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Contribution of Coconut Fat to the Daily Calorie and Fat Intake of Adult Women from Rural Settings in Sri Lanka

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ABSTRACT

Background: Coconut is a major ingredient in habitual South-Asian diets including Sri Lanka and is a major source of fat. Reliable and recent information on dietary energy and macronutrient intakes and coconut consumption levels are lacking.
Aim: This study aimed to assess the dietary energy and macronutrient intake and the contribution of coconut to the energy and fat intake of women in rural settings in Sri Lanka.
Methods: A cross-sectional survey was conducted with 408 women (age: 33 ± 6 years) living in rural settings. Nutrient intakes were determined using 24-hour recalls. Socio-demographic and lifestyle characteristics, perceptions, and practices of coconut consumption were collected by an interviewer-administered questionnaire. Habits of coconut consumption were assessed by a food frequency questionnaire.
Results: The daily energy intake of women was 1765 ± 390 kcal/d and the fat intake was 46 ± 18 g/d, which accounted for 23 ± 7% of the total energy intake. The polyunsaturated: saturated fat (P:S) ratio was 0.08. Coconuts contributed to 14 ± 6% of the total energy, 54 ± 21% of the total fat, and 68 ± 26% of the total saturated fat intake. Coconut milk was the major source of coconut fat (33 ± 20%) in their habitual diet followed by coconut scrapes (15 ± 14%) and coconut oil (6 ± 8%).
Conclusions: Coconut contributes to more than half of the total fat and two-thirds of the saturated fat in the high saturated-low polyunsaturated fat diet of women in the rural setting in Sri Lanka. Coconut milk is the major individual contributor of fats.

INTRODUCTION

Coconut palm (*Cocos nucifera*) is one of the major plantation crops in tropical Asian countries including Sri Lanka, India and the Philippines. Almost all the lipids in coconut are present in its kernel. Coconut oil, milk, and scraped or ground flesh are the main coconut products used for culinary purposes. Approximately 92% of the total fatty acids in coconut oil comprises of saturated fatty acids (SFA), in which 63.3% is medium chain triglycerides (MCT) and the most abundant fatty acid is lauric acid (12:0) (Chempakan, 1992). Coconut is a poor source of mono-unsaturated fatty acids (MUFA) and poly-unsaturated fatty acids (PUFA), while oleic (18:1) and linoleic (18:2) acids are the only MUFA and PUFA present in considerable amounts (Perera, 2002).

National-level data on dietary coconut fat (CF) consumption among Sri Lankans is not available. According to a consumer demand report, approximately 10-20% of the total energy in an average Sri Lankan diet is derived from coconut, which is second only to the staple, rice (Samarajeewa and Gunathilake, 2002). Dietary intake studies conducted about two decades ago have shown that Sri Lankans consumed nearly 60% of their dietary fats from coconut (Alahakoon and Silva, 2003; Marambe, Silva, and Sivakanesan, 2005). The mean CF consumption of people in a rural coconut growing area in Sri Lanka was 37.6 ± 18.9 g/d, which contributed to 15.9 ± 5.4% of the total energy and 78.4 ± 12.3% of the total saturated fat intake (Marambe, Silva and Sivakanesan, 2005). However, the dietary habits and CF consumption levels of the Sri Lankan community may have changed over time with the socio-demographic changes, nutrition transition, and changes in economic systems in the recent past.

An increase in per capita availability of food, especially, animal protein and fat as well as plant oils and hydrogenated fats, might have changed the percentage contribution of CF to the daily energy intake (Jayatissa, Wickramasinghe and Piyasena, 2014; Wijesekere, 2015). In addition, the increase in consumption of imported oils such as palm and sunflower oils and the negative perception regarding CF about increasing cardiovascular disease (CVD) risk (Eyres *et al.*, 2016) might have also influenced the coconut consumption in the recent past. However, CF is still one of the significant sources of saturated fat in the diets of Sri Lankans. Thus, it is an important dietary component to modify for the reduction in saturated fat consumption combating the epidemic of chronic non-communicable diseases. Therefore, it is a timely need to update the local literature on the contribution of CF to the total energy and fat intake as well as the perceptions and practices of coconut consumption among Sri Lankans. The findings will support understanding the required dietary modifications to address the growing prevalence of obesity and other chronic diseases such as CVD and diabetes. Therefore, the present study was conducted to assess the daily macronutrient intake, CF consumption, contribution of CF to the total energy and fat intake, and the perceptions and practices of coconut consumption among women in rural settings in Sri Lanka.

