laboratory work. S.H.W. wrote the manuscript. They drafted the original manuscript, prepared the introduction, results, discussion, methodology, and conclusions. S. and S.B also contributed ideas for the research process, data processing, translation into English, review, and editing. All members of the research team collaborated on each stage until this article was completed.

Conflicts of Interest

This research is conducted to provide information to the public regarding the research that has been conducted so that it can be used for educational purposes. in addition, this research is used by researchers for lecturer performance loads and accreditation needs of study programs and institutions.

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