Biochemical and anthropometric profile of obese subjects of different *Prakriti* (Constitution) at Jamnagar District, Gujarat, India

Hetal Amin, Rohit Sharma[1]

Departments of Basic Principles and [1]Rasashastra and Bhaishajya Kalpana, IPGT and RA, Gujarat Ayurved University, Jamnagar, Gujarat, India

Abstract

Background and Aim: Obesity is the most menacing life-style disorder in Ayurveda and it is equated to *Sthoulya*. Concept of *Prakriti* (human constitution) can be applied for manifestation and prognosis of diseases. Therefore in this study, we intend to study the biochemical, anthropometric and skin fold thickness parameters of different *Sharirika Prakriti* (body constitution) in *Sthoulya* subjects.

Methods: *Prakriti* of 106 subjects of *Sthoulya* was assessed as per *Prakriti* assessment proforma. *Vata, Pitta,* and *Kapha Dosha* (bodily humors) dominant *Prakriti* were analyzed according to characteristics found in subjects. Biochemical, anthropometric, and skin fold thickness parameters were measured and interpreted according to individual *Prakriti*. Biochemical parameters were compared in different *Prakriti* subjects.

Results: *Kapha* dominant *Prakriti* subjects were found to have higher serum levels of cholesterol, triglycerides, high-density lipoprotein, low-density lipoprotein and very low density lipoprotein than the other *Prakriti.* Alkaline phosphatase, serum glutamate-pyruvate transaminase, and serum glutamic oxaloacetic transaminase levels were higher in *Pitta* dominant *Prakriti,* but they were within normal range. Subjects with *Vata* dominant *Prakriti* had higher serum levels of protein, albumin, and globulin but they were within normal limits. All these parameters were compared with dominant *Dosha Prakriti* and discussed accordingly.

Conclusion: Dominant *Prakriti* has influence on biochemical, anthropometric, and skin fold thickness parameters of *Sthoulya* subjects.

Key words: Anthropometric, biochemical, obesity, *Prakriti*, skin fold thickness, *Sthoulya*

INTRODUCTION

Sthoulya (~obesity) is one of the most profound public health problems today. Significance of *Sthoulya* as a pathological condition has changed over years from the time of Charaka Samhita (ancient Ayurvedic treatise) to the later authors. This may be due to the prevalence of disease which gradually increased in the course of time.

Understanding this disease from Ayurvedic perspective is the most important need of the present era, as it has reached the pandemic levels and has a great influence on morbidity and mortality. Ayurveda consider *Sthoulya* as a condition of a person, "who on account of the excessive increase of *Meda* (~fatty tissue) and *Mamsa* (~muscular tissue), is disfigured with pendulous, buttocks, belly and breasts; and whose increased bulk is not matched by a corresponding increase in energy."[1] Ayurveda and allopathy, both system of medicines consider obesity as metabolic disorder.[2,3]

Due to the adaptation of modern lifestyle, physical activity has been reduced while the mental work is constantly increasing. Consequently, the diseases caused by psychogenic factors are gaining prevalence. Ayurveda has mentioned some psychogenic causes of *Sthoulya*,[4]

Address for correspondence: Dr. Hetal Amin, Department of Basic Principle, IPGT and RA, Gujarat Ayurved University, Jamnagar - 361 008, Gujarat, India. E-mail: dr.hetal1985@gmail.com

and contemporary researches also reports the same; hence it is considered under the group of psychosomatic disorders.[5]

Undoubtedly, *Sthoulya* is an incremental threat to the global health and substantial evidence now suggest that obesity is strongly associated with subjects' unhealthy lifestyle, behavioral patterns, sedentary life, and socioeconomic changes.[6] The World Health Report 2002 of WHO listed obesity under the 10 top selected risks to the health.[7] At present, Gujarat is second largest state in India regarding prevalence of obesity and heart diseases. Every 6 person out of 10 have either generalized obesity or abdominal adiposity.[8] High incidences of *Sthoulya* has been observed at outpatient department (OPD) level in Gujarat Ayurved University, Jamnagar, Gujarat, India. Based on which, necessity for a well-planned regional study was sensed in different *Sharirika Prakriti* (bodily constitution) people on various biochemical, anthropometric, and skin fold thickness parameters of *Sthoulya* subjects.