MATERIALS & METHODS

Study design

A cross-sectional survey was conducted among non-pregnant, non-lactating, and apparently healthy adult women at the age between 20-55 years, whose dietary habits were not compromised due to uncontrolled non-communicable diseases and who resided in purposely selected two rural settings in Sri Lanka during 2015 and 2016. A sample of 245 women from the Matale Divisional Secretariat in Matale district of Central Province and 163 women from a community living in rubber plantations in Mathugama Divisional Secretariat of Kalutara district in the Western Province of Sri Lanka were recruited.

Ethical approval was obtained from the ethics review committee of the Faculty of Livestock, Fisheries & Nutrition, Wayamba University of Sri Lanka (No. 201509H102) and it was conducted adhering to the ethical principles. Subjects were interviewed at their homes and

written consent was obtained from all participants before the data collection.

Data collection tools and measurements

Information on socio-demographic characteristics such as age, level of education, and lifestyle characteristics were obtained by a pre-tested, interviewer-administered questionnaire. Information on weekly household coconut consumption, monthly coconut oil intake, knowledge and perceptions of the subjects on coconut consumption, and their cooking practices were also collected.
From each subject, a single 24-hour recall was taken via an in-depth interview for food items, preparation methods and quantity eaten. The subjects defined the food quantities eaten using household food measures and those quantities were converted into grams. A qualitative Food Frequency Questionnaire (FFQ) was used to collect data on CF consumption frequencies. The questionnaire consisted of common foods that are prepared with CF, which includes coconut milk, scrapes, or oil.

Data analysis

The dietary intakes of energy and macronutrients of the subjects were determined by analyzing the 24-hour recalls using the modified version of Foodbase 2000 software (Institute of Brain Chemistry and Human Nutrition, UK) (Thamilini, Silva and Krishnapriya, 2014), which consists of nutrient compositions of local food dishes. The percentage contribution of CF to the daily energy intake was calculated as: [(energy intake from coconut/ total energy intake) * 100%]. The percentage contribution of CF to the daily total fat intake was calculated as: [(CF intake/ total fat intake) * 100%]. The percentage contribution of CF to the daily SFA intakes was calculated as: [(SFA from CF/ total SFA intake) * 100%]. Amounts of CF contained in various food dishes were calculated separately for coconut scrapes, milk, and oil using the recipes of each mixed dish- for the amounts of each ingredient in the recipe.

The frequency of consumption of coconut-containing dishes was assessed by the FFQ using a frequency scale; daily, weekly, monthly, and rarely (eaten less than once a month). Statistical analysis was carried out using SPSS statistical software, version 15.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

The study population consisted of 408 women with a mean age of 33 ± 6 years. These women were from 408 households, of which the average number of members was four. The majority of the women (52%) attained the education level up to the General Certificate of Education Ordinary Level examination (Grade 11).

Household coconut consumption

The mean daily household coconut consumption in a family of four members was 0.92 ± 0.42 nuts. Coconut was mainly used for coconut milk extraction (0.72 ± 0.38 nuts/d) and the rest was used for coconut scrapes (0.20 ± 0.12 nuts/d) for culinary purposes. The mean household coconut oil consumption was 2.67 ± 1.52 L/month. Coconut oil was consumed by 98.1% of households as their major cooking oil, whereas others consumed different types of oils such as palm oil and sunflower oil.

Dietary energy and macronutrient intakes

Daily energy and macronutrient intakes and the percentage contribution of macronutrients to the total energy intake of women in the rural setting in Sri Lanka are presented in Table 1. Daily energy and protein intakes were 1765 ± 390 kcal/d and 46 ± 17 g/d, respectively. Daily total fat intake (46 ± 18 g/d) has contributed to 23 ± 7% of their total energy intake, of which saturated fat has contributed to 17 ± 6%. The Polyunsaturated: saturated fat (P:S) ratio was 0.08 ± 0.04.

