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Finger millet (*Eleusine coracana* L.) and white rice diets elicit similar glycaemic response in Asian Indians: Evidence from a randomised clinical trial using continuous glucose monitoring

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ABSTRACT

Introduction: Finger millet (FM) or *Eleusine coracana* L. is considered as a healthier cereal option, especially based on its higher dietary fibre, phytochemical and mineral contents. FM is also recommended for individuals with diabetes, as it is believed to elicit a lower glycaemic response. **Methods:** The glycaemic response of FM diet was evaluated and compared with white rice (WR) diets using a continuous glucose monitoring system (CGMS™) iPro 2™ among 14 healthy male and female volunteers aged 25-45 years with normal Body Mass Index (≥22.9kg/m^2) in a crossover trial. They were recruited from Madras Diabetes Research Foundation volunteers registry. The participants consumed randomised iso-caloric FM or WR based diets for five consecutive days and 24 h interstitial glucose concentrations were recorded. **Results:** The FM diet had significantly higher dietary fibre than WR (29.9 g vs 15.8 g/1000 kcal, p<0.01) but the other macronutrients were similar. The 5-day average incremental area under the curve (IAUC) of FM diet [Mean (95% CI) = 73.6 (62.1-85.1) mg*min/dl] was not significantly different from that for WR diet [Mean (95% CI) = 78.3(67.9-88.7) mg*min/dl]. **Conclusion:** Both finger millet and white rice diets showed similar 24 h glycaemic responses, despite the former having higher amounts of dietary fibre. The result suggests that use of FM flour-based food preparations and decorticated FM grains to replace WR in the Indian diets offer no significant benefit with regards to 24 h glycaemic response. Studies of longer duration with larger sample size are needed to verify our findings.

Keywords: Finger millet, white rice, dietary intervention, dietary fibre, diabetes

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INTRODUCTION

The prevalence of diabetes and obesity are rising rapidly. Individuals of south Asian origin specifically Asian Indians are known to be highly susceptible to diabetes (Anjana *et al*., 2015). Although genetic factors may influence this susceptibility, lifestyle factors; faulty diets (high in refined carbohydrates) and sedentary lifestyle play a major role (WHO, 2003). In this context, foods with lower glycaemic properties are beneficial in combating the rising prevalence of the aforementioned disorders (Misra *et al*., 2011).

Finger millet (FM) or *Eleusine coracana* L. is one of the most important millets consumed since ancient times. This millet contains higher levels of dietary fibre (12%), phytochemicals and minerals (Shobana *et al*., 2013). Hence, millet preparations are often considered as healthy dietary options for individuals with diabetes. Additionally, there is a common perception that millet-based foods elicit a lower glycaemic response although systematic studies in this direction are lacking (Shobana *et al*., 2013).

Though millets were a part of traditional Indian diets, their consumption has diminished considerably, notwithstanding their superior nutritional value (NSSO, 2014). Presently, polished white rice and refined cereal- based foods are the major staples in the southern Indian region (Radhika *et al*., 2009) due to government support for rice prices in this region. Refined grains and their products increase the glycaemic load of diets owing to their higher glycaemic and insulinaemic responses and could lead insulin resistance (Willett *et al*., 2002; Radhika *et al*., 2009). Thus, it is crucial to study the glycaemic properties of ancient grains such as millets using appropriate methods so that they can be recommended as a healthier replacement to refined grain staples for individuals with diabetes.

Though FM contains higher levels of dietary fibre and phytochemicals (Shobana *et al*., 2013), this grain remains less explored for its glycaemic properties (Glycaemic index) using standardised international GI testing protocol (Shobana *et al*., 2013). There are mixed reports on the glycaemic indices/response of FM based foods. This is because few earlier studies (Lakshmi & Sumathi, 2002; Shukla & Srivastava, 2014), had shown that FM preparations elicit a lower glycaemic response compared to rice and other cereals while others have equally shown higher glycaemic responses for the millet- based preparations (Urooj *et al*., 2006; Shobana *et al*., 2007; Shobana, 2009).

In addition, FM-based food products with diabetes-friendly label claims (unpublished in-house market survey data) available in the market pose major challenges as there is usually no scientific backing for these claims. Systematic intervention studies on the glycaemic properties of FM-based foods or diets using appropriate protocols are scarce (Shobana *et al*., 2013). We have earlier shown that the FM products used in the present study (iso-caloric FM diet, i.e. FM extruded snack, *upma* prepared from decorticated FM, FM vermicelli and FM flakes) belonged to the medium to high GI categories (Shobana *et al*., 2018).

