Cloud Publications
International Journal of Advanced Nutritional and Health Science
2017, Volume 5, Issue 1, pp. 234-241, Article ID Med-331
ISSN 2348-5140

Cloud Publications

Research Article **Open Access**

Sensory Characteristics of Papad Prepared using Mushroom Powder

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Publication Date: 20 February 2017

Article Link: http://medical.cloud-journals.com/index.php/IJANHS/article/view/Med-331

Abstract Mushroom cultivation and consumption is increasing in this modern world. Mushroom is a form of plant life and considered as one of the useful and delicious member of the vegetable kingdom. Utilization of dried & powdered oyster mushrooms into traditional foods has increased these days. Papad is the one of most popular Indian snack consumed either after deep-fat frying or roasting and it is one such snack where mushroom powder can be added. For the present study, experimental papads were prepared using oyster mushroom powder at 10% (E1), 15% (E2) & 20% (E3) levels with black gram & green gram dhals. Papads were sun dried and roasted on LPG gas-stove & deep fried and compared with control papad for palatability. Appearance of E3 papad received comparatively lower scores because of darker colour imparted by mushroom powder. E1 & E2 papads were well accepted for all sensory attributes. Mushroom papads prepared in the present study were good in protein, dietary fiber, iron, calcium and phosphorus. It can be concluded that oyster mushroom powder can be incorporated in papad without affecting the sensory quality.
Keywords *Mushroom powder; papad; oyster mushroom; palatability*

1. Introduction

The history of mushroom is as old as the origin of man himself. These have existed for millions of years and are considered as valuable food for flavour and nutrition. Mushrooms have been used by man from time immemorial and their use of culinary purpose is closely related to the history of mankind. In the more affluent countries, mushrooms are considered as somewhat expensive type of vegetables that are eaten almost entirely for their culinary properties, and for providing flavour and/or garnish for other foods (Flegg, 1977).

A need for food protein compels one to explore unconventional protein sources is the single cell protein. Mushrooms are the oldest single cell protein food of man. There is a great demand for edible mushroom for its flavour and nutrient content and therefore, it leads itself to many novel recipes. The most popular varieties of mushrooms are white button (*agaricus bisporus*), paddy straw *(volveriella volvacea*), shiitake (*lentinus edodes*) and oyster *(pleurotus species)*. But mushroom being highly

perishable forces the producer to preserve and process it. In many regions of Europe and Asia, mushrooms are gathered every year in quantities and immediately pickled or salted or dried for use during the winter (Sawaya et al., 1985).

Mushroom is the most priced commodity among vegetables not because of its nutritive value but because of its characteristic aroma and flavor. However, it is now a well-established fact that mushrooms are excellent sources of vitamins and minerals (Khader, 1999). Fresh mushrooms contain about 85-95% moisture content, 3% protein, 4% carbohydrate, 0.3-0.4% fat and 1% minerals and vitamins. They also contain appreciable amount of niacin, pantothenic acid and biotin. In addition, mushroom also contain folic acid and vitamin B_{12} which are absent in most of the vegetables (Ude and Ezenwugo, 2001). It is also good in calcium (3%), iron (1.3%), magnesium (18%), phosphorus (120%) & selenium (2.6%) (http://nutritiondata.self.com/facts/vegetables-and-vegetable-products/3050/2).

Mushroom shows activity against cancer. It has shown antitumor, anti-inflammatory, antiviral and antibiotic activities. The consumption of mushroom-containing diet prevented serum cholesterol increase at the end of four week period and lowered by almost 40% as compared with control group which have not had mushroom in their diet (Ghosh and Chakravorty, 1990). Oyster mushrooms are also suitable additions to the diets of people with obesity, diabetes, dyslipidemia and high blood pressure. This is primarily because these mushrooms are low in sodium and zero in cholesterol. Other health benefits include antioxidant and anti-bacterial properties (Gregori et al., 2007; Cheung, P.C.K., 2010 & http://www.diethealthclub.com/health-food/oyster-mushrooms.html).

Mushroom may be baked, fried, boiled, creamed, roasted, pickled and stuffed. In India, it is mostly consumed fresh. However, where mushrooms can be grown at ambient temperature (i.e. hilly areas) but cannot be transported quickly to consumption places, the only way to its utilization is its processing. They can be processed as canned, dried or frozen mushrooms. The vitamins in mushroom are well retained during cooking, canning and dehydration. The moisture content in dried mushrooms should be between 5 and 8%. Drying of mushrooms is done to remove free water to such a level such that the biochemical and microbial activity are checked due to reduced water activity (Suguna, S. et al., 1995; Lidhoo, C.K. and Agrawal, Y.C., 2006). Dried mushrooms are rich in calories (300%), protein (10%), carbohydrates (80%) & total dietary fiber (10%) (https://ndb.nal.usda.gov). Further their high lysine, leucine, valine and tryptophan content make them good supplement to cereal-based Indian diets (Bano and Rajarathnam, 1988 & https://ndb.nal.usda.gov). These characteristics have made them a very valuable food. Mushroom powder have been used by many researchers for development of variety of food products like mathri & rava idli (Singh, V., and Verma, A., 2013), besan laddoo (Verma, A. and Singh, V., 2014), jam & squash (Lakshmipathy, G. et al., 2013) & biscuits (Wakchaure, G.C. et al., 2010). Regula, J. and Michalowska, G. (2010) successfully prepared cookies & breads with 10 and 20% dried mushroom powder added to the flour & they recommended it as a good quality dietary supplement.

A large section of population consumes papads. Papad is one of the many preserved dehydrated form of foods. Since centuries, papad has been a popular snack item of India and many varieties are available commercially (Saxena et al., 1989). Papads are mostly prepared either on cottage scale or on home scale, some of which have grown into large organized sectors.

This study was undertaken with the objective of developing papad with incorporation of oyster mushroom powder.

2. Materials and Methods

2.1. Procurement of mushroom powder

Dried samples of oyster mushrooms were obtained from Mushroom Research Centre (Jawahar Lal Nehru Agriculture college of Jabalpur). Dried mushrooms were grinded in a mixer grinder and passed through 60 mesh sieve to get very fine powder. Other ingredients were purchased from the local market of Nagpur city, Maharashtra, India.

2.2. Preparation of papad

Standardized recipe of papad was selected from one of the leading Griha Udyog from Nagpur city. Dried mushroom powder was incorporated at different levels (10%, 15% & 20%).

2.3. Composition of papad

Standard method of preparation of papad was used as shown in Table 1. Papads were sundried & stored in airtight container for palatability trials.

Table 1: *Composition of Control and Experimental Papad*

Sr. No.	INGREDIENTS	Quantity (g)			
		Control (C)	Experimental 1 (E1) (10% Mushroom Powder)	Experimental 2 (E2) (15% Mushroom Powder)	Experimental 3 (E3) (20% Mushroom Powder)
1	Black gram dhal	125	115.6	110.9	106.2
2	Green gram dhal	62.5	53.14	48.4	43.7
3	Common salt	7.5	7.5	7.5	7.5
4	Papad khar	5.62	5.62	5.62	5.62
5	Black pepper	7	7	7	7
6	Cumin seeds	3	3	3	3
7	Soda	0.11	0.11	0.11	0.11
8	Asafoetida	0.06	0.06	0.06	0.06
9	Mushroom powder	-	18.75	28.12	37.5
10	Water (ml)	75	80	88	99

2.4. Sensory evaluation of Papad

The sensory characteristics of papads were screened by six trained judges in three trials for consecutive three days. Coded papad samples (roasted on LPG stove & deep fried at 180^0C) were served to the panelists in random order to guard against any bias. Water at room temperature was used to clear the mouth before the each test sample. Scoring was done for maximum score of 10 to a minimum score of 4 for sensory attributes like appearance, texture, flavour, taste and acceptability (Table 2 & 3).

Table 2: Sample *Score Card for Sensory Evaluation of Papad*

Sr. No.	Papad Codes	Trials	Appearance	Texture	Flavour	Taste	Acceptability
1	C	T1					
		T2					
		T3					
2	E1	T1					
		T2					
		T3					
3	E2	T1					
		T2					
		T3					
4	E3	T1					
		T2					
		T3					

Table 3: *Key Sensory Evaluation of Papad*

Sr. No.	Appearance	Texture	Flavour	Taste	Acceptability	Score
1	Very good	Very good	Very good	Very good	Highly acceptable	10
2	Good	Good	Good	Good	Acceptable	8
3	Fair	Fair	Fair	Fair	Fairley acceptable	6
4	Poor	Poor	Poor	Poor	Unacceptable	4

2.5. Nutritive value of papad

Nutritive value of papad was calculated using food composition tables given by Gopalan et al. (2006) & USDA (https://ndb.nal.usda.gov).

3. Statistical Analysis

Results of sensory evaluation were collected and tabulated. Means were calculated. Comparisons between control & experimental papads were done by using students ‘t’ test. A level of significance at both 5 % and 1 % levels was assumed to draw conclusions.

4. Results and Discussion

Figure 1 shows data on moisture content of papads. With increase in the level of mushroom powder, moisture content was also found to be high (14.05 to 15.14 %).

An attempt was made to record absorption of oil in deep fried papads (Figure 2). With increase in the level of mushroom powder in papads, % oil absorption was found to be decreased (from 1.95 to 1.6%).

