

The Association between Body Composition and Obesity-Related Conditions of University Male Sumo Wrestlers

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Abstract- The purpose of this study is to clarify the obesity-related problem in university sumo wrestlers by analyzing their blood biochemical values. Subjects were 18 university male sumo wrestlers. Their ages ranged from 18 to 24 years with average of 20.3 ± 1.5 years. The measurements were derived from anthropometric parameters and blood biochemistries such as glucose, total protein, albumin, triglycerides, total cholesterol, HDL cholesterol, AST, ALT, γ GTP and uric acid in serum. Subjects were divided into two groups (light bodyweight group and heavy bodyweight group) according to their bodyweight by median. The prevalence of obesity, hyperglycemia, hyperlipidemia, fatty liver, and hyperuricaciduria in university sumo wrestlers were high compared with general population. This tendency was observed in both groups, though it was more notable in the heavy bodyweight group than in the light bodyweight group. It suggests that their nutritional intakes were excessive and inadequate in terms of their health management, leading to the increased risk of lifestyle diseases in the future. Our results suggested that it was important for sumo wrestlers to manage the amount of daily training and nutritional intake appropriately, and to increase bodyweight not by building up the body fat, but by trying to increase the muscular tissue.

Keywords- Sumo Wrestler; Obesity; Obesity-Related Conditions; Fatty Liver; Lifestyle Diseases

I. INTRODUCTION

Due to a high prevalence of obesity in retired and active

sumo wrestlers, their life spans are known to be shorter compared to the general population. The obesity is progressed after they retire from the career, when the amount of physical exercise becomes considerably less for the amount of dietary intake, which is difficult to reduce. As they face difficulty in adjusting with restricted diet that matches the amount of physical exercise, obesity is accelerated leading to lifestyle diseases in many retired sumo wrestlers ^[1]. It applies not only to retired professional sumo wrestlers, but also retired amateur sumo wrestlers whose physical exercise is decreased dramatically after retirement.

For many years, heavy bodyweight of any sumo wrestlers has been considered extremely important during the sumo tournament to achieve a strong and stable initial charge with the opponent, also known as *tachiai* ^[2]. For this reason, even coaches often asked sumo wrestlers to put on some extra weight as well as the ordinary sumo training. However, like famous sumo wrestlers including *Chiyo-no-fuji* and *Asa-shoryu*, sumo wrestling in recent generation tends to focus more on speed of movement rather than bodyweight. Also, it has been revealed that obesity is one of the major bases for causing lifestyle diseases, which causes 3/4 of death in Japanese populations. Thus, we have to consider the health consequences carefully before promoting the weight gain to sumo wrestlers.

Obesity-related conditions such as hyperglycemia, hyperlipidemia, fatty liver, and hyperuricaciduria can

become the bases of lifestyle diseases ^[3, 4]. They were also considered to be the specific factors that shorten lifespans of professional and amateur sumo wrestlers ^[5-7].

In spite of medically-proven facts and background of diseases and conditions, association between obesity and obesity-related conditions in sumo wrestlers have yet been thoroughly investigated.

In the present study, we have investigated the prevalence of obesity-related conditions such as hyperglycemia, hyperlipidemia, fatty liver, and hyperuricaciduria in university male sumo wrestlers. Subjects were young male university sumo wrestlers who were expected to be too young to develop any lifestyle diseases. The main purpose of this study was to establish preventive methods and appropriate health management for young sumo wrestlers.

II. SUBJECTS AND METHOD

A. Subjects

Subjects were 18 male university students who were in the sumo wrestling team at the Nippon Science University.

Table I shows the number of subjects according to bodyweight groups. Their ages ranged from 18 to 24 years with average of 20.3 ± 1.5 years.