Table 1. Intake of energy and nutrients by Sri Lankan women in the rural settings

Parameter	Daily intake (Mean ± SD) (n=408)
Total energy (kcal)	1765 ± 390
Protein (g)	46 ± 17
Carbohydrates (g)	307 ± 73
Fat (g)	46 ± 18
SFA (g)	32 ± 14
Cis MUFA (g)	5.7 ± 3.2
Cis PUFA (g)	2.4 ± 1.1
Energy from protein (%)	10 ± 3
Energy from carbohydrates (%)	67 ± 8
Energy from fat (%)	23 ± 7
Energy from SFA (%)	17 ± 6
Energy from Cis MUFA (%)	2.8 ± 1.3
Energy from Cis PUFA (%)	1.2 ± 0.4
PUFA: SFA ratio	0.08 ± 0.04

MUFA = Monounsaturated fatty acids, PUFA= Polyunsaturated fatty acids, SFA= Saturated fatty acids, SD = Standard deviation

Energy and fat intake from coconut

Daily energy and fat intake from coconut (coconut milk, oil, and scrapes) and the percentage contribution of CF to the total energy and fat intakes of women in the rural setting in Sri Lanka are presented in Table 2. Overall, CF contributed 14 ± 6% of the total energy, 54 ± 21% of the total fat, and 68 ± 26% of the total SFA intakes of the women in this study. The CF in these diets is derived from coconut milk (14 ± 9 g) followed by coconut scrapes (7 ± 8 g) and coconut oil (2.8 ± 4 g).

Table 2. Contribution of coconut to energy and fat for Sri Lankan women in rural settings

Level of consumption (Mean ± SD)	Coconut milk	Coconut scrapes	Coconut oil	Total
Amount (g)	59 ± 39	21 ± 22	2.9 ± 4.0	
Energy (Kcal)	135 ± 89	75 ± 79	26 ± 36	236 ± 117
Fat (g)	14 ± 9	7 ± 8	2.8 ± 4.0	24 ± 12
SFA (g)	13 ± 8	6 ± 7	2.4 ± 3.3	21 ± 10
Contribution for total energy (%)	8 ± 5	4 ± 4	1.5 ± 2.0	14 ± 6
Contribution for total fat (%)	33 ± 20	15 ± 14	6.3 ± 7.7	54 ± 21
Contribution for total SFA (%)	42 ± 25	19 ± 18	7.6 ± 9.3	68 ± 26

SAF = Saturated fatty acids, SD = Standard deviation

The frequency of consumption of different coconut-containing food dishes by women in the rural setting in Sri Lanka is presented in Table 3. The majority (93%) of women consumed dishes with coconut milk daily whereas the dishes with coconut scrapes (73%) and oil (60%) were consumed weekly.

Table 3. Frequency of coconut product consumption by Sri Lankan women in rural settings

Coconut product	Frequency of consumption (%)			
	Daily	Weekly	Monthly	Rarely or not consumed
Dishes with coconut milk	93	6	1.0	0
Dishes with coconut scrapes	19	73	5.3	3.4
Dishes with coconut oil	34	60	3.8	2.4

Perceptions and practices regarding coconut consumption

Among them, 78% of participants had not restricted either or both coconut oil and coconut milk. The reasons given by them for not restricting were "because it is an ingredient in traditional cooking practice', 'prefer the taste', 'a nutritious food', 'trust on local oil products than the imported oils' and 'easy accessibility to the coconuts and coconut oil'. Those who have restricted coconut milk and/or oil consumption had given the reasons as 'coconut is high in saturated fat and cholesterol which will increase the risk for coronary heart disease (CHD)', 'medical advice to restrict coconut oil consumption', 'its ability to aggravate gastritis and/ or diabetes conditions', 'its ability to increase body weight and pimples', 'dislike of the taste and smell of coconut oil' and ' it is not a healthy oil which affects the overall health'.

During cooking, the first extraction of coconut milk (added only a little water and milk extraction is the richest with CF) was used by all women in the study with no restriction. To get the extraction of coconut milk, water at room temperature was used by the majority (91%), while 3.8% used warm water and 4.8% used both warm water and water at room temperature alternatively. Hand squeezing of coconut scrapes to extract milk was the most common practice among these women (84%), whereas 11% used a blender and 5.8% used both methods alternatively. The household coconut supply was mainly fulfilled through retail purchases (81%) and others obtained coconut from home gardens (9.1%) and received by neighbors and relatives (9.9%).

DISCUSSION

The dietary assessment of women in the present study reveals important information on macronutrient intake, especially dietary fats in Sri Lankan rural population. We assume that the dietary patterns of these women reflect the dietary patterns of the entire household as consumption of home-made food by all the family members is the usual practice in rural settings in Sri Lanka. The energy and protein intake of women in the present study was lower than the Recommended Dietary Allowance (RDA) for Sri Lankan adult women (RDA: 1950 kcal/day and 53 g/day, respectively) (MRI, 2007). Their percentage consumption of energy from protein and fat fell within the recommended ranges of Food Based Dietary Guidelines for Sri Lankans (10-15% and 15-30%, respectively) (*Food Based Dietary Guidelines for Sri Lankans*. 2021). However, the percentage consumption of energy from carbohydrates and SFA was greater than the recommended dietary guidelines (50-65% and <10%, respectively) (WHO, 2003; *Food Based Dietary Guidelines for Sri Lankans*. 2nd edn, 2011).