MATERIALS AND METHODS

Selection of subjects

A cross-sectional study was conducted on 106 *Sthoulya* subjects, attending the OPD and inpatient department of IPGT and RA, Gujarat Ayurved University, Jamnagar, Gujarat, India, from December 1, 2013 to February 28, 2014, after obtaining approval from the Institutional Ethics Committee. The subjects were selected using simple random sampling and written informed consent was taken as per Helsinki declaration after offering sufficient explanations about the study and its aims. All participants were interviewed in the local language by a single person.

Inclusion criteria

Obese participants that had no confirmed mental illness to participate were selected without any bar of age, sex, cast, and religion. The diagnosis was mainly based on the sign and symptoms of *Sthoulya* as mentioned in Ayurvedic and allopathic literature. Participant between age group of 20 and 60 years, with body mass index (BMI) > 25 (BMI = weight in kg/height in m^2) considered as obese were included in the study.

Exclusion criteria

Participants having age group <20 and >60 years, obesity associated with cardiovascular disease, hemiplegia, diabetes, and severe hypertension were excluded from the study. Females with a history of pregnancy and lactation were also excluded.

Assessment of *Prakriti*

Prakriti determination proforma was prepared having *Vata, Pitta,* and *Kapha* characters with reference to anatomical, physiological, and sociological characters, by following *Brihatrayi* (three prime Ayurvedic treatises, viz. Charaka, Sushruta, and Ashtanga Hridaya Samhita).[4,9-11] Assessment was made by analyzing obtained data from filled questionnaire and physical examination of subjects. All anatomical characteristics were assessed by visual and tactile examination. *Vata, Pitta,* and *Kapha* dominant *Prakriti* were analyzed with proforma according to the character found in individuals. Maximum characteristic of any *Dosha* indicates dominant *Dosha Prakriti* of that individual. All calculations and statistics were done with sigmastat software version 3.5.

Procedure

After assessing *Prakriti*, subjects were further divided into three categories, that is, *Vata* dominant, *Pitta* dominant, and *Kapha* dominant *Prakriti*; and afterward biochemical, anthropometric, and skin fold thickness parameters were taken and analyzed.

A volume of 5 ml fasting blood was taken from all the subjects for the estimation of biochemical investigations such as hemoglobin, erythrocyte sedimentation rate (ESR), serum cholesterol, serum triglyceride, serum high density lipoprotein (HDL), low density lipoprotein (LDL), very low density lipoprotein (VLDL), serum urea, serum creatinine, alkaline phosphate (ALP), serum glutamic pyruvate transaminase (SGPT), serum glutamic oxaloacetic transaminase (SGOT), serum protein, serum albumin, and serum globulin. Anthropometric parameters such as height, weight, BMI, circumference of neck, mid arm, fore arm, chest, abdomen, hip, mid-thigh, and mid-calf were recorded. The body fat was assessed by measuring the skin fold thickness by Vernier caliper (Lange's skin fold Vernier caliper [Lange 85300, Texas, USA]). Skin fold thickness of the middle portion of the biceps muscle and triceps muscle, inferior portion of the scapula, thickness of the abdomen, and middle portion of the supra iliac region. The skin fold measurement was carried out bilaterally after exposing the skin properly in above mentioned region. Superficial skin along with subcutaneous fat but except muscles a clinch was made and the proportionate, which is stretched as skin fold was measured by placing it between two points of Vernier Calipers. For all the regions, the mean values of both sides of the body have been recorded.

Groups

Selected subjects were divided into three groups after assessing their dominant *Prakriti*. In Group A: *Vata* dominant *Prakriti* subjects (n = 20), Group B: *Pitta* dominant *Prakriti* subjects (n = 26), and in Group C: *Kapha* dominant *Prakriti* subjects (n = 60).

Statistical analysis of data

The obtained data were analyzed statistically and presented as mean ± standard error of mean. The statistical analysis of data was performed using (IBM SPSS) statistics software version 22.0. The mean value and standard deviation was analyzed by using this software.

RESULTS

A total of 106 subjects (female: 57, male: 49) of *Sthoulya* were studied. *Kapha* dominant *Prakriti* subjects were found to be more prevalent (56.60%) in *Sthoulya,* while *Vata* dominant and *Pitta* dominant *Prakriti* subjects were 18.87% and 24.53% respectively.

