Original article:

The effect of Ramadan fasting on sebum production: association with nutritional intakes and sleeping pattern

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Abstract:

Background: Sebum production is associated with several factors including hormonal, and nutritional factors. Sleeping pattern could also affect changes in androgen levels associated with sebum production and acne. During Ramadan, moslems are obliged to fast from dawn to sunset, causing nutritional intake and sleeping pattern changes. ***Objectives:*** This study was aimed to find association between nutritional intake and sleeping pattern during Ramadan with sebum production. ***Methods:*** Ramadan fasting practitioners (40 male, mean age ±SD : 19.19±1.03 years) were evaluted before and 3 weeks into Ramadan fasting. Parameters assessed were nutrient intakes (using 24-hour food recalls), sleep quality and duration (using Pittsburgh Sleep Quality Index) and sleep diary. Sebum productions were measured using Sebutape^{R} technique. ***Results:*** Significant decreases were found in protein (p=0.014), total fat (p=0.031), milkshake(p=0.001) and cheese intakes (p=0.013). Glycemic load was also decreased significantly (p=0.006). Despite no reduction in total sleep duration, night sleep duration was significantly reduced during Ramadan (p=0.000) associated with more subjects with poor sleep quality (p=0.039). Sebum production was increased significantly during Ramadan (p=0.028) ***Conclusion:*** Despite lower glycemic load and dairy products intakes, and lower sleep duration, Ramadan fasting was associated with increased sebum production. It was likely a result of circadian rhythm shift in sebaceous glands activities.

Keywords: Ramadan; fasting; sebum; sleep; nutrition

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Introduction

Sebum is a complex mixture of lipids, which is produced by folliculopilosebaceous unit. Its precise function was not known, but it is suggested that sebum is critical to maintain hydration of the stratum corneum, and it also has mild antibacterial action. Sebum can serve to deliver vitamin E to the surface of the skin, where it protects the skin from oxidation[1,2]. Several factors are suggested as influencing sebum production, e.g. androgens (particularly testosteron and dihydrotestosteron (DHT), melanocortins, peroxisome-proliferator activated receptor (PPAR), retinoids, insulin growth factor-1 (IGF-1), and other factors[1,3–5]. Increased sebum production has been related to oily skin[6] and acne vulgaris[7–9]. Recently, some studies reported the importance of nutritional factors,particularly the glycemic load and milk intake, on acne development and pathogenesis[10–12].

Periods of intermittent fasting were obligatory for adult moslems during Ramadan, the ninth month of Hijri calendar. During this holy month, healthy adult moslems must refrain from drinking, eating, smoking and sexual intercourse from dawn until sunset. There is no restriction in calory intake during Ramadan fasting. However, due to restriction in time of feeding, changes in the number of food and drink consumed

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and sleep pattern might occur [13,14]. Previous studies reported the effect of Ramadan fasting on body weight, blood lipids and blood glucose in population from various geographic regions[13,15,16] .

Ramadan fasting was also reported to affect endocrine system including testosterone levels and IGF-1[17–19]. But it is not clear yet, whether these changes affecting skin sebum production. This study was aimed to explore the effect of the changes of nutritional intake and sleeping pattern during Ramadan fasting on skin sebum production.

Methods

Study Subjects

The study was conducted in 2016 in Yogyakarta, Indonesia. Ramadan of that year was observed from June 6 to July 5, with fasting duration about 13 hours/ day (from around 04.25 to 17.30 local time).

Medical students of the Universitas Islam Indonesia Yogyakarta were recruited according to convenience sampling methods to be study participants. Forty-two male students, age 18-22 years old, gave written consent to follow the study protocol, including full participation in Ramadan fasting. Two of them were excluded from the study, one subject because underwent treatment for acne, and the other because not completed fasting for more than one week due to illness. Three subjects were not included in sleep data analysis because not completed PSQI questionnaires. The study was conducted in accordance to Declaration of Helsinki.

Sleep and Diet Measurements

The sleeping pattern of each participant was measured during the third week of Shaaban (the eighth month of Hijra calendar, month before Ramadan), and the third week of Ramadan.Participants were asked to record sleep activity 3 days before each measurements to quantify mean of total sleep duration. Sleep quality were assessed using Pittsburgh Sleep Quality Index (PSQI) in Indonesian language. PSQI assesses seven components of sleep: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Each component of sleep was scored from 0 (the best) to 3 (the worst), and then summed up to yield a global PSQI score that ranges from 0 to 21. A score >5 is associated with poor sleep quality[20].

Two 24-hour food recall interviews were performed for each measurement week, recording food eaten on weekends and weekdays. Daily glycemic load (GL) values and nutrient analysis were assessed by a nutritionist. Dietary GL were calculated from 24hour food recall by multiplying the quality of carbohydrate in a given food (glycemic index, GI) by the amount of carbohydrate in a serving of that food. The GI and GL values were taken from International Table of Glycemic Index and the Glycemic Load Values: 2008 [21]. If the GI of a food type from Indonesia was not available, then the GI was estimated using similar food of known value.Nutrient intakes were calculated using Nutrisurvey 2007 software with Indonesian Food database. Means of weekly milk and dairy products consumption were estimated from Food frequency questionnaire. Indonesian Table of Food Composition/Tabel Komposisi Pangan Indonesia[22] was used as food composition database.