The percentage of energy consumption from PUFA is significantly lower than the recommendation (6-11%) and the PUFA: SFA (P: S) ratio of the women is notably lower than the recommended value of 1.0. This is potentially due to the high SFA and low PUFA content in CF which includes about 92% of SFA and 2.5% of PUFA (Mendis, 1996). The major source of fat for the study participants was coconut in the present study. It is found that a low P: S ratio of around 0.2 raises blood cholesterol levels and thus, increases the risk

for CHD, whereas higher ratios around 0.8 are associated with favorable effects on blood cholesterol and cardiovascular health (Garrow, James, and Ralph, 2000). Hence, the diet of present study participants comprises unfavorably high levels of SFA and low levels of PUFA, which potentially contribute to elevating their risk of CHD.

Participants of the present study have consumed a major portion of their fat and SFA in the daily diet from CF. The other dietary fat sources such as animal fat (meat, eggs, fish, milk, butter, cheese, etc.) and other vegetable oils (palm oil, sunflower oil) were consumed at lower levels. The contribution of CF to the total fat intake of the women in this study (54 ± 21%) was only marginally lower than the findings of another recent study (59%) in 2005 (Marambe, Silva, and Sivakanesan, 2005). Thus, the consumption of CF has decreased over time, which may be due to several reasons such as the availability of other dietary fat sources in the market, an increase of animal sources of food consumption, urbanization and changes in food habits, a decline of coconut cultivation and the harvest, fluctuations of coconut prices and health concerns on SFA, cholesterol and chronic diseases.

Daily household coconut consumption in this study (0.92 ± 0.42 nuts per day for a family of four) was slightly higher than the general recommendation of one medium-sized coconut per day for a Sri Lankan family of five members (*Food Based Dietary Guidelines for Sri Lankans*, 2021). The highest contribution for daily CF intake of women was from coconut milk (59%) followed by coconut scrapes (29%) and coconut oil (12%). This reflects the Sri Lankan traditional cooking practices that are mainly based on curries made with coconut milk, porridge, and milk rice (rice cooked in coconut milk). Coconut scrapes are mainly used for coconut Sambol (a mixture of coconut scrapes, onion, and chili as key ingredients) and coconut Rotti (a flatbread mixed with coconut) which are frequent components of Sri Lankan diet. Cooking in oil such as frying and tempering was less frequent among this study group and thus, the consumption of coconut oil was comparatively lower than coconut milk and scrapes. This finding emphasizes that limiting the consumption of coconut milk and scrapes, which accounts for nearly 90% of the CF in the diet of women in rural settings in Sri Lanka, is a potential avenue to reduce the high SFA content in their diet.

However, national-level data on the energy, macronutrient intakes and dietary CF consumption levels among Sri Lankans are still inconsistent. Findings from this present study may not adequately represent the national-level nutrient consumption of Sri Lankans due to the limited sample size, and it is possible under or over-reporting due to the usage of a single 24-hour recall as the primary source of data collection. Therefore, there is a timely need for a national-level population survey to assess the CF intake among adults in Sri Lanka and its association with the risk of CHD. It is crucial to recognize the major sources of SFA in the diet to initiate dietary modifications and to develop translational approaches for dietary behavioral change to increase the P:S ratio of Sri Lankans' diet to reduce the risk of CHD.

CONCLUSION

Coconut fat, which predominantly comprises SFA with low PUFA, is the major source of dietary fat among the rural population in Sri Lanka. Coconut milk is the most common component consumed, followed by coconut scrapes and coconut oil. Intake of high SFA and low PUFA were the major concerns in the habitual diet of Sri Lankan women in rural settings. Dietary modifications to reduce SFA and to increase PUFA contents in the diet of the rural population in Sri Lanka are of paramount importance.

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DECLARATION OF CONFLICT OF INTERESTS

The content of this publication is solely the responsibility of the authors and does not necessarily represent the official views of the National Science Foundation of Sri Lanka. The authors declare no conflict of interest.

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