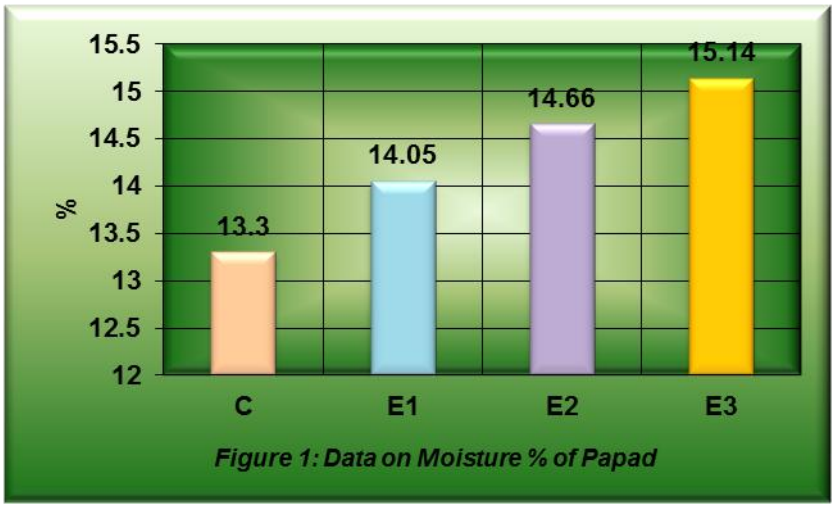

Figure 1: *Data on Moisture % of Papad*

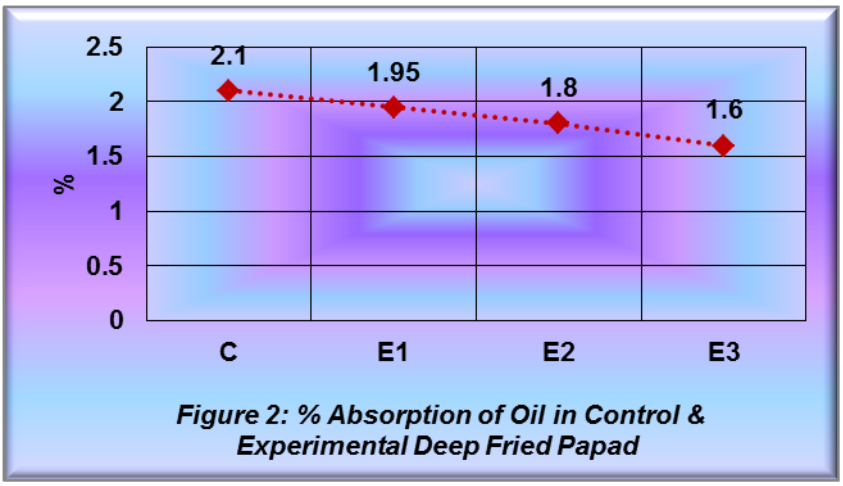

Figure 2: *% Absorption of oil in control & experimental deep fried papad*

Table 4: *Basic Data for Control & Experimental Papad*

Sr. No.	Papads	Water Required for Kneading (ml)	Kneading Time (min)	Weight of Dough (g)	Total No. of Papad	Weight of Papad (g)	
						Raw	After Sun Drying
1	C	90	8.5	282	23	9.0	8.9
2	E1	92	8	286	24	9.2	9.0
3	E2	95	7.5	295.6	24	10	9.2
4	E3	98	7	299.6	25	11	9.4

Increment in the quantity of mushroom powder also increased amount of water required for kneading dough. Yield was found to be also increased (Table 4).

Table 5: *Mean Palatability Evaluation Scores & Statistical Interpretation of Comparison between Various Sensory Attributes of Control and Experimental Papad*

Sr. No.	Sensory Attributes	Mean Palatability Evaluation Scores				t Values		
		C	E1	E2	E3	C vs. E1	C vs. E2	C vs. E3
1	**Roasted Papad**							
i	Appearance	9.5	9.3	8.0	7.8	0.42	2.34*	2.57*
ii	Texture	9.5	9.4	9.4	9.4	0.83	0.19	0.23
iii	Flavour	8.8	8.9	8.9	8.5	0.17	0.16	0.48
iv	Taste	9.5	9.1	9.1	8.3	0.88	1.50	2.52*
v	Acceptability	9.4	8.9	8.9	8.53	1.16	1.37	1.55
2	**Deep Fried Papad**							
i	Appearance	9.4	8.6	7.7	7.6	0.41	2.21*	2.24*
ii	Texture	9.2	9.3	8.9	8.6	0.15	0.73	0.42
iii	Flavour	8.8	8.7	8.5	8.2	0.13	0.46	0.89
iv	Taste	9.7	9.4	9.0	8.4	0.74	1.14	2.43*
v	Acceptability	9.3	9.2	8.76	8.4	0.57	1.06	1.47

*- Signification at 0.05 level but in significant at 0.01 level (0.01<p<0.05)
All the values show insignificant differences at both 0.05 & 0.01 levels (p>0.05)

Appearance of roasted & deep fried E3 papad prepared from 20% mushroom powder received lowest mean scores (7.8 & 7.6, respectively) as compared to C papad (t=2.57 & 2.24, respectively, 0.01<p<0.05, Table 5). Similar results were obtained for comparison between E2 & C papad for appearance. E1 papad prepared using 10% mushroom powder was well accepted for appearance. Lower mean scores for appearance of mushroom papad might be because dark brownish colour imparted by addition of mushroom power. Roasted papad were more acceptable than deep fried papad for appearance (t=0.23 to 1.12, p>0.05).

All experimental roasted & deep fried papads were well accepted for their texture, with insignificantly lower mean scores than control papad (t=0.83, 0.19 & 0.23 & 0.15, 0.73 & 0.42, respectively for comparison for C vs. E1, C vs. E2 & C vs. E3, respectively for roasted & deep fried, p>0.05). Papads were found crisp after roasting & deep frying. Roasted papad received slightly higher mean scores for texture than deep fried papad (Table 5).

Flavour of roasted mushroom papads was found to be acceptable. Insignificant differences between flavour of control & experimental roasted & deep fried papads were noted (t=0.16 to 0.18 for roasted & t=0.13 to 0.89 for deep fried papad, p>0.05). It was noted that addition of 20% mushroom powder was also rated good for flavour. It indicates acceptability of mushroom powder for its flavour. Scores for flavour of roasted papad were found to be slightly higher than deep fried papad.

Increment in the level of mushroom powder in E3 papad reduced the taste profile (t=2.52 for roasted & t=2.43 for deep fried, 0.01<p<0.05). However, E1 & E2 papads were very well accepted for their taste indicating suitability of mushroom powder up to 15% in making papad. Insignificant differences were obtained when control papad was compared with E1 & E2 (t=0.88 & 1.50 for roasted & t=0.74 & 1.14 for deep fried papad, respectively, p>0.05). Control, E1 & E3 deep fried papad rated higher than roasted papad for their taste.

Both roasted & deep fried experimental papads were well accepted when compared with control with very insignificant differences as also clear from Table 5 (t=1.16 for C vs. E1, 1.37 for C vs. E2 & 1.55 for C vs. E3 for roasted papads and t=0.57 for C vs. E1, 1.06 for C vs. E2 & 1.47 for C vs. E3 for deep fried papad).

Table 6: *Nutritive Value of Papad (per 100 g)*

Sr. No.	Nutrients	C	E1	E2	E3
1	Energy (kcal)	324	317	313	310
2	Carbohydrate (g)	55.22	54.43	54.04	53.64
3	Protein(g)	22.15	24.49	24.60	24.71
4	Fat (g)	1.63	1.65	2.14	2.16
5	Crude Fibre (g)	1.44	2.54	3.09	3.64
6	Calcium (mg)	144.2	136.3	132.8	129.0
7	Phosphorus (mg)	129.7	491.7	556.3	621.1
8	Iron (mg)	3.99	3.79	3.70	3.61
9	Sodium (mg)	1457	1454	1452	1451
10	Potassium (mg)	828	1155	1307	1471

Mushroom papads prepared in the present study can serve a very good source of protein, dietary fiber, calcium and phosphorus. Protein content of mushroom found to be increased with increased level of mushroom powder in experimental papad (24.49 to 24.71%) whereas energy & carbohydrate contents decreased (Table 6). Protein content of mushroom fortified rava idli & mathari developed by Singh, V. and Verma, A. (2013) was 12.93 and 8.26%, respectively. The mean values of protein of besan laddoo prepared with 10% & 15% oyster mushroom powder by Verma, A. and Singh, V. (2014) were reported as 9.4 & 9.6%, respectively.

These papads were found to be high in fiber & hence, can serve a very good source for those who need fiber rich diets. Calcium, phosphorus, iron, sodium & potassium content of these papads were found to be good (Table 6). Mushroom fortified papads can be prescribed for vegetarian population like children, pregnant & lactating women & as these are low in fat, these papads can also be recommended for diabetics, obese individuals & also for heart disease patients in roasted form.

For the present study, dehydrated oyster mushroom powder was successfully incorporated in making papads. Papads prepared with 10% & 15% dehydrated mushroom powder did not affect appearance, texture, flavour, taste and overall acceptability. 10%-15% of mushroom powder can be incorporated in papads with black gram dhal and green gram dhal without any significant adverse effect on sensory quality of papads.

Result of present study confirmed the fact that dehydrated mushroom powder can be successfully incorporated without affecting sensory qualities.

Acknowledgement

The author is thankful to Ms. Amita Kawre for her help in preparation of papads.