Sebum excretion rate measurement

Sebum excretion were measured from five area of the face (forehead, right and left cheeks, nose, and chin). The skin were degreased using 70% ethanol pads. After degreasing, Sebutape^{R} (CuDerm, Dallas, TX, USA) were applied for 15 seconds on each designated point. Measurements were made at about the same time in the afternoon. Subjects were instructed not to do vigorous activity or exposed to bright sunlight 3-4 hours before each measurements. Sebutape^{R} cards were immediately scanned after each measurements, with 600 dpi on Canoscan Lide 120 scanner (Canon, Vietnam). Percentage of areas covered by sebum were calculated using ImageJ ver 1.50i (National Institute of Health, Bethesda, MD, USA).

Statistical analysis

Data from measurements were compared using paired samples T-test for glycemic load, total energy intake, macronutrient(carbohydrate, protein, log of total fat, saturated fat) and total sleep durationanalysis. Wilcoxon signed rank test was used for comparisonsof dairy products intake, night sleep duration and sebum excretion. McNemar statistical test was used for comparing sleep quality, while Marginal homogeneity test was used for comparing bedding time. Result was considered statistically significant if p values was≤ 0.05.

Ethical clearance: The ethical clearance for this study was obtained from The Ethical Committe of Faculty of Medicine Universitas Islam Indonesia, Yogyakarta.

Results

The mean age of study participants was 19.9 ± 1.03 years. The mean of body weight at baseline (third week of Shaaban) was 64.79±12.13 kg, and mean of BMI was 22.49±3.97 kg/m2. Based on BMI, 7 subjects were considered underweight (BMI less than

18.5 kg/m2), 24 subjects were normal weight (BMI 18.5 – 24.9 kg/m2), 6 subjects were overweight (BMI 25.0 – 29.9 kg/m2), and 3 subjects were obese (BMI >30.0 kg/m2). The majority (45%) of the subjects said that they had oily skin (Table 1).

Table 1 Baseline characteristics of subjects

	Mean ± SD*	Min	Max
Age (years)	19.9 ± 1.03	18	22
Weight (Kg)	64.79 ± 12.13	47.20	103.10
Height (cm)	169.67 ± 5.64	160	179.10
BMI (Kg/M^2)	22.49 ± 3.97	16.60	34.20
Subjective skin type			
• Dry	1 (2.5%)		
• Normal	10 (25%)		
• Combination	11 (27.5%)		
• Oily	18 (45%)		

*SD = Standard Deviation

Generally, nutrient intakes decreased during Ramadan fasting, except for percentage of saturated fat compared to Shaaban.However, this differences were statistically significant only for protein, total fat and glycemic load (Table 2). Milk and dairy products consumption were not statistically different among measurements, except for milkshake and cheese (Table 3).

Table 2. Diet and macronutrient intake

	Shaaban	Ramadan	*p* value*
	Mean ± SD	Mean ± SD	
Carbohydrate (g)	261.37 ± 96.18	236.47 ± 82.98	0.114
Protein (g)	66.82 ± 21.66	56.44 ± 16.19	0.014
Total fat (g)	76.45 ± 30.92	63.98 ± 29.82	0.031
Saturated fat (% of total fat)	47.93 ± 12.38	50.56 ± 10.23	0.249
Total energy (kkal)	1990.50 ± 637.37	1737.28 ± 570.98	0.072
Glycemic load	164.76 ± 66.25	132.29 ± 53.43	0.006

* Paired sample T-test

Table 3 Milk and dairy products intake

	Shaaban	Ramadan	*p* value*
	Mean ± SD	Mean ± SD	
Milk (mL/week)	626.56 ± 1063.39	517.06 ± 1062.2	0.199
Milkshake/milk smoothie (mL/ week)	300.88 ± 546.49	75 ± 129.22	0.001
Yoghurt (mL/ week)	43.45 ± 67.1	30.58 ± 110.22	0.108
Ice cream (mL/ week)	23.25 ± 40.47	99 ± 471.61	0.156
Cheese (g/week)	11.29 ± 17.64	4.31 ± 7.28	0.013

*Wilcoxon signed rank test

Sleep quality generally decreased during Ramadan (table 4). There was higher proportion of subjects with poor sleep quality (p=0.039). This was probably due to shorter night sleep duration (p=0.000) that could be caused by changes in meal time, religious or social activities. Significant increase were found in means of facial sebum production (Table 4).