Baseline characters related to principle variables viz., age, gender, religion, marital status, occupation, socioeconomic status (SES), *Desha* (habitat), chronicity, family history, addiction, physical activity (*Sharirika shrama*), BMI, emotional makeup, mental stress, sleeping habits (*Nidra*), type of diet (*Ahara*), frequency of food, dietetic incompatibilities (*Viruddh Ahara*), *Satmya* (wholesomeness), *Satva* (mental ability), *Agni* (appetite), *Deha* (body built), *Bala* (physical strength), *Rasapriyata* (liking of taste), *Deha Prakriti* and *Manasa Prakriti* (physical and mental constitution) are depicted in Table 1. Bio-chemical investigations, anthropometric, and skin fold thickness parameters of different *Prakriti* subjects of *Sthaolya* are depicted in Table 2.

DISCUSSION

Ayurvedic literature considers *Sthoulya* as *Kapha* disorder.[1] The present study also proves the higher prevalence of *Sthoulya* in *Kapha* dominant *Prakriti*, indicating their increased susceptibility to *Sthoulya*.

Most subjects belonged to young age group (between 20 and 40 years), which signifies the increasing trend of sedentary life style and changing food habits in Indian youth. Recent reports also support the increasing prevalence of obesity in adolescent age, which is an alarming signal for modern society.[12] According to Ayurveda; in middle age, all body tissues (~*Dhatu*) reach to completeness (~*Paripurnata*). More prevalence was found in female gender, which could be due to faulty dietary and lifestyle habits, hormonal variations (postpartal or menopausal), and more vulnerability to thyroid diseases in females.[13-15] Maximum subjects were of Hindu religion. However, this data may be only a reflection of the demographic predominance of Hindu in this particular region. The religion may not be having major role in etiology of disease.

There is a clear inverse relationship between SES and obesity.[16] In developing countries, obesity can occur only in the prosperous elite. Recent reports highlight the relatively higher prevalence of obesity in middle socioeconomic classes.[17] These reports concord with the findings of the present study. Maximum subjects in the present survey were married. The spousal concordance of poor health (including obesity) among married couples is primarily a phenomenon occurring among households of low SES, whereas high SES couples are relatively untouched. Even as increase in life expectancy can be thought of as a leveling of lifetime health, marital sorting undermines those leveling trends.[18]

Maximum subjects were having day sleep habit. Short sleep duration is associated with higher obesity markers, particularly in female adolescents, which could be due to the combination of increased food intake and more sedentary habits.[19]

Anxiety was found to be maximum in obese subjects. Ayurveda considers anxiety (~*Chinta*) as one of the factors responsible for *Sthoulya* (~obesity).[20] Recent published reports also support the same.[21] Combination of increased stress, binge eating, negative thoughts, poor adherence to weight loss programmes, and reduced social support, could make it difficult for patients with depression to avoid weight gain.[22] Patients with chronic or repeated episodes of depression are at increased risk of subsequent obesity.[23] A study confirmed a link between depressive disorders and obesity that was influenced by lower social and physical activities among the depressed.[24] A study showed increased in prevalence of overweight and obesity among urban adolescents,[25] which is in accordance with the present study.

Majority of subjects had history of *Sthoulya* in their 1st degree relatives and it reflects the hereditary background of the disease. Ayurveda has mentioned that *Beeja Dosha* (defect in gametes) plays a major role for *Medovriddhi* (increase in extra body fat).[4] Defect in part of *Beeja* (~chromosome), which resembles with genes, may lead to defective development of that organ. Ayurveda also opines that increased proportion of *Meda* (~fat) and decreased proportion of *Shukra Beeja* (~spermatozoa) at the time of conception predisposes towards development of stout but weak body.[26] Over nutrition particularly with sweet taste dominant diet during pregnancy is mentioned as a causative factor for birth of obese child.[4]

Majority of subjects were not having habits of exercise or hard physical work. Lack of physical work is one of the major causes of obesity.[27] Along with sedentary lifestyle habits, increased intake of high-calorie starchy foods causes obesity.[28] Therefore, from the present study it is evident that the prevalence of obesity is related to faulty

Table 1: Baseline characteristics, dietary and lifestyle observations of subjects