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Cloud Publications
International Journal of Advanced Nutritional and Health Science
2017, Volume 5, Issue 1, pp. 242-250
ISSN 2348-5140, doi:10.23953/cloud.ijanhs.110

Research Article | Open Access

Diet & Nutrition Profile of Children of Gond and Kharwar Tribes Population of Eastern Uttar Pradesh

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Publication Date: 7 April 2017

https://doi.org/10.23953/cloud.ijanhs.110

Abstract This was a cross-sectional study designed to collect information on dietary intake and food patterns of Gond and Kharwar children of Sonbhadra district. 350 Gond and 307 Kharwar tribal children samples were selected from the rural villages of Sonbhadra district. A pretested food frequency questionnaire and 24 hour dietary recall was used to collect information on food intake and meal pattern. Average daily nutrient intake of tribes children were calculated and compared with recommended dietary allowances (RDA) for Indian. Average daily dietary intake of both Gond and Kharwar tribe's children was found significantly lower when compared with RDA. Mostly cereals were consumed by subjects and are the main source of energy. Daily consumption of milk and milk products was very low. Vegetables and fruits consumption was almost negligible. Their daily diet mostly contains cereals, pulses and little amount of milk and milk product and meat and poultry. Results indicated an overall poor nutritional status among Gond and Kharwar children of Sonbhadra. A very high incidence of under-nourishment was seen among these tribes' children. Nutritional and health professional are required to educate and encourage tribal people to improve intake of milk and milk products, fruits and green leafy vegetables. Improper cooking method and unhygienic food habit was seen in these people.

Keywords *Gond; Kharwar; dietary pattern; dietary intake; food frequency questionnaire; recommended dietary allowances*

1. Introduction

India has the largest concentration of tribal people in the world after Africa. According to census 2011 tribal population of our country is 8.6% of the total population. Most of the tribal population lives in rural areas. It is estimated that approximately 89.99% of them are living in rural areas and only 10.08% in urban areas. Gond is the largest tribe of central India and is popularly known as Gondwana. It is the second largest tribe in India and has the largest tribal population in Uttar Pradesh (census 2011). In Uttar Pradesh Gond percent is 50.16% to the total scheduled tribe's population. Kharwar on the other hand is the second populous tribe in Uttar Pradesh, constituting about 14.16% of the total ST population. In this community majority of population are agricultural labors whereas

very few are workers. The Kharwar tribes have six endogamous groups which are Surajbansi, Daulat bandi Paraband, Kharia, Bhogti and Mauijhia [1].

In the current scenario Gond and Kharwar tribes are not aloof from the outer world. Today these tribal have come in contact with the advance communities. Interaction between them leads changes in their socio-cultural settings [2]. But still these tribes are at a high risk of undernutrition due to their dependence on primitive agricultural practices, poverty, illiteracy and poor personal and environmental hygiene practices. These tribal have lots of traditional beliefs and customs which they are still following. Poor communication facilities and lack of access to healthcare makes their life more miserable. It is very important to understand each tribe's eating habits because their life style is very different from each other and also from others. Usually the habitants of tribes are far away from the rural and urban areas. They mostly lives in dense jungles and near to nature and are still not that much connected to the cities. Interaction between tribal and advanced communities didn't have much influence on their eating and dietary habits. They are still suffering from various food problems as their food habits were different from those living in urban and rural areas. Earlier several studies were conducted by various researchers' showing that their diets are nutritionally deficient [3, 4, 5, 6].

In Sonbhadra district these tribes are still living in deprivation. Still after so many years of independence they are living with no land, no education and no assets. Their economic condition and the standard of living are very low. As most of the young adults of these tribes migrate to the urban areas in search of work so they are aware of a lot of things. But due to their far away habitation from both rural and urban areas and their low economic conditions they are not able to afford it. Gond and Kharwar of Sonbhadra are highly vulnerable to undernutrition, because of their geographical isolation, socio-economic disadvantage and inadequate health facilities. They depend on minor forest produce and manual labour for livelihood. Their food consumption pattern is dependent on the vagaries of nature and varies from extreme deprivation (in the lean seasons) to high intakes (in the post-harvest period).

Little has been published on the diet and nutrition intake of these tribal children. The purpose of this study was to assess the dietary intake and food pattern of Gond and Kharwar tribal children. On the other hand information from this study will be useful in defining nutritional initiatives for these tribal children.

2. Materials and Methods

Three hundred fifty (350) Gond children and three hundred seven (307) Kharwar children in age group 4 to 11 years were selected from various villages of Sonbhadra district. Out of the 350 Gond children 190 children were male and 160 were female where as in Kharwar out of 307, 161 children were male and 146 were female. Villages from rural areas were purposively selected with having larger number of Gond and Kharwar tribes' population. From the entire three Tahsil of Sonbhadra district i.e. Ghorawal, Robertganj and Dudhi villages were purposively selected. One stage cluster sampling method was implied for collecting data. Thus the present investigation has been conducted by using pre tested, structured interview schedule. Visits were made to the selected areas and all available subjects lying in our selection criteria were taken. Two questionnaires were made which include a food frequency questionnaire (FFQ) and a 24-hour dietary recall. These questionnaires were filled in a personal interview and dietary intake data was calculated on all food items and beverages. Food consumption frequency was recorded in terms of cereals, pulses, milk and milk products, green leafy vegetables (GLV), roots and tubers, fruits, meat and poultry, fat and oils and sugars. The average daily nutrient intake was calculated with the help of the food composition tables of Gopalan. In addition to questionnaire food habit and dietary pattern e.g. the consumption pattern of breakfast, lunch and dinner was also recorded.

Statistical Method Data were coded, entered in MS Excel 2007 and unpaired t-test and one sample t-test were used to know the significance of data between the two tribal groups. $P < 0.05$ was considered to be statistically significant.

3. Results

The age range of Gond and Kharwar children was from 4 to 11 years. As shown in Table 1 all children were non-vegetarian (100 percent). This means that all tribal children are taking non-vegetarian food available in their locality. Dietary pattern of these children shows total respondent (100 percent) with a dietary pattern of breakfast+ lunch+ dinner.

Table 1: *Food habit and Dietary pattern of Gond and Kharwar tribal children*

Sr. No.	Particulars	Gond (No. of children)	Gond (%)	Kharwar (No. of children)	Kharwar (%)
1.	**Food Habit**				
	Vegetarian	-	-	-	-
	Non-vegetarian	350	100	307	100
	Eggetarian	-	-	-	-
2.	**Dietary pattern**				
	Breakfast+Lunch+Dinner	350	100	307	100
	Breakfast + Lunch + Evening tea+ Dinner	-	-	-	-
	Breakfast + Mid-morning + Lunch + Evening tea+ Dinner+ Bed time	-	-	-	-

Note: All children from both groups were non-vegetarian and having a dietary pattern of Breakfast+Lunch+Dinner.

Food consumption chart of Gond and Kharwar tribes was given in Table 2 and 3 respectively. From Table 2 we can conclude that Gond children were taking only three food groups daily i.e. cereals (100%) and pulses (32.86%) and milk (59.43%). Half of populations (43.71%) were also taking meat, fish and poultry frequently. But their daily diet is lacking in vegetables and fruits. Only 19.14% children were taking fruits 4-6 times in a week and rest of them (80.86%) were taking it infrequently.

Table 3 shows the frequency consumption of Kharwar tribes, in which we could see that only three food groups were taken on daily basis. Cereals were taken on daily basis by 100% children, pulses by 37.80% and milk and milk products by 29.14%. Fruits and vegetables were taken by very few children on daily basis. Consumption of fruits and vegetables were frequent only in 9.71% and 18.57% of Kharwar children respectively whereas meat, fish and poultry was frequent only in 35.50% and rest of them taking it either occasionally or 3 times a week.

Table 2: *Frequency of consumption from each food group by Gond children*

Food groups	Frequent consumption			Infrequent consumption			
	D %(n)	4-6x/wk %(n)	Total %(n)	<3x/wk %(n)	O %(n)	Never %(n)	Total %(n)
1. Bread and cereals	100(350)	-	100(350)	-	-	-	-
2. Pulses	32.86(115)	67.14(235)	100(350)	-	-	-	-
3. Vegetables	-	14.28(50)	14.28(50)	45.71(160)	25.71(90)	14.28(50)	85.72(300)
4. Fruits	-	19.14(67)	19.14(67)	35.71(125)	48.14(158)	-	80.86(283)
5. Milk and milk Products	59.43(208)	12(42)	71.43(250)	2.86(10)	25.71(90)	-	28.57(100)
6. Meat, fish and Poultry	-	43.71(153)	43.71(153)	29.71(104)	26.57(93)	-	56.29(197)
7. Soft drinks, sweets and beverage	-	18(63)	-	24.86(87)	57.14(200)	-	82(287)

D: Daily, n: total number of respondents, 4-6x/wk: 4-6 times per week, O: occasionally, <3x/wk: less than three times per week

Table 3: *Frequency of consumption from each food group by Kharwar children*

Food groups	Frequent consumption			Infrequent consumption			
	D %(n)	4-6x/wk %(n)	Total %(n)	<3x/wk %(n)	O %(n)	Never %(n)	Total %(n)
1.Bread and cereals	100(307)	-	100(350)	-	-	-	-
2. Pulses	37.80(109)	62.54(182)	94.78(291)	4.57(16)	-	-	4.57(16)
3. Vegetables	-	18.57(65)	18.57(65)	12(42)	52.86(185)	4.29(15)	69.14(242)
4. Fruits	-	9.71(34)	9.71(34)	32.86(115)	45.14(158)	-	78(273)
5. Milk and milk products	29.14(102)	12.86(45)	42(147)	17.14(60)	24.29(85)	4.29(15)	45.71(160)
6. Meat, fish and Poultry	-	31.14(109)	35.50(109)	33.71(118)	22.85(80)	-	56.57(198)
7. Soft drinks, sweets and beverage	-	15.43(54)	-	38(133)	34.29(120)	-	72.29(253)

D: Daily, n: total number of respondents, 4-6x/wk: 4-6 times per week, O: occasionally, <3x/wk: less than three times per week

Average daily consumption of all food groups of Gond and Kharwar were calculated. For calculating this we first classified all children (4 to 11 years) into three group's i.e. 4 to 6, 7 to 9 and 10 to 12 years. This categorization is in line with RDA guidelines as children within each group have same dietary requirement. While comparing average daily consumption of food groups between Gond and Kharwar children aged between 4 to 6 years the difference was found significant in all groups except in roots and tuber and other vegetables as shown in Table 4. Whereas children aged 7 to 9 years, it was not found significant in 3 food groups (roots and tubers, other vegetable, fats and oils).