TABLE I NUMBER OF SUBJECTS IN EACH WEIGHT CLASS

Weight class	Number of subjects
-75kg	1
-85kg	3
-100kg	3
-115kg	3
-135kg	4
+135kg	4
Total	18

As shown in Table II, their average height was 176.2 ± 6.0 cm, bodyweight was 113.2 ± 27.2 kg, body fat percentage was $21.7 \pm 7.1\%$, fat-free mass was 87.0 ± 13.5 kg and body fat mass was 26.2 ± 14.4 kg (all shown as average value $\pm$ S.D.).

TABLE II BODY COMPOSITION AND BLOOD BIOCHEMICAL VALUES IN EACH BODY WEIGHT GROUP

	Light bodyweight group	Heavy bodyweight group	All subjects (Average)
Bodyweight (kg)	90.8 $\pm$ 8.6	135.6 $\pm$ 19.1***	113.2 $\pm$ 27.2
Height (cm)	172.9 $\pm$ 3.5	179.6 $\pm$ 6.2*	176.2 $\pm$ 6.0
BMI	30.5 $\pm$ 3.6	42.1 $\pm$ 5.4**	36.3 $\pm$ 7.4
Body fat percentage (%)	15.7 $\pm$ 2.7	27.6 $\pm$ 4.6**	21.7 $\pm$ 7.1
Fat-free mass (kg)	76.4 $\pm$ 5.8	97.6 $\pm$ 10.0***	87.0 $\pm$ 13.5
Body fat mass (kg)	14.4 $\pm$ 3.6	38.0 $\pm$ 10.5***	26.2 $\pm$ 14.3
Total protein (g/dL)	7.3 $\pm$ 0.4	7.5 $\pm$ 0.3	7.4 $\pm$ 0.3
Albumin (g/dL)	4.8 $\pm$ 0.1	4.7 $\pm$ 0.1	4.8 $\pm$ 0.1
AST (IU/L)	29.3 $\pm$ 13.7	35.7 $\pm$ 15.7**	32.5 $\pm$ 14.7
ALT (IU/L)	36.8 $\pm$ 18.3	75.6 $\pm$ 50.5***	56.2 $\pm$ 41.9
γ GTP (IU/L)	37.1 $\pm$ 19.4	58.7 $\pm$ 36.4*	47.9 $\pm$ 30.4
Uric acid (mg/dL)	7.6 $\pm$ 1.4	8.1 $\pm$ 1.9*	7.9 $\pm$ 1.6
Glucose (mg/dL)	89.9 $\pm$ 7.1	102.1 $\pm$ 15.0*	96.0 $\pm$ 13.0
Triglyceride (mg/dL)	152.2 $\pm$ 51.3	192.1 $\pm$ 63.5*	172.2 $\pm$ 59.6
Total cholesterol (mg/dL)	187.1 $\pm$ 28.8	201.0 $\pm$ 26.3	194.1 $\pm$ 27.7
HDL cholesterol (mg/dL)	47.1 $\pm$ 12.0	48.2 $\pm$ 5.0	47.7 $\pm$ 8.9

All values are shown as average $\pm$ Standard deviation.

*P<0.05, **P<0.01, ***P<0.0

The current study was approved by the Ethics Committee at Hirosaki University Graduate School of Medicine. The purpose and contents of this study was explained to all subjects and consents were obtained from all participants prior to the investigation.

B. Investigation Method

The investigation was conducted before the sumo training under fasting condition. Their body compositions (bodyweight, body fat percentage, body fat mass and fat-free mass) and blood biochemical values were measured.

1) Body Composition:

After measuring subjects' height, the Body Fat Analyzer (TANITA, Tokyo, Japan) using the impedance method was used to measure bodyweight, body fat percentage and fat-free mass.

2) Blood Biochemistry:

With the subjects sitting comfortably on a chair and their arms at the same level as the heart, blood samples (15 ml) were collected from the forearm vein of each subject in the early morning of the investigation day. The serum was separated from the blood sample by centrifugation for 10 minutes at 3,000 rpm (radius was 12 cm) and kept frozen at -30 °C until analysis.