Table 4. Sleep and sebum parameters

	Shaaban	Ramadan	*p* value
Sleep quality			
• Good (PSQI ≤ 5)	18 (48.65%)	10 (27.03%)	0.039[a]
• Poor (PSQI > 5)	19 (51.35%)	27 (72.97%)	
Bedding time			
• ≤ 22.00	13 (35.14%)	16 (43.24%)	0.637[b]
• > 22.00 - ≤ 24.00	21 (56.76%)	17 (45.95%)	
• > 24.00	3 (8.18%)	4 (10.81%)	
Total sleep duration (hour)	5.34 ± 1.13	4.98 ± 1.15	0.157[c]
Night sleep duration (hour)	5.61 ± 0.97	4.76 ± 1.1	0.000[d]
Sebum excretion (mean of %area)	3.09 ± 3.16	3.77 ± 3.35	0.028[d]

[a]McNemar test

[b]Marginal homogeneity test

[c]Paired sample T-test

[d]Wilcoxon signed rank test

Discussion

The decrease in nutrient intakes was similar with the result from a systematic review by Sadeghirad et al[13]. This review resumed that about one-third of included

studies reported reduction of energy intake during Ramadan, the majority come from studies conducted in West and Asianpopulations. In Indonesia, one previous study reported significant reduction in energy intake, that related to significant reduction in carbohydrate intake [23]. In contrast with other studies, this study also assessed glycemic load and dairy intake parameters before, and during Ramadan fasting. Previous studies showed that glycemic load and dairy intake were correlated with acne severity and sebum production [12,24–27]. Possible mechanism involved was through the increase of insulin and IGF-1 production induced by high glycemic content of diet [11]. Lower glycemic load found in this study should theoretically correlated with lower sebum excretion.

Shorter night sleep duration found in this study, probably caused by subjects woke up early for suhoor or pre-dawn meal continued with Fajr prayer and other morning activities, or stay up late to do religious or social activities. In Indonesia, some stores and shopping centers were open until late at night during Ramadan. The result was similar with a study by BaHammam[28] in Saudi Arabia, which showed significant reduction in total sleep duration, and also a delay in bedtime and wake-up time. In our study, there was no significant difference in total sleep duration, despite shorter night sleep. This was probably a result of changes in sleep pattern, that the subjects took nap time longer or more frequent during the day of Ramadan to compensate the reduction of night sleep.This changes could probably caused a shift in circadian rhythms of many organs and systems in human bodies.

Some studies reported correlation between sebum excretion rate and sleep parameters, its quality or duration. Bissonette et al[5] reported that sebum excretion rate correlated with duration of night sleep (increase in longer duration of sleep associated with increase in sebum excretion rate) and inversely correlated with free testosteron and 5-alpha reductase expression, butthis correlations were only significant in female. This was intriguing since testosterone is usually suggested as a powerful signaling for sebum production.Other study by Bilgiç et al[29]on female acne patients showed that sebum production level was higher in good sleeper (based on PSQI score) particularly sebum excretion on the T-zone of the face. In male subjects however, due to naturally higher levels of testosterone, the effects of small changes in testosterone probably not as profound as in female subjects. A study by Schmid et al[30]in 15 young, healthy men, found that reduced duration of night sleep that started early and ended before dawn (the similar situation in this study) wasassociated with significant reduction in testosterone level. Theoretically, the implication should be a decreased sebum production.

In this study, we found a significant increase in sebum production during Ramadan fasting (Table 4). This result was interesting, because it was not in accordance with lower glycemic load, lower dairy intake and lower night sleep durationshowed during Ramadan. Subgroup analysis of sebum production between poor sleepers and good sleepers during Ramadan did not found significant difference (mean difference -0.07±0.74, p=0.927, independent sample T-test). Subgroup analysis among 3 different bedtime groups were not significant either (p=0.541, oneway ANOVA).

One possible explanation of the sebum increase is related to circadian rhythm changes of the sebaceous glands. Sebum production of sebaceous glands follows circadian rhythm with peak at 12.00 and additional peak at 4.00 in healthy women[31]. It has been described that normal circadian rhythms were disrupted during Ramadan fasting[32]. Nevertheless, a studyfound that when caloric intake, sleep time and also environmental factors (light) were controlled, there was no significant change in melatonin levels as a marker of circadian rhythm disruption[33]. In our study, subjects were not confined in controlled environment so that many environmental factors other than nutritional intake and sleep were not controlled. These factors could be the reason of the changes of sebaceous glands production.

The wide range of standard deviation in results of this study showed the failure to recruited sufficient size of subjects for the study. This limitation dissappointedly made this study failed to reach firm conclusion. However, the result of this study does suggest that there were changes in skin physiology that occur in association with Ramadan fasting.

Apparently, the effects of lowering glycemic load and dairy products intakes, and changes in sleeping pattern were attenuated by other factors causing changes in circadian rhythm of sebaceous glands production. Further studies with larger number of subjects and better control in factors associated with circadian rhythm shift are needed to reveal the correlation.

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Conflict of Interest and Funding Disclosure

The authors declare that they have no conflict of interest.

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Author's contribution:

Data gathering and idea owner of this study, Study design, Data gathering, Writing and submitting manuscript, Editing and approval of final draft, all events done by all the authors.

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