Table 5 shows the average daily consumption of children aged 10 to 12 years of both tribes. It was found highly significant except for one food group i.e. roots and tubers. From the mean of all food groups given in table we can say that the intake of Kharwar children was low as compared to the Gond.

Table 4: *Average daily consumption of food groups by Gond and Kharwar tribal children (age 4 to 9 years)*

Food groups	Gond (4-6 years) N=114	Kharwar (4-6 years) N=99	t-value	p-value	Gond (7-9 years) N=119	Kharwar (7-9 years) N=107	t-value	p-value
Cereals (g)	183.07±24.56	167.67±20.56	4.91	<0.0001*	195.78±31.21	176.78±20.12	5.37	<0.0001*
Pulses(g)	22.45±3.78	18.56±2.45	8.76	<0.0001*	24.34±3.54	21.32±2.56	7.27	<0.0001*
Green leafy vegetable(g)	12.32±5.89	10.67±4.32	2.30	<0.0224*	15.67±6.89	12.67±3.67	4.01	<0.0001*
Roots and tubers(g)	30.65±12.76	27.89±8.98	1.79	0.0734	32.65±15.76	31.45±9.78	0.67	0.4980
Other vegetables(g)	21.76±20.87	18.67±15.43	1.21	0.2265	16.56±22.87	15.87±18.98	0.24	0.8065
Fruits(g)	12.98±12.76	8.76±6.98	2.93	<0.0037*	13.65±12.87	10.56±7.87	2.14	<0.0328*
Milk and milk products (ml)	290.67±20.67	205.67±16.78	32.6	<0.0001*	324.76±45.87	276.45±28.67	9.10	<0.0001*
Fats and oils (g)	6.67±3.76	5.45±5.34	1.94	<0.0529*	7.98±4.98	6.98±5.87	1.38	0.1674
Sugar and jaggery(g)	10.67±4.78	12.43±4.89	2.65	<0.0086*	10.87±5.98	7.87±3.87	4.42	<0.0001*
Animal products(g)	26.87±12.98	21.56±4.76	3.85	<0.0002*	28.56±17.65	29.45±11.65	0.44	0.6588

*** = significant**

Table 5: *Average daily consumption of food groups by Gond and Kharwar tribal children (age 10 to 12 years)*

Food groups	Gond (10-12 years) N=117	Kharwar (10-12 years) N=101	t-value	p-value
Cereals (g)	236.67±23.76	217.56±31.76	5.06	<0.0001*
Pulses(g)	28.65±2.76	25.98±1.23	8.98	<0.0001*
Green leafy vegetable(g)	18.89±5.76	16.56±3.21	3.60	<0.0004*
Roots and tubers(g)	37.78±43.34	36.56±26.45	0.24	0.8059
Other vegetables(g)	20.65±5.78	18.54±3.67	3.15	<0.0018*
Fruits(g)	21.23±4.12	16.87±3.76	8.11	<0.0001*
Milk and milk products (ml)	350.54±45.65	289.67±36.76	10.72	<0.0001*
Fats and oils (g)	6.23±2.32	4.65±3.12	4.27	<0.0001*
Sugar and jaggery(g)	12.87±3.54	16.34±1.65	9.03	<0.0001*
Animal products(g)	30.76±12.87	24.23±15.87	3.35	<0.0009*

*** = significant**

Average daily nutrient intake of both tribes' children aged 4 to 6 years were compared with recommended dietary allowances (RDA) in Table 6. A highly significant difference was seen in between the average daily intake and RDA of both Gond and Kharwar tribe's children for all the nutrients. Means of calorie, protein and iron of both Gond children are 1089.34, 17.56 and 9.34 and Kharwar children are 998.56, 17.56 and 7.45. Average daily intake of calcium is all very low in both Gond (401.21) and Kharwar (354.85).

Average daily nutrient intake of 7 to 9 years children were shown in Table 7. Average daily nutrient intake of Gond children of calorie (1232.12kcal), protein (21.21g), calcium (356.45mg), iron (12.76mg), carotene (1376.4µg), thiamine (0.4mg), vitamin C (24.87mg) and riboflavin (0.4mg) was very less than their RDA. On the other hand average daily nutrient intake of Kharwar children of calorie (1232.12kcal), protein (21.21g), calcium (356.45mg), iron (12.76mg), carotene (1376.4µg), thiamine (0.4mg), vitamin C (24.87mg) and riboflavin (0.4mg) was also very less than their RDA.

Table 8 shows the average daily nutrient intake of boys and girls age 10 to 12 years of Gond tribes. boys average daily intake of calories (1693.75%), protein (31.1%), calcium (401.56%), iron (17.5%), carotene (1900.6%), thiamin (0.3%), vitamin c (21.5%) and riboflavin (0.6%) was very low than their RDA requirement. Again in girls their intake of calories (1424.5%), protein (30.2%), calcium (382.54%), Iron (16.6%), carotene (1610.5%), thiamin (0.4%), vitamin c (21.5%) and riboflavin (0.6%) was also very low than the RDA.

Table 9 shows the average daily nutrient intake of boys and girls of Kharwar tribes aged 10 to 12 years. From the given table we can see that the average daily dietary intake of boys of calorie (1545.76%), protein (30.56%), calcium (354.87%), iron (15.56%), carotene (2190.5%), thiamin (0.6%), vitamin C (18.76%) and riboflavin (0.4%) was very from their RDA. On the other hand intake of girls for calories (1365.45%), protein (29.65%), calcium (354.87%), iron (15.56%), carotene (2190.5%), thiamin (0.6%), vitamin C (18.76%) and riboflavin (0.4%) was also very low in comparison to RDA standards.

Table 6: *Average daily nutrient intake of Gond and Kharwar children (4- 6 years)*

Group	Particular	Calories (kcal)	Protein (g)	Calcium (mg)	Iron (mg)	Carotene (µg)	Thiamin (mg)	Vitamin C (mg)	Riboflavin (mg)
Gond (4-6years) N=114	Average Intake	1089.34±93.67	17.56±2.67	401.21±53.87	9.34±2.23	1698.34±332.65	0.3±0.3	23.34±5.76	0.4±0.2
	RDA	1350	20.1	600	13	3200	0.7	40	0.8
	Difference	-260.66	-2.54	-198.79	-5.66	-1501.66	-0.4	-16.66	0.4
	t-value	29.71	10.16	39.40	17.52	48.19	14.23	30.88	21.35
	p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Kharwar (4-6years) N=99	Average Intake	998.56±99.78	16.45±3.54	354.85±32.65	7.45±2.76	1465.45±242.67	0.4±0.2	21.45±7.67	0.2±0.3
	RDA	1350	20.1	600	13	3200	0.7	40	0.8
	Difference	-351.44	-3.65	-245.15	-7.55	-1834.55	-0.3	-18.55	-0.6
	t-value	35.04	10.25	74.70	20.00	71.11	14.92	24.06	19.89
	p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

RDA Source: ICMR, NIN, 2009

Table 7: *Average daily nutrient intake of Gond and Kharwar children (7- 9 years)*

Group	Particular	Calories (kcal)	Protein (g)	Calcium (mg)	Iron (mg)	Carotene (µg)	Thiamin (mg)	Vitamin C (mg)	Riboflavin (mg)
Gond (7-9 years) **N=119**	Average intake	1232.12±98.56	21.21±4.45	356.45±37.76	12.76±3.59	1376.4±95.6	0.4±0.3	24.87±10.2	0.4±0.2
	RDA	1690	29.5	600	16	4800	0.8	40	1.0
	Difference	-457.88	-8.29	-243.55	-3.24	-3423.6	-0.4	-15.13	-0.6
	t-value	50.67	20.32	70.36	9.84	390.65	14.54	16.18	32.72
	p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Kharwar (7-9 years) **N=107**	Average intake	1065.32±78.98	18.87±5.87	287.32±26.78	10.65±4.76	1198.5±67.7	0.3±0.4	18.76±9.87	0.2±0.4
	RDA	1690	29.5	600	16	4800	0.8	40	1.0
	Difference	-624.68	-10.63	-312.68	-5.35	-3601.5	-0.5	-21.24	-0.8
	t-value	81.81	18.73	120.7	11.62	550.28	12.93	22.26	20.68
	p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

RDA Source: ICMR, NIN, 2009

Table 8: *Average daily nutrient intake of Gond children (10- 12 years)*

Group	Particular	Calories (kcal)	Protein (g)	Calcium (mg)	Iron (mg)	Carotene (µg)	Thiamin (mg)	Vitamin C (mg)	Riboflavin (mg)
Boys (10-12 years) N=62	Average intake	1693.75±56.87	31.1±4.34	401.56±39.56	17.5±3.27	1900.6±54.7	0.3±0.4	21.5±8.45	0.6±0.2
	RDA	2190	39.9	800	21	4800	1.1	40	1.3
	Difference	-496.25	-8.8	-398.44	-3.5	-2899.4	-0.8	-18.5	-0.7
	t-value	68.70	15.96	79.30	8.42	359.78	15.74	17.23	27.55
	p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Girls (10-12 years) N=55	Average intake	1424.75±45.98	30.2±4.87	382.54±31.98	16.6±2.76	1610.5±45.65	0.4±0.2	18.9±9.87	0.5±0.3
	RDA	2010	40.4	800	27	4800	1.0	40	1.2
	Difference	-585.25	-10.2	-417.46	-10.4	-3189.5	-0.6	-21.1	-0.7
	t-value	94.39	15.53	96.80	27.94	518.15	22.24	15.85	17.30
	p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