Levels of glucose, total protein and albumin were measured using the enzymatic method, burette method and BCG method, respectively. Total cholesterol, HDL cholesterol and triglycerides were measured using the enzymatic method. AST and ALT were determined using the UV method (with compliance of JSCC law) and γ GTP was measured according to the JSCC law.

III. STATISTICAL ANALYSIS

Subjects were divided into two groups (light bodyweight group and heavy bodyweight group) according to their bodyweight by median. The comparison between

the two groups was made using the Mann-Whitney U test. The percentage of subjects that showed abnormal values in measured items were also calculated, and were compared between the groups using the χ^2 test. All values at $p < 0.05$ were considered statistically significant.

IV. RESULTS

As shown in Table 2, the average values of triglyceride, ALT and uric acid were above the clinically normal range. The average values of bodyweight, height, BMI, body fat percentage, fat-free mass, body fat mass, AST, ALT, γ GTP, uric acid, glucose and triglyceride were higher in the heavy bodyweight group than in the light bodyweight group.

Table III shows the prevalence of clinically abnormal value. Prevalence of obesity was 38.9%, and the prevalence of subjects with abnormal values was the highest in uric acid followed by triglycerides, ALT, γ GTP and AST (77.8%, 66.7%, 55.6%, 44.4% and 22.2%, respectively). The values were extremely high considering their young age. Such tendency was noted in the heavy bodyweight group than the light bodyweight group, although subjects in light bodyweight group even showed abnormal value in levels of triglycerides, uric acid and ALT (66.7%, 66.7% and 44.4% of subjects, respectively).

Table IV shows the Spearman's coefficients between subjects' body composition items (body fat percentage, BMI and body fat mass) and blood biochemical values (total protein, albumin, AST, ALT, γ GTP, uric acid, glucose, triglycerides, total cholesterol and HDL cholesterol). As a result, glucose showed significant positive correlations with all three items of body compositions ($P < 0.01$ for all). Also, triglyceride showed significant positive correlations with all three items of body compositions ($P < 0.01$ for body fat percentage and $P < 0.05$ for BMI and body fat mass). The level of ALT was correlated with body fat percentage and body fat mass ($P < 0.05$ in all), and the level of uric acid was found to be correlated with body fat percentage and BMI ($P < 0.05$ in all).

TABLE III PREVALENCE OF ABNORMAL VALUES OF OBESE-RELATED CONDITIONS

	Light bodyweight group		Heavy bodyweight group		All subjects	
	%	n	%	N	%	n
Obesity (Body fat percentage $\geq$ 25.0%)	0.0	(0/9)	77.8	(7/9)*	38.9	(7/18)
Hyperglycemia (Serum glucose $\geq$ 110mg/dL)	0.0	(0/9)	33.3	(3/9)	16.7	(3/18)
High triglycerides (Neutral fat $\geq$ 150mg/dL)	66.7	(6/9)	66.7	(6/9)	66.7	(12/18)
High total cholesterol (Total cholesterol $\geq$ 220mg/dL)	11.1	(1/9)	22.2	(2/9)	16.7	(3/18)
High HDL cholesterol (HDL cholesterol $\geq$ 40mg/dL)	33.3	(3/9)	11.1	(1/9)	22.2	(4/18)
High AST (AST $\geq$ 41IU/L)	11.1	(1/9)	33.3	(3/9)	22.2	(4/18)
High ALT (ALT $\geq$ 41IU/L)	44.4	(4/9)	66.6	(6/9)	55.6	(10/18)
High γ GTP (%) (γ GTP $\geq$ 51IU/L)	33.3	(3/9)	55.6	(5/9)	44.4	(8/18)
Hyperuricaciduria (%) (Uric acid $\geq$ 7.1mg/dL)	66.7	(6/9)	88.9	(8/9)	77.8	(14/18)