Characters	Categories	n (%)	Group A (n=20)	Group B (n=26)	Group C (n=60)
Age (years)	20-40	52 (49.06)	11	07	34
	41-60	54 (50.94)	09	19	26
Gender	Male	49 (46.23)	11	08	15
	Female	57 (53.77)	09	18	45
Religion	Hindu	74 (69.81)	17	19	39
	Muslim	32 (30.19)	03	07	21
Marital status	Married	62 (58.49)	16	19	51
	Unmarried	44 (41.51)	04	07	09
Family history	Maternal	77 (72.64)	16	18	46
	Paternal	29 (27.36)	04	08	14
SES	Poor	06 (5.66)	02	03	01
	Middle	77 (72.64)	14	18	45
	Higher middle	23 (21.70)	14	05	14
Habitat	Urban	79 (74.53)	09	19	36
	Rural	27 (25.47)	11	07	24
Physical activity	Routine work	60 (56.60)	15	16	29
	Regular	40 (37.74)	06	04	30
	Irregular	06 (5.66)	00	06	00
Emotional makeup	Normal	38 (35.85)	12	14	12
	Tensile	07 (6.60)	02	03	02
	Depressed	2 (1.89)	00	01	01
	Anxious	59 (55.66)	06	02	52
Sleeping habits	Day	89 (83.96)	20	23	46
Mental stress	Social	72 (67.92)	18	16	38
	Professional	19 (17.92)	01	02	16
	Domestic	15 (14.15)	01	08	06
Water intake	During meals	26 (24.53)	07	15	04
	After meals	80 (75.47)	13	11	56
Type of diet	Vegetarian	71 (66.98)	14	22	18
	Vegetarian+non-vegetarian	35 (33.02)	06	04	32
Frequency of food (per day)	2 times	26 (24.53)	07	04	03
	3 times	49 (46.23)	09	12	28
	4 times	31 (29.25)	04	10	07
Frequent eating in hotels	Regular	62 (58.49)	12	15	35
	Irregular	44 (41.51)	08	11	25
Affliction for fast food and sweets	Yes	94 (88.68)	16	19	59
	No	12 (11.32)	04	07	01
Dietetic incompatibilities	Positive	92 (86.79)	17	20	55
	Negative	14 (13.21)	03	06	05
Diet and sleep timings	Regular	89 (83.96)	17	22	50
	Irregular	17 (16.03)	03	04	10
Awareness about obesity complications	Yes	19 (17.92)	01	05	13
	No	87 (82.07)	19	21	47

Group A: *Vata* dominant *Prakriti* patients (n=20), Group B: *Pitta* dominant *Prakriti* patients (n=26), Group C: *Kapha* dominant *Prakriti* patients (n=60). SES: Socioeconomic status

eating habits and life stye, rather than the quantum of money.

Two times meal in a day is advocated in the Ayurveda for the healthy life[29] and more than this may lead to diseases like *Sthoulya*. Most subjects were taking three meals per day and fond of taking meals regularly outside in hotels, may add to the increased incidence of obesity. Majority of subjects were having water at the end of meals. According to Ayurveda, this habit can lead to *Sthoulya*.[29] The water taken after meals adds to the bulk of the body (due to synergism received by the activated *Kapha*) and consequently leads to extra weight gain.

Maximum participants were unaware of the possible complications of obesity, such as diabetes, hypertension, and cardiac disorders.[30,31] Recent reports also underline this lack of awareness among Indian youth,[32] thus, a need for an educational intervention to create alertness among the community should be highlighted and addressed.

Serum cholesterol, serum triglyceride, HDL, LDL, and VLDL were in the upper limit of normal in *Kapha* dominant *Prakriti* subjects. These three lipid molecules are digested and absorbed by small intestine,[33] and may be compared with *Ama Rasa* (~undigested food substance), which further is converted into chylomicrons.[34] *Ama Rasa*, produced due

Table 2: Bio-chemical, anthropometric and skin fold thickness profile of patients