RDA Source: ICMR, NIN, 2009

Table 9: *Average daily nutrient intake of Kharwar children (10- 12 years)*

Group	Particular	Calories (kcal)	Protein (g)	Calcium (mg)	Iron (mg)	Carotene (µg)	Thiamin (mg)	Vitamin C (mg)	Riboflavin (mg)
Boys (10-12 years) N=56	Average Intake	1545.76±.95.67	30.56±3.76	354.87±89.56	15.56±4.76	2190.5±321.6	0.6±0.3	18.76±4.32	0.4±0.3
	RDA	2190	39.9	800	21	4800	1.1	40	1.3
	Difference	-644.24	-9.34	-445.13	-5.44	-2609.5	-0.5	-21.24	-0.9
	t-value	50.39	18.58	37.19	8.55	60.72	12.47	36.79	22.44
	p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Girls (10-12 years) N=45	Average Intake	1365.45±68.76	29.65±4.21	356.45±45.76	17.56±3.65	1898.8±234.4	0.3±0.5	16.87±4.65	0.4±0.5
	RDA	2010	40.4	800	27	4800	1.0	40	1.2
	Difference	-644.55	-10.75	-443.55	-9.44	-2901.2	-0.7	-23.13	-0.8
	t-value	62.88	17.12	65.02	17.34	83.02	9.39	33.36	10.73
	p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

RDA Source: ICMR, NIN, 2009

4. Discussion

Nutrition during early years of child's life is linked to performance in later years. Effects of nutrition on the brain begin before birth with the nutrition of mother. Early age nutrition is very important for the cognitive development of children. Many aspects of nutrition, from entire diets to individual nutrients, have been implicated in cognition, mental health, dysfunction and disease [7-11]. Tribal populations are more vulnerable to undernutrition as their food intake is influenced by vagaries of nature, with large seasonal variations, depending upon availability of agricultural and forest produce. Several studies have documented a close relationship between the tribal ecosystem and their nutritional status [12-14]. The result of present study revealed that the dietary intake of foods as compared to balanced diets was very poor and less than the recommended level. Calorie, protein and fat are the main source of energy from diet. Gond and Kharwar children diet was deficit in calorie, protein and fat. From our study we can say that their everyday diet include only three food groups which are cereals, pulses and milk and milk products. The extent of deficit in the intakes was relatively higher with respect to micronutrients such as vitamin A, vitamin B_1, vitamin B_2 and iron. The mean intake of all the foodstuffs, especially the income elastic foods such as pulses, milk & milk products, oils & fats and sugar & jaggery were lower than the recommended levels of ICMR. Intake of green leafy vegetables

was very low in both tribes and was highly dependent on roots and tubers. Intake of fruits is almost negligible in tribal children. Tribal children of Sonbhadra are still highly suffering from both stunting and wasting [15]. Our study also reveals that over nutrition is very rare among tribal population.

5. Conclusion

Tribes of Sonbhadra district of Uttar Pradesh are living a life of deprived condition. Poor economic condition makes their life style very poor. They have no lands and no education. Lack of access to healthcare, poor communication, traditional beliefs and customs aggravate the situation. These are main difficulties which haunt them. They are known as backward by the society. Lack of awareness about the nutritional values of food and also about the role of healthy food in growing children is the main cause of under nourishment among them. The overall nutritional status of children of both the tribes is not satisfactory. Average daily nutrient intake of these children was very less in comparison of RDA standards. FFQ shows a very low consumption of vegetables and fruits. Hence the present study reveals a high incidence of under-nutrition and dietary inadequacy in respects of energy, protein and micronutrients.

Acknowledgement

This study was carried out under an on-going Department of Science & Technology (DST) project “Effect of malnutrition on cognitive development of tribal children of eastern Uttar Pradesh with especial reference to psychosomatic constitution”. The authors acknowledge Dr. Grish Singh from the department of Bio-statistic for helping in data calculation.

Financial Support & Sponsorship

Department of Science & Technology sponsored project.

Conflicts of Interest

There are no conflicts of interest.

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Cloud Publications
International Journal of Advanced Nutritional and Health Science
2017, Volume 5, Issue 1, pp. 251-255
ISSN 2348-5140, Crossref: 10.23953/cloud.ijanhs.306

Research Article

Food and Energy Intakes of Adolescent Girls from Different Deprived Communities

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Publication Date: 11 September 2017

DOI: https://doi.org/10.23953/cloud.ijanhs.306

Abstract The increase in energy needs with age reflects increase in the energy needed by basal metabolism, increased activity and increased growth of muscle and adipose tissue. The present investigation was undertaken and with a major objective of assessing the energy intakes of female adolescent girls (10-18 years) residing in rural areas and urban slums of Chittoor District. A group of age matched urban elite girls was also studied who acted as experimental control. The study sample of girls was selected by adopting multi stage sampling technique. The dietary survey of all the subjects was carried out to get food intake data for 3 alternated days in a week and by one day weighing method. Thus mean of 3 days in take was considered and mean of 3 days energy intakes were compared with recommended allowances of ICMR. SPSS 13 was used for statistical analysis, student t-test and analysis of variance was done for comparison among 4 different communities for dietary in takes. Results found that the mean calorie intakes of rural S.C. (RSC) as well as urban slum (USL) were far below the ICMR, RDA values in all age groups. The calorie gap ranges from 347-848 Kcal. Urban elite girls are better in their energy intakes than rural forward caste (RFC), Rural Scheduled Caste (RSC) and urban slum girls (USL). The difference between RDA and the intakes of calories by girls are statistically significant at 1% level. This trend is observed in all age and community groups. The calorie gaps present an important picture that growing girls from 10 years onwards are consuming roughly 500-800 kcal less than the ICMR, RDA. This high gap, calorie insult is an important causative factor for high incidence of chronic energy deficiency, under nutrition and low body weight of girl children. All these girls with poor nutritional status are running with negative energy balance which affects their physical work capacity and their overall nutritional status. Long term interventions are necessary for better in growth and the bio-chemical levels.
Keywords *Chronic energy deficiency; Diet survey; Nutritional status; Negative energy balance; Physical work capacity*

1. Introduction

Growth does continue throughout childhood, however, and must sustain by an adequate supply of nutrients. Children tend to grow in spurts, and so the nutrients available in their diet at all times should be able to meet the demand for nutrients during growth spurts. The dietary standards for children proposed by the food and nutritional board represent the intakes believed to promote optimal health in practically all children in each age-group. In times of rapid growth, these standards are probably providing realistic estimates of the amount of nutrients required. Firm experimental evidence to back

up the dietary standards is available for a few nutrients. Some other standards are based on extrapolation from information on adult needs. The remaining standards simply reflected the level of the nutrients that are known to be consumed by apparently healthy children.

The increase in energy needs with age reflects increase in the energy needed by basal metabolism, increased activity, and increased growth of muscle and adipose tissue. Recommended energy intakes make no distinction between boys and girls until age 11. Several studies, however, indicate that boys as young as 6 have greater energy needs as do girls and that the boys eat more to met their greater needs.

Many water-soluble vitamins are involved in energy metabolism, including thiamin, riboflavin, niacin and pantothenic acid. Accordingly, the needs for many water soluble vitamins increase in proportion to total energy needs. Pyridoxine is required in greater amounts during periods of rapid tissue growth, reflecting this vitamin's role in the use of dietary proteins and the synthesis of new tissue protein. The increase in muscle mass during growth requires that positive nitrogen be maintained. This is usually ensured by daily consumption of 1.5 to 2g of protein per kilogram of body weight. Nutrients involved in blood formation are also important during growth because the vascular system must grow to bring blood to all new cells. This increase in the vascular system demands adequate supplies of iron, protein folate and pyridoxine. Bone growth creates need for calcium, phosphorous, fluoride and vitamin D. The body needs for vitamin A and C is believed to increase during growth because of the involvement of vitamin A in bone growth maintaining epithelial cells involvement of vitamin C in the synthesis collagen.

2. Materials and Methods

The present investigation was undertaken with a major objective of assessing the dietary energy intakes of female adolescent girls (10-18 y) residing in rural areas and urban slums. A group of age matched urban elite girls was also studied who acted as experimental control. The present study aims at purposive sampling of growing girls from deprived communities like rural, rural scheduled caste, urban slum in relation to a control group of urban elite. The deprived castes, age, literacy status, the economic status and the food they eat, the practices they follow form as independent variables which affect and alter the depended variables i.e., growth and development, nutritional status and physical work capacity of girl children. Chittoor District of Andhra Pradesh was selected as the study area.

The district consists of 66 mandals and by random sampling, ten rural mandals were selected. From each mandal, two villages i.e. a total of 20 villages from ten mandals having separate harizanawadas (the place the SC, ST population live) were selected. Further from each village, families consisting girls aged 10 to 18 year old were identified and number was noted both from main village area and harizanawadas of the village. For urban control group (Age matched) high socio-economic families having girls from Tirupati and Chittoor were selected and girl population was identified and noted. The study sample of 10 to 18 year old girls both from rural, SC, ST, urban elite and urban slum were selected by adopting multistage sampling technique. This was done to maintain the characteristic of homogeneity among the sample.

In each village selected (20 villages), the total population of girls from 10 years onwards was surveyed. By following demographic variables the study sample of rural and urban girls were classified into four groups as RFC, RSC, USL and UE. Girls from main village and forward castes form as rural forward caste girls (RFC) and girls from rural SC and ST colonies form as girls of deprived communities (RSC). To match this two groups, urban girls from main urban towns of Tirupati and Chittoor areas of high socio-economic and elite families studying in public schools. The urban elite group (UE) acted as control and girls from different slums and deprived communities of these two urban areas formed as the fourth group as urban slum (USL) covering slum deprived families.