*P<0.05

TABLE IV CORRELATION COEFFICIENT BETWEEN BLOOD BIOCHEMICAL VALUES AND BODY COMPOSITIONS

	Body fat percentage	BMI	Body fat mass
Total protein	0.290	0.237	0.218
Albumin	-0.198	-0.198	-0.248
AST	0.406	0.394	0.340
ALT	0.536*	0.465	0.474*
γ GTP	0.414	0.403	0.340
Uric acid	0.481*	0.499*	0.459
Glucose	0.699**	0.634**	0.729**
Triglycerides	0.599**	0.557*	0.553*
Total cholesterol	0.331	0.448	0.379
HDL cholesterol	-0.007	-0.085	0.037

Spearman's correlation coefficient

*P<0.05 **P<0.01

V. DISCUSSION

A number of previous researches reported that obesity is the major risk of causing lifestyle diseases [3, 4]. Many researches also indicated that professional as well as amateur sumo wrestlers are at high risk of developing lifestyle diseases [5-7].

As most sumo wrestling competitions do not have weight classes, wrestlers with heavier bodyweight are considered advantageous to win a match [2]. From this reason, many sumo wrestlers aim to plan their dietary intake to purposely increase their bodyweights. In this research, out of 8 subjects whose bodyweights were 120 kg or above (between 120.4 kg and 171.2 kg), 7 of them had body fat percentage of over 25.0%.

The prevalence of hyperglycemia, hyperlipidemia, fatty liver and hyperuricaciduria were higher in the current subjects than in the general population.

In the present study, there are three important results that were observed in blood biochemical values.

Firstly, obesity-related conditions such as hyperglycemia, hyperlipidemia, fatty liver, and hyperuricaciduria tended to increase together with bodyweight.

Secondly, we have to raise an important point that such trend was observed in subjects who are at a considerably young age (average age of 21.1 years). For many years, lifestyle diseases were assumed to occur later in life, as a result of long-term accumulation of inadequate lifestyle in younger age. Thus, the present results strongly suggest that the subjects are at large risk of lifestyle diseases later in their lives.

Lastly, such obesity-related conditions were seen in subjects who are considered light bodyweight for a sumo wrestler and do not seem to be obese from their appearances. It demonstrated how deep the health problem of amateur sumo wrestlers really is, and the need of immediate improvement in their health management.

The results obtained in current investigation revealed a health problem associated with obesity in spite of their young age. Such trend is likely to progress with age, suggesting the possible appearance of lifestyle diseases earlier than general populations. More importantly, it has to be noted that large proportion of subjects in light bodyweight group already showed to have preliminary lifestyle diseases (obesity-related conditions).

In recent years, winning the sumo tournament does not necessarily mean a sumo wrestler needs to be bigger and heavier. Instead, those with more muscle power and speed tend to become a winner. In other words, sumo wrestlers need to have a proficient physical ability that is relative to their bodyweights in order to win a competition. Thus, they must aim to achieve a balanced body tissue between muscle and fat, and it was considered to be essential in determining the outcome of the tournament.

In the present study, one of the subjects who were obese had bodyweight of 130.5kg. However, his body fat percentage was 23.9%, and thus, he was considered to have an ideal body composition. Therefore, it showed a large possibility for sumo wrestlers to increase bodyweight with well-balanced amount of muscle and fat. A key to achieve an ideal body composition for sumo wrestling was suggested to be a well-managed daily training as well as dietary intake, aiming to increase muscle tissues rather than fat tissues. This was considered important not only to polish their athletic skills, but also beneficial for health management and to prevent lifestyle diseases in their later lives.

VI. CONCLUSIONS

The obesity-related problem in university sumo wrestlers by analyzing their blood biochemical values were surveyed in this study. The prevalence of hyperglycemia, hyperlipidemia, fatty liver and hyperuricaciduria were higher in the current subjects than in the general population. Such obesity-related conditions were seen in subjects who

are considered light bodyweight. In conclusion, their nutritional intakes were excessive and inadequate in terms of their health management, leading to the increased risk of lifestyle diseases in the future. It was important for sumo wrestlers to manage the amount of daily training and nutritional intake appropriately, and to increase bodyweight not by building up the body fat, but by trying to increase the muscular tissue.

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