Continuous glucose monitoring (CGM) systems have been found to be useful to study the glycaemic response to diets over 24 hours for five consecutive days. We recently reported a study with brown rice vs. white rice (WR) based diets in overweight Asian Indians (Mohan *et al*., 2014) using CGM. In the current paper, we aim to evaluate the glycaemic responses of FM-based diets compared to iso-caloric WR based diets in 14 normal healthy individuals aged 20-40 y.

MATERIALS AND METHODS

Participants

Fourteen volunteers (7 males and 7 females) in the age group of 20-40 years with Body Mass Index (BMI) <22.9 kg/ m^2 were recruited from our volunteer registry. Study participants were excluded if they were overweight (BMI ≥ 23 kg/m^2) (WHO, 2004) or were on any special diet, had a family history of diabetes, suffered from any illness or food allergy, used regular medications, or had a fasting blood glucose value of >5.6 mmol/l (>100 mg/dl) (American Diabetes Association, 2003). Pregnant or lactating women were also excluded (Figure 1). The study was conducted according to the guidelines laid down by the Declaration of Helsinki, and was approved by the Ethics Committee of the Madras Diabetes Research Foundation. All participants gave written informed consent before participation in the study.

Dietary intervention

In a randomised cross-over design, volunteers were assigned to FM and WR-based iso-caloric diets for breakfast, lunch and dinner for five consecutive test days as shown in Figure 1. The entire study protocol was explained to the participants in detail and they were encouraged to discuss any concerns they might have on any aspects of the dietary intervention or protocol. They were further requested to abstain from partying, smoking and alcohol as well as strenuous exercise during the study period and this was ensured by daily dietary recalls. The intervention menu