Table 1: *Age wise distribution of experimental subject from four select different communities*

Age in years	Age and number of girls studied from four communities			
	Urban Elite (UE)	Urban Slum (USL)	Rural Forward Caste (RFC)	Rural Scheduled Caste (RSC)
10+	25	30	30	30
11+	25	30	30	30
12+	25	30	30	30
13+	25	30	30	30
14+	25	30	30	30
15+	25	30	30	30
16+	25	30	30	30
17+	25	30	30	30
18+	25	30	30	30
Total no.	225	270	270	270

The selected sample units of 1035 girls covering 9 age groups with an interval of one year i.e., from 10 years to 18 years i.e., 10+, 11+, 12+, …., 18+, etc. From each age group, 30 girls from RFC, 30 girls from RSC, 30 girls from USL and 25 from UE were studied. A total of 115 numbers in each age group were chosen for the study. Thus, a representative sample of 270 from RFC, 270 from RSC and 270 from urban slum (USL) formed as experimental groups covering 9 age groups. Urban elite (UE) group of 225 numbers acted as experimental control group. The distribution of the study sample is presented in Table 1.

Table 2: *Mean caloric intake of rural and urban adolescent girls from different deprived communities. A comparison with urban elite (control) and recommended dietary allowances (ICMR) along with calculated 't' and 'F' values for the differences*

Age (years)	**ICMR RDA Kcal (R_1)**	**Mean Caloric intake (Kcal) and related 't' values against R_1 and between groups**								
		UE Mean	**t value (R_1 vs. UE)**	**USL mean**	**T value (R_1 vs. USL)**	**RFC mean**	**t value (R_1 vs. RFC)**	**RSC mean**	**t value (R_1 vs. RSC**	**$ F value (UE vs. USL RFC, RSC)**
10+	1907	1810.59 81.51±	4.99**	1124.73 ±63.58	16.82**	1332.17 ±53.05	19.35**	1089.92 ±55.51	16.54**	610.22
11+	1956	1825.88 ±82.49	2.73**	1148.93 ±39.21	18.33**	1390.47 ±33.70	10.16**	1109.87 ±16.41	19.49**	1101.13
12+	2032	1863.20 ±42.31	3.40**	1274.07 ±39.30	19.64**	1468.11 ±56.38	18.53**	1166.33 ±28.27	14.37**	174.08
13+	2.37	1891.64 ±48.13	8.38**	1275.87 ±57.96	16.48**	1542.97 ±52.06	12.64**	1288.93 ±28.27	14.37**	174.08
14+	2060	1917.04 ±87.99	9.12**	1359.13 ±30.47	13.32**	1564.73 ±17.35	15.36**	1395.27 ±12.20	20.66**	883.74
15+	2060	1921.16 ±44.32	16.55**	1437.53 ±65.29	17.13**	1575.87 ±82.27	17.52**	1397.27 ±12.20	20.66**	883.74
16+	2060	1932.72 ±44.32	15.48**	1451.80 ±61.39	10.22**	1666.67 ±64.61	11.95**	1591.93 ±16.05	11.95**	850.75
17+	2060	1991.20 ±25.89	11.74**	1651.60 ±65.02	10.50**	1852.40 ±70.94	14.30**	1619.20 ±11.53	14.46**	1480.77
18+	2060	1994.56 ±17.96	18.22**	1678.07 ±74.63	13.88**	1872.83 ±70.53	17.37**	1668.47 ±24.06	11.93**	2010.83

* p<0.05 R1 ICMR, 1972; ** p<0.01 r2 NCHS, 1983

$ - 'F' value obtained from one way analysis of variance for comparison among the means due to the four groups.

Diet surveys are an essential part of any complete study of the nutritional status of individuals or groups. They give useful information on nutrient intake levels, sources of nutrients, food habits and attitudes. The dietary survey of all the households/subjects was carried out to get food intake data for 3 alternate days in a week and by one day weighing method. A standard food weighing machine was used to measure actual food intake in terms of both cooked and raw food weights. Thus, a mean of 3 days intake was considered. Accordingly, nutritive values of the diets were calculated using food values book of ICMR, India (Gopalan et al., 1993). The mean values for all nutrient intakes of girls were compared with recommended dietary allowance of ICMR. SPSS 13 (statistical package for social sciences) was used for statistical analysis. Student t-test was done to find out significant difference with standard values. One way analysis variance (ANOVA) was done for comparison among four different communities.

3. Results and Discussion

The mean caloric intake of rural and urban girls was presented in the Table 2 and compared with RDA (ICMR). The calorie intakes of girls of rural SC (RSC) as well as urban slum (USL) were far below the ICMR, RDA values in all age groups. The caloric gap ranges from 347-848 Kcal. The intake ranges from 1089.92 Kcal to 1994.56 Kcal. Urban elite girls are better in their intakes than RFC, RSC and USL girls. The deficit against RDA in UE girls was lowest i.e. 5.05% to 8.30% where as in RSC girls, it was high 19.00 to 42.84% in all the age groups, respectively. It is observed that among the four different communities, rural horizon and urban slum girls are worst affected and had significantly deficit intakes than RFC and UE girls. At all age levels, the mean in takes of RSC and USL satisfy only 56.73 to 67.82 percent of the caloric commendation. It is clearly evident from the Table no. 2 as age increases, the percent deficit also decrease to some extent.

The differences between RDA and the intakes of calories by girls are statistically significant at one present level. This trend is observed in all the age and community groups. When the girls is at 10 year old, the ICMR, RDA is 1907 Kcal., the intakes by UE was 97 less by ICMR, RDA whereas it was with RFC is 574 and with RSC is 817. These observations clearly indicate that the most affected groups are RFC, next USL and it was RFC, respectively, Comparatively the UE, the control group consuming much better than the other three deprived groups. There was an also significant difference between the caloric intakes of UE, USL, RFC and RSC.

Table 3: *Calorie gap in the intakes of rural and urban adolescent girls' different communities as against ICMR recommended dietary allowances.*

Age (Years)	ICMR RDA (RI) calories (Kcal)	Calorie gap (K. Cat) in the intakes of four different communities as against RDA			
		UE Mean	USL Mean	RFC Mean	RSC Mean
10+	1907	97.00	782.27	574.83	817.08
11+	1956	130.12	807.07	565.53	846.13
12+	2032	168.80	757.93	563.89	865.67
13+	2037	145.37	761.13	494.03	748.07
14+	2060	142.96	700.87	495.87	664.47
15+	2060	138.84	622.47	484.13	662.73
16+	2060	127.28	608.20	399.33	468.67
17+	2060	68.80	408.40	207.60	440.80
18+	2060	65.44	381.93	187.17	391.53

The calculated 6F' values are significant at one percent level between UE vs. USL, RFC and RSC indicating that the control (UE group) consuming calories much better way than the girls from deprived communities. Both the calculated 4t' values of significant for the differences as against ICMR RDA

and ‘F’ values between the groups are significant at one percent level indicating that girls from deprived communities are consuming significantly less than the ICMR and UE.

The calorie gaps are presented in Table 3 on caloric gaps present an important picture that growing girls from 10 years onwards are consuming roughly 500-800 Kcal less than the ICMR, RDA. This high gap, calorie insult is an important causative factor for higher incidence of chronic energy deficiency, under nutrition and for low body weight of girl children. Krishna Swamy, K. (2000) reported out that an average gap of 500 Kcal observed among the poor communities. The principal cause for under nutrition is of course inadequate dietary intake. Owing to the increased demands of growth in adolescence, the dietary intakes of adolescent girls also fall short of the RDA. Computation of dietary intake in adolescent girls’ shows that 25% of them eat less than 70% of requirements of energy; and 15% consume protein less than 70% of the RDA. Kusuma, D.L. (1996) observed that at all age levels, the mean intakes of calories are below the RDA. The intakes satisfy only 67 and 68 percent of the calorie recommendation at 10 and 11 years. NNMB (1972-97) also reported that in the case of energy, the consumption showed a declining trend from 1982, and was below the RDA.

4. Conclusion

From the results, it is to note that income and education are considered to be two of the most important factors influencing nutritional status. In the present study, UE (control) girls influenced their intakes over three different communities. UE girls belonged to better socioeconomic status and better education facilities makes it possible for them to select better foods to meet their personal needs. Well-educated individuals are thought to choose their foods in more informed way. Thus we are able to calorie intakes of girls from different deprived communities. So, that better designs for well targeted nutrition interventions strategies could be established.

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Cloud Publications
International Journal of Advanced Nutritional and Health Science
2017, Volume 5, Issue 1, pp. 256-265
ISSN 2348-5140, Crossref: 10.23953/cloud.ijanhs.322

Review Article

Diabetes Mellitus and Ramadan: Physiopathological, Clinical and Therapeutic Aspects

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Publication Date: 11 November 2017

DOI: https://doi.org/10.23953/cloud.ijanhs.322

Abstract Fasting from dawn to sunset during Ramadan is one of the five pillars of Islam. A significant number of diabetic patients insist on fasting during Ramadan against the recommendations of their physicians. Fasting in diabetic subjects may be associated with increased risk of hypoglycemia and hyperglycemia, diabetic ketoacidosis, dehydration and thrombosis. Patients with uncontrolled diabetes mellitus are predisposed to major metabolic risks. Another problem is the reluctance of diabetic patients in taking their medications during the fast; therefore the timing and the dosage of anti-diabetic drugs must be adapted for each patient. It is important for diabetic patients who wish to fast during Ramadan to effect the necessary preparation to approach the fasting as safely as possible. Up to now, the management of these patients is a challenge for healthcare professionals. The aim of this minireview is that to offer a simple guide for management of Muslim diabetic patient during Ramadan.
Keywords *Diabetes mellitus; Fasting; Ramadan*

1. Introduction

With the worldwide prevalence of diabetes increasing, and the number of fasting Muslims set to rise, the importance of effective guidelines for the management of diabetes during Ramadan fasting is clear.

Ramadan is widely observed across the world. A recent survey in 39 countries involving over 38,000 Muslims reported that a median of 93% fasted during Ramadan (Ghani, 2013).