Parameters	Mean±SD		
	Group A	Group B	Group C
Bio-chemical investigations (in pathological limits)			
Serum cholesterol (mg/dl)	167.54±0.87	169.11±1.45*	171.98±1.29***,#
Serum triglyceride (mg/dl)	112.04±0.78	116.09±1.88*	118.11±1.98**,#
HDL (mg/dl)	34.67±0.08	37.77±0.09*	42.86±1.09***,##
LDL (mg/dl)	108.31±1.04	109.10±1.99*	110.49±2.32*,#
VLDL (mg/dl)	17.43±0.02	20.38±0.07**	24.33±0.09**,##
Bio-chemical investigations (in physiological limits)			
Hb (%)	11.62±2.13	12.55±1.19*	12.55±1.42*,#
ESR (mm/h)	27.67±21.80	27.56±26.62*	25.62±21.25*,#
Blood urea (mg %)	26.25±8.68	25.71±7.52*	23.22±4.94*,#
Serum creatinine (mg/dl)	0.93±0.16	0.84±0.17*	0.90±0.18*,##
ALP (U/L)	61.01±19.42	64.31±20.22**	62.04±21.57*,#
SGPT (U/L)	19.85±17.07	26.50±29.53**	19.31±14.66*,#
SGOT (U/L)	22.05±10.20	25.04±8.70**	21.46±19.05*,#
Serum protein (g/dl)	7.48±0.52	7.15±0.52*	7.25±0.37*,#
Serum albumin (g/dl)	4.08±0.22	4.04±0.15*	4.01±0.14*,#
Serum globulin (g/dl)	3.33±0.32	3.01±0.36*	3.14±0.29*,#
Systolic blood pressure	122.38±11.6	122±5.03*	115.5±3.01*,#
Diastolic blood pressure	85.00±16.26	80.72±3.02*	79.25±5.00**,#
Anthropometric parameters			
Height (m)	1.59±0.08	1.57±0.06*	1.58±0.08*,#
Weight (kg)	76.6±9.48	80.37±10.38**	83.40±10.97**,#
BMI (kg/m2)	31.96±3.54	32.08±3.93*	33.87±4.26*,#
Neck circumference (cm)	35.33±2.24	35.12±2.64*	37.29±2.83*,#
Mid arm circumference (cm)	30.11±1.97	30.88±3.02*	33.52±2.82*,#
Fore arm circumference (cm)	23.88±1.28	24.44±1.01*	27.25±1.34**,#
Chest circumference (cm)	99.17±6.82	99.04±5.04*	105.29±5.04***,##
Abdomen circumference (cm)	105.18±11.67	106.53±9.86*	108.43±6.87**,#
Hip circumference (cm)	112.61±8.09	115.14±9.95**	115.54±7.49*,#
Mid thigh circumference (cm)	49.89±4.78	49.95±5.58*	57.72±4.57**,###
Mid calf circumference (cm)	36.49±4.91	37.69±5.35*	39.19±4.58**,#
Skin fold thickness			
Biceps	0.96±0.01	0.98±0.02**	1.91±0.01*,#
Triceps	2.23±0.07	2.37±0.03*	2.56±0.03*,#
Scapular	2.67±0.05	2.77±0.01*	2.79±0.02*,#
Abdomen	3.77±0.04	3.79±0.03*	3.84±0.21*,#
Supra iliac	3.71±0.03	3.73±0.05*	3.74±0.12*,#

*Comparison with Group A – *($P<0.05$), **($P<0.01$), ***($P<0.001$). #Comparison with Group B – #($P<0.05$), ##($P<0.01$), ###($P<0.001$). Group A: *Vata* dominant *Prakriti* patients (n=20), Group B: *Pitta* dominant *Prakriti* patients (n=26), Group C: *Kapha* dominant *Prakriti* patients (n=60). Statistical analysis was done by one-way ANOVA test followed by *post-hoc* Tukey test among 3 *Prakriti*. Hb: Hemoglobin, ESR: Erythrocyte sedimentation rate, HDL: High density lipoprotein, LDL: Low density lipoprotein, VLDL: Very low density lipoprotein, ALP: Alkaline phosphate, SGPT: Serum glutamic pyruvate transaminase, SGOT: Serum glutamic oxaloacetic transaminase, BMI: Body mass index, SD: Standard deviation

to *Kapha* dominant diet, *Adhyashana* (frequent eating), *Avyayama* (lack exercise), and *Divaswapa* (day-sleep), moves within the body and causes fat deposition, which produces excessive stoutness.[35] Ayurveda opines that decreased level of *Medodhatvagni* (~tissue metabolism) than *Jatharagni* (~digestive power) produces *Ama*, which consequently leads to *Sthoulya*.[35] It is established in recent reports that *Kapha* dominant *Prakriti* persons are more likely to have higher lipid profile values.[36] It was found that the levels of cholesterol, triglycerides, LDL and VLDL tend to increase with age and was higher in *Kapha* dominant *Prakriti.* Hence, life style changes and regular exercise must be followed by *Kapha* dominant *Prakriti* subjects with increasing age.[37]