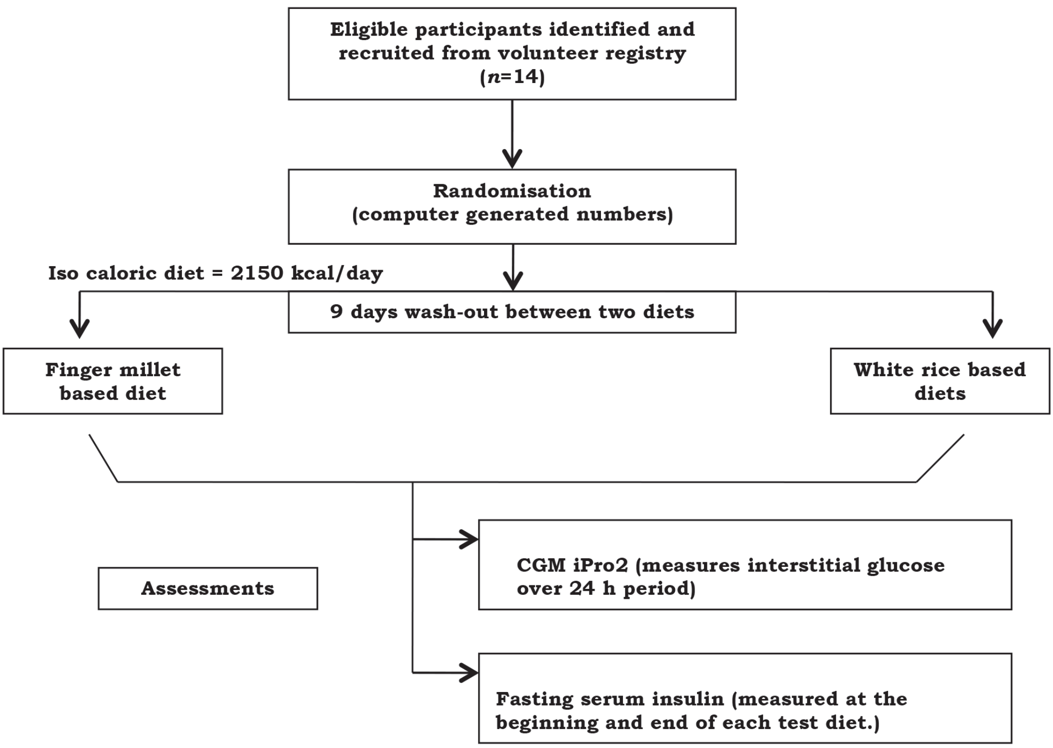

Figure 1. The study protocol

Table 1. Finger millet and white rice based diets menu plan

Menu	*Meal & Time*	*Finger millet diet*[†] *(Main course and accompaniments)*	*Quantity (g)*	*White rice diet (Main course and accompaniments)*	*Quantity (g)*
Day 1	Breakfast (8.30-9.30AM)	FMV *upma*	210	Rice vermicelli *upma*	275
		Sambar	150	*Sambar*	150
		Chutney-onion	75	Chutney-onion	75
	Mid-morning (11.00am -12.00 noon)	Lemon juice	200	Lemon juice	200
	Lunch (1.00-2.00PM)	Tomato flavored DFM	175	Tomato rice	175
		Plain cooked DFM	150	Plain rice	100
		Mixed vegetable *kootu*	75	Mixed vegetable *kootu*	75
		Cucumber *raitha*	100	Cucumber *raitha*	100
		Rasam	100	*Rasam*	100
	Mid-evening (4.00-4.30PM)	Tea with sugar	150	Tea with sugar	150
		FM based extruded snack	30	Masala puffed rice	30
	Dinner (8.00-9.00PM)	Finger millet *adai*	275	Rice *adai*	225
		Mint coriander chutney	150	Mint coriander chutney	150
Day 2	Breakfast (8.30-9.30AM)	DFM *upma*	250	Rice *upma*	240
		Sambar	125	*Sambar*	125
		Chutney-tomato	45	Chutney-tomato	45
	Mid-morning (11.00am -12.00 noon)	Vegetable soup	125	Vegetable soup	125
	Lunch (1.00-2.00PM)	DFM plain (cooked)	275	Plain rice	275
		Curry spicy gravy	100	Curry spicy gravy	100
		Cabbage *poriyal*	75	Cabbage *poriyal*	75
		Rasam	100	*Rasam*	100
		Curd	75	Curd	75
	Mid-evening (4.00-4.30PM)	Finger millet bread sandwich	168	Dhokla sandwich	100
	Dinner (8.00-9.00PM)	Finger millet *dosa*	220	Rice *dosa*	200
		Veg. *kurma*	175	Veg. *kurma*	175
Day 3	Breakfast (8.30-9.30AM)	Finger millet balls	175	Rice balls	235
		Legumes gravy	150	Legumes gravy	175
	Mid-morning (11.00am -12.00 noon)	Lemon juice	200	Lemon juice	200
	Lunch (1.00-2.00PM)	DFM *bisebelebath*	250	White rice *bisebelebath*	250
		DFM plain (cooked)	100	Plain cooked rice	100
		Potato *poriyal*	75	Potato *poriyal*	75
		Cucumber *raitha*	100	Cucumber *raitha*	100
		Rasam	100	*Rasam*	100
	Mid-evening (4.00-4.30PM)	Tea with sugar	150	Tea with sugar	150
		FM based extruded snack	30	Masala puffed rice	30
	Dinner (8.00-9.00PM)	FMV *kitchidi*	275	Rice vermicelli *kitchidi*	300
		Sambar	150	*Sambar*	150
		Coconut chutney	75	*Coconut chutney*	75

Day 4	Breakfast (8.30- 9.30AM)	Finger millet *pongal*	300	Rice *pongal*	275
		Brinjal *masiyal*	150	Brinjal *masiyal*	150
		Chutney-onion	75	Chutney-onion	60
	Mid-morning (11.00am -12.00 noon)	Vegetable soup	125	Vegetable soup	125
	Lunch (1.00 -2.00PM)	DFM (cooked)	300	Plain rice	300
		Sambar	125	*Sambar,*	125
		Beetroot *poriyal*	75	Beetroot *poriyal*	75
		Rasam	100	*Rasam*	100
		Curd	75	Curd	75
	Mid-evening (4.00-4.30PM)	Finger millet bread sandwich	168	Dhokla sandwich	100
	Dinner (8.00-9.00PM)	Finger millet *oothappam*	275	Rice *oothappam*	225
		Tomato *kurma*	175	Tomato *kurma*	150
Day 5	Breakfast (8.30- 9.30AM)	FMF *upma*	275	Rice flakes *upma*	275
		Sambar	150	*Sambar*	150
		Chutney-coconut	45	Chutney-coconut	45
	Mid-morning (11.00am -12.00 noon)	Lemon juice	200	Lemon juice	200
	Lunch (1.00 -2.00PM)	DFM (cooked)	275	Plain cooked rice	275
		Channa gravy	100	Channa gravy	100
		Brinjal *poriyal*	75	Brinjal *poriyal*	75
		Rasam	100	*Rasam*	100
		Curd	75	Curd	75
	Mid-evening (4.00-4.30PM)	Tea with sugar	150	Tea with sugar	150
		FM based extruded snack	30	Masala puffed rice	30
	Dinner (8.00-9.00PM)	Finger millet *roti*	225	Rice *roti*	225
		Vadai curry	165	*Vadai* curry	165

†FMV-Finger millet vermicelli, DFM- Decorticated finger millet, FMF- Finger millet flake

Table 2. Average nutrient composition of the iso-caloric control and test diets

Nutrients	*Finger millet based diet*		*White rice based diet*		*p-value*
	Mean	*SD*	*Mean*	*SD*	