The Epidemiology of Diabetes and Ramadan (EPIDIAR) study performed in 2001 found that 42.8% of patients with type 1 diabetes mellitus and 78.7% of those with type 2 diabetes mellitus fasted for at least 15 days during Ramadan (Salti et al., 2004). More recently, the 2010 CREED study reported that 94.2% of patients with T2DM enrolled in the study fasted for at least 15 days, and 63.6% fasted every day (Babineaux et al., 2015).

Therefore, Ramadan may have a major impact on the management of diabetes in the Muslim population.

There is a paucity of evidence-based medicine in the field of diabetes management during Ramadan. Indeed, many recommendations are based on expert opinion rather than clinical evidence (IDF-DAR, 2016). Fasting during Ramadan has a number of physiological effects on endocrine processes. In patients with diabetes, these changes and the type of medication being taken to treat the condition can be associated with the development of complications such as hypoglycemia and hyperglycemia (Al-Arouj et al., 2010).

Ramadan fasting not only alters the timings of meals but it may also disturb sleeping patterns and circadian rhythms, all of which can affect a person's metabolic state. Individuals with diabetes can be stratified into different groups according to the risk that fasting would impose. Different factors, such as the type of diabetes, level of glycaemic control, medication, presence of comorbidities and personal circumstances, can be used to assess individual risk.

A cornerstone of Ramadan diabetes management is patient education, which should include information on risks, glucose monitoring, nutrition, exercise and medication (Hassan et al., 2014; Bravis et al., 2010).

Different medications to treat diabetes have varying levels of hypoglycemic risk, and Ramadan-specific treatment regimens including dose and/or timing adjustments should be produced for each patient in order to minimize the risk of complications. Implementation of guidelines requires communication and education of all those involved, including patients, health care professionals (HCPs) and religious leaders. The aim of this review is that to offer a simple guide for management of Muslim diabetic patient during Ramadan.

2. An Overview on Fasting Metabolism

Between meals and during prolonged fasting the body experiences metabolic changes due to the need to preserve glucose and the limited reserves of glycogen in the liver and muscles to supply the brain and erythrocytes, and to ensure the availability of alternative metabolic substrate of other tissues. In fact, glucose represents the only energetic substrate for the erythrocytes while the brain may metabolize ketone bodies and satisfy up to 20% of its energetic requirements (Longo and Mattson, 2014).

During fasting, the plasma levels of glucose levels, amminoacids and tryacylglicerol tend to decrease. The reduction of the insulin/glucagon ratio and the reduced availability of circulating substrate make fasting a catabolic period, characterised by degrading triacylglycerol, glycogen and proteins. In the first fasting phase, a small reduction of plasma glucose levels and an increase of free fatty acids is observed. In the instance of prolonged fasting, the plasma concentration of ketone bodies (acetoacetate and β–hydroxybutyrate) increase exceedingly (Murray Robert, 2012).

During fasting following the reduction of blood glucose levels, the secretion of insulin decreases and consequently the transport of glucose are reduced at a musculoskeletal and adipose tissue level. The glycogen represents the main reserve of carbohydrates in the liver and in the muscles. In the liver, its principal function is to supply glucose to extra hepatic tissues; as for the muscles, it represents a rapid source of energy, such that in the absence of glucose-6-phosphatase is unable to release free glucose from the glycogen. Insulin causes an inhibition of the glycogenolysis and stimulates glycogen synthesis. In the absence of other sources of glucose, the liver and muscle glycogen is exhausted after about 18 hours. If fasting is prolonged, the amino acids released as a result of protein breakdown are used in the liver and kidney for gluconeogenesis. Fasting and diabetes mellitus are characterized by an increase of the oxidation of the fatty acids, which results in the liver producing ketone bodies (ketogenesis). In poorly controlled diabetes, hyperglycaemia is due in part to the absence of insulin, which stimulates the uptake and utilization of glucose and in part to increased

gluconeogenesis from amino acids. At the same time, the absence of insulin leads to an increase of lipolysis in adipose tissue and free fatty acids which are a substrate for ketogenesis in the liver (Longo and Mattson, 2014) (Figure 1).

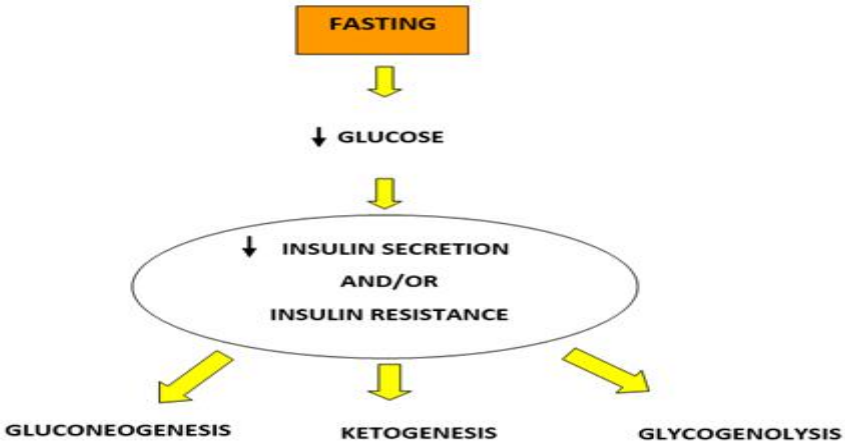

Figure 1: *Physiology of fasting in diabetic individuals*

The ketosis may be sufficiently severe such that it results in a noticeable acidosis (ketoacidosis) considering that the acetoacetate and 3-hydroxybutyrate is strong acids.

The entity of ketoacidosis is moderately low during fasting while it is noticeable in decompensated diabetes mellitus (Cahill, 2014; Kreisberg, 1978).

3. Diabetes and Ramadan

Fasting from sunrise to sunset during the holy month of Ramadan is one of the five basic pillars of Islamic worship, and it is mandatory for healthy adults. For the duration of Ramadan (29-30 days) it is forbidden to eat or drink, take oral or inject medications, from sunrise to sunset. Since the Islamic calendar is made up of 354 or 355 days (10 or 11 days less than the solar year), Ramadan does not always fall in the same season. Depending on the season and region, periods of fasting can last up to 20 hours.

During Ramadan after the announcement of the intention (niyyah), fasting begins at dawn. The iftar meal eaten at sunset is the moment when fasting temporarily stops. It is characterized by 3 courses. The first dish is an odd number of dates. The second dish is a soup (traditional in Morocco, for example, carrot and orange soup) and the third dish is the main course; cold drinks are also served, in large quantities, such as sorrel, tamarind, dates with milk, carob. A lot of salads are eaten; vegetables with a high concentration of water are preferred. The suhur is a meal that is eaten before sunrise; it is believed that it strengthens and helps the individual during fasting (Karamat et al., 2010).

Healthcare professionals need to be able to offer structured education and proper patient preparation in terms of nutrition, exercise and medication adjustments, informing them about the possible complications of diabetes during prolonged fasting. HCPs' duty is to classify patients into risk levels (mild, moderate and severe) based on their clinical history, laboratory results and general conditions, in order to determine the therapeutic strategy that suits everyone (IDF-DAR, 2016).

4. Risks Associated with Fasting

The Muslim religion does not require diabetics to observe fasting, but many choose to do so themselves to risks. Prolonged fasting can cause severe alterations of glucose homeostasis mechanisms to diabetics, particularly in subjects with type 1 diabetes (DM 1). There are a number of known complications such as hypoglycaemia (the risk increases by 4.7 times in the DM 1 and 7.5 times in DM 2 during Ramadan), hyperglycaemia and diabetic ketoacidosis. Very important is also the risk of dehydration and thrombosis (Figure 2).

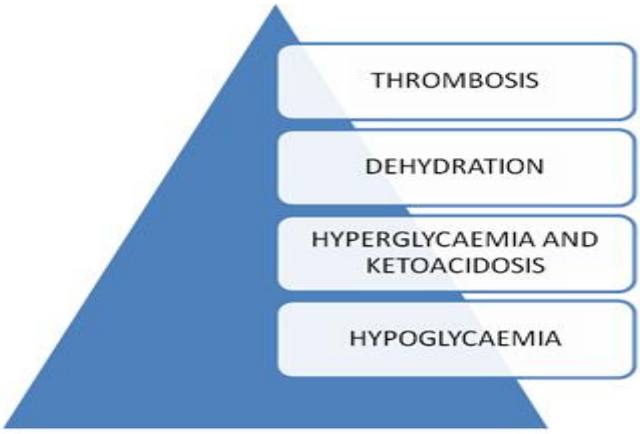

Figure 2: *The risks associated with fasting in diabetic patients*

A survey conducted in Saudi Arabia revealed for example that 30% of all cases of retinal vein thrombosis occur during Ramadan. Guidelines advise general practitioners on patients' regional and cultural differences in order to help them in their advisory task (IDF-DAR, 2016).

4.1. Hypoglycaemia

Food reduction is a known cause of hypoglycaemia (Al-Arouj et al., 2005). In patients with DM 1 it causes death in 2-4% of the cases (Laing et al., 2014). It is unknown whether mortality is associated with hypoglycaemia in patients with DM 2. The study of EPIDIAR (Salti et al., 2004), conducted in 13 countries with a presence of Muslims, has studied the effects of fasting during Ramadan on 12.243 diabetics, of which 8.7% suffering from DM 1. During fasting less than 50% of patients changed drug therapy. The number of reported hypoglycaemia was relatively low. Instead there has been a number of severe hypoglycaemia, requiring hospitalization, significantly increased compared to the other months of the year, especially in those who have spontaneously changed the therapy without a prior educational process. In patients with DM 1 and DM 2, the increase in the number of severe hypoglycaemia was 4.7 and 7.5 times higher than in other months of the year, respectively.