Kapha dominant *Prakriti* subjects were having greater association of BMI level with anthropometric and skin fold thickness parameters. BMI is the most commonly used measure for monitoring the prevalence of overweight and obesity at population level.[38] As per Ayurveda, due to obstruction of *Srota* (~micro and macro body channels) by fatty molecules, the *Vata* present in digestive tract whips up the *Agni* (~digestive power) and absorbs the food. Excessive eating produces more production morbid fatty molecules, leading to *Sthoulya* and diabetes.[39-42]

Findings of other biochemical parameters of *Sthoulya* subjects also establish a very strong association with dominant *Prakriti* in their physiological limits. Hemoglobin level in *Pitta* dominant *Prakriti* persons was higher, but it

was in physiological limit. It may be because hemoglobin is a part of red blood cells.[43] Ayurveda opines the blood components and *Pitta* are complementing to each other.[44] Hematological differences can also be correlated at gene expression levels. Higher expression of genes which affects hemoglobin levels were found to be strongly associated with *Pitta* compared to Vata, and Kapha.[44,45] No significant findings were found to establish a relation between *Prakriti* and ESR.

Values of liver function enzymes were higher but within the physiological limit in *Pitta* dominant *Prakriti*. This is because the functions of these enzymes have a similar role of transformation of nutrients as *Pitta*[46] and is mainly responsible for digestion and metabolism.[47] Serum protein, serum albumin, and serum globulin were higher but within physiological limit in *Vata* dominant *Prakriti* because all these three have a major function of transportation[48] similar to *Vata.*[20]

Vata dominant *Prakriti* subjects had relatively higher physiological limit of blood pressure. As per the concepts of Ayurveda, vitiated *Vyana Vata* (a type of body humor, running all over the body, responsible for blood circulation) is responsible for the rise in blood pressure.[49] Recent reports have established that the Vata dominant Prakriti individuals have higher physiological limits of blood pressure, pulse pressure, and respiratory rate, which is in agreement with the present study.[50] Therefore, it can be said that, dominant *Prakriti* has influence on the biochemical and anthropometric parameters of *Sthoulya* subjects.

Limitations of the study

The sample size was very small, as only 106 *Sthoulya* subjects were accommodated in the study due to the limited time period. Extensive well stratified studies involving more number of subjects would have given a clearer picture about *Prakriti*. In addition, the present work is only an observational study and suitable diet and lifestyle interventions program as per *Prakriti* could have provided rigid outcomes to the health sector. Nevertheless, a concerted global initiative is required to address the epidemic of obesity in each sects of society, to improve their health conditions.

CONCLUSION

Kapha dominant *Prakriti* subjects were found to be more prevalent (56.60%) to *Sthoulya* as compared to *Vata* and *Pitta* dominant *Prakriti*. Serum cholesterol, serum triglyceride, HDL, LDL, and VLDL were in the upper limit of normal in *Kapha* dominant *Prakriti* subjects. *Kapha* dominant *Prakriti* subjects were having greater association of BMI level with anthropometric and skin

fold thickness parameters. Hemoglobin level in *Pitta* dominant *Prakriti* persons was higher, but it was under physiological limit. Values of liver function enzymes were higher but within the physiological limit in *Pitta* dominant *Prakriti*. *Vata* dominant *Prakriti* subjects had relatively higher physiological limit of blood pressure. Findings on biochemical, anthropometric and skin fold parameters of *Sthoulya* subjects suggest an association with dominant *Prakriti*. *Prakriti* plays an important role in manifestation of disease and adopting personalized approach as per *Prakriti* can help in assessing the susceptible clinical features of each *Prakriti* type and may prove supportive to take preventive measure in arresting the far-reaching ominous clinical impacts of disease. To sum up, the present study is preliminary, but it accentuates the knowledge of *Prakriti* to explore a new dimension of scientific research in diagnosis, selection of the drug or therapy, and prognosis of the disease.

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