4.2. Hyperglycaemia and Ketoacidosis

A recent study has shown the influence of breakfast in the control of glucose levels; avoiding breakfast for patients suffering from DM 2 determines, in fact, a high glycaemic response, after lunch and after dinner, associated with elevated glucagon levels and to a reduced secretion of insulin, this is confirmed by the reduced plasma levels of C-peptide (Jakubowicz et al., 2015).

Although major studies such as the DCCT (The Diabetes Control and Complications Trial Research Group) (The Diabetes Control and Complications Trial Research Group, 1993) and UKPDS (UK Prospective Diabetes Study Group) (UKPDS Group, 1998) have shown a close correlation between hyperglycaemia, macro- and microvascular complications of diabetes, no study has been carried out

on the influence that repeated episodes of hyperglycaemia in a short period of a few weeks may have on the development or progression of complications. Certainly, the EPIDIAR study (Salti et al., 2004) has demonstrated the significant increase in severe hyperglycaemia with or without ketoacidosis, with need for hospitalization, during Ramadan, to the extent of 1: 5 for the DM 1 and 1: 3 for the DM 2. The causes are to be found in the increase of glycogenolysis and gluconeogenesis, in the reduction of uncontrolled drug treatment, justified by a reduction of food intake and in the insufficient glyco-metabolic control in the period preceding Ramadan. Recently, patients with type 2 diabetes were kept into observation in order to monitor their blood glucose levels during Ramadan (Lessan et al., 2012). Although they lacked any serious events of hypo- or hyperglycaemia, significant glucose excursions were observed with a high intra- and inter-individual variability, confirming the importance of the educational process in the run-up to Ramadan.

4.3. Dehydration

People, living in hot and humid environments or exercising physical activity of high intensity, become dehydrated if they limit the intake of liquids for long periods, especially if combined with sweating. The osmotic diuresis, typical in hyperglycaemia, in addition involves hydro-electrolyte depletion with possible orthostatic hypotension, particularly in patients with autonomic neuropathy; the risk of syncope and falls is therefore increased. Dehydration can be associated with hypercoagulability and thrombosis. In literature to date, there is no evidence of an increase of cardiovascular accidents during Ramadan; however, a report published in 1993, describes an increased incidence of retinal vein occlusion during Ramadan in Saudi Arabia (Alghadyan, 1993).

4.4. Changes in Circadian Rhythms

Changes in sleep/wake cycle and food consumption also have an impact on the circadian rhythms, including changes in body temperature and cortisol levels. Compared to periods of non-Ramadan, the study reported low cortisol levels in the morning and higher levels during the evening. The alterations of the circadian rhythm of cortisol may explain, in part, lethargy reported by some Muslims during Ramadan (Haouari et al., 2008; Bahijri et al., 2013).

5. Nutritional Recommendations

The change in the timing and the widening gap between the main meals intensify the feeling of hunger, therefore an excessive caloric intake typically occurs at the time of the “iftar” leading to weight gain. A meta-analysis that evaluated the effect of fasting on body weight highlighted a weight loss among the examined healthy subjects. A sub-analysis revealed a gender difference in weight change; specifically, it has been observed that men lost weight whereas women did not (Kul et al., 2014).

The diet during this period should not differ significantly from a balanced diet for it is important not to exceed the intake of food at the end of the day. In addition, it is advisable to eat high-fibre foods especially during suhur. It is also necessary to compensate for the lack of water intake during the day by drinking 10-12 glasses a day and consuming plenty of fruits (ADI-AMD-SID “Nutrizione e diabete”, 2013-14).

6. The Risk Categories

Three risk categories among diabetics have been defined: very high, high, low-moderate. The first category includes people with diabetes who have experienced episodes of severe hypoglycaemia, diabetic ketoacidosis, hyperosmolar coma in the three months preceding Ramadan, pregnant women with diabetes, patients on dialysis or with end-stage renal failure, patients with acute disease and the frail elderly. The high-risk category includes patients with poorly controlled DM 2 or insulin treatment,

patients with DM 1, those with renal insufficiency stage 3, with macrovascular complications, those with DM 2 who have heavy jobs and those treated with drugs which may impair their cognitive function. These two risk categories should definitely be dissuaded from engaging in prolonged fasting (IDF-DAR, 2016).

7. Patients' Education

Patients' education in pre-Ramadan plays a vital role in managing diabetes. The patient should be sent information on the quantification of risk, the importance of self-monitoring blood glucose, diet and exercise, the adaptation of the anti-diabetes treatment, recognition of symptoms of complications and especially when we need to interrupt fasting. The EPIDIAR study showed that only about two-thirds of the patients received recommendations from their health care providers regarding the management of diabetes during Ramadan, and highlighted the need for intensive training before fasting (Salti et al., 2004).

In the most recent study conducted by CREED, 96% of physicians provided advice to patients during fasting, although only 63% of them followed the requirements set by the guidelines. In addition, only 67% of physicians used a proper educational programme (Babineaux et al., 2015).

8. Adjusting the Hypoglycaemic Therapy for Diabetic Patients during Ramadan

The scheme that involves the use of intermediate insulin or double administration of ultra-short-acting insulin with the addition of rapid-acting insulin before the two meals is risky because the possibility of hypoglycaemia is very high. Currently, it is believed that the basal-bolus scheme best stabilizes glucose levels and avoids severe hypo or hyperglycaemia. The long or intermediate analogues (glargine or detemir) should be administered in the evening. For patients with type 1 diabetes, insulin glargine resulted in an excellent glycaemic stabilizer as a basal (Mucha et al., 2004, Kadiri et al., 2001).

In a small study of five adolescents with DM 1, in the age of 15 to 19, the subcutaneous infusion of insulin during Ramadan (CSII) was associated with improved glycaemic control and fewer hypoglycaemic episodes in comparison to conventional insulin treatment. The insulin pump therapy provides a flexible treatment and it is potentially safer, but only for selected subjects, given the high cost of the procedure and the required intensive glucose monitoring (Abbas, 2007).

Insulin sensitizers (metformin and pioglitazone) do not induce hypoglycaemia; therefore, the dosage should not be modified. It is advisable to distribute the dose of metformin for 2/3 iftar (the evening meal that interrupts fasting) and the remaining dose, lower, at suhur (in the morning) (Bolen et al., 2007; Vasan, 2006).

More complex is the management of patients treated with sulfonylureas or glinides; in fact, these drugs are burdened by the risk of hypoglycaemia, especially those of the first generation such as glibenclamide. Among the sulfonylurea, however, there are minor risks with glimepiride and gliclazide, which reduce significantly major hypoglycaemic events, especially when the patients have committed to a proper preparation for the Ramadan. Even with the use of glinides minor hypoglycaemic events were reported compared with the use of other sulfonylureas (Hassanein, 2004; Sari et al., 2004; Zargar et al., 2010; Schernthaner et al., 2004).

There was no severe hypoglycaemia with the use of repaglinide. Bakiner et al. have reported that a dose of repaglinide taken before the two main meals of the day in addition to a single insulin glargine is safe and it does not provoke hypoglycaemia or changes in body weight in low-risk individuals committing to fasting (Bakiner et al., 2009).

Cesur et al. have compared the effects of glimepiride, repaglinide and insulin glargine in individuals with DM 2 during Ramadan; fasting blood glucose (FBG), postprandial blood glucose (PBG), HBA1c and fructosamine were measured before the start of Ramadan, immediately after, and one month later. No significant differences were reported amongst the three phases of the study. The risk of hypoglycaemia did not differ in the sample in the study compared to control and does not show any difference among the three treatment regimens (Bakiner et al., 2009; Cesur et al., 2007).

As for the incretin hormones, analogues of GLP-1 do not require titration, as they do not induce hypoglycaemia, but if associated with sulphonylureas or insulin, they may increase the hypoglycaemic effect (Brady et al., 2014).

DDP-IV inhibitors do not require titration thanks to their low propensity to induce hypoglycaemia, but if associated with sulfonylureas or insulin they may potentiate the hypoglycaemic effect. Vildagliptin, in particular, has demonstrated a reduction of hypoglycaemia in the course of Ramadan compared with sulfonylureas (Devendra et al., 2009; Hassoun et al., 2016).

Regarding the use of SGLT2 inhibitors during Ramadan, there is no unambiguous consent and despite being safe in most diabetic individuals, their use is not recommended during fasting (Beshyah et al., 2016).

9. Advice on Breaking the Fast

All patients should break their fast if blood glucose is <70 mg/dl (3.9 mmol/L) or >300 mg/dl (16.6 mmol/L). All patients should understand that they will need to break the fast if symptoms of hypoglycaemia, hyperglycaemia, dehydration or acute illness occur (IDF-DAR, 2016).

10. Conclusion

Table 1: *Management of Muslim diabetic patient during Ramadan*

Patients Education	• Quantification of risk • Self monitoring blood glucose • Recognition of symptoms of complications • To break the fast if blood glucose is <70 mg/dl (3,9 mmol/L) or >300 mg/dl (16,6 mmol/L)
Nutritional Recommendations	• Not to exceed the intake of food at the end of day. • To eat high-fibre foods especially during suhur. • It is also necessary to compensate for the lack of water intake
Adjusting Therapy	• To prefer the insulin basal-bolus scheme. • Insulin glargine or detemir should be administered in the evening. • For DM 1 patients, insulin glargine resulted in an excellent glycaemic stabilizer. • The dosage of metformin and pioglitazone should not be modified. It is advisable to distribute the dose of metformin for 2/3 at iftar and the remaining dose at suhur. • The new oral agents are certainly safer than older sulfonylurea, while we must be cautious with the SGLT2 inhibitors.

Fasting in Ramadan for a diabetic individual should be granted under close medical supervision and after an appropriate educational program focused on controlling glucose levels and medication management (Table 1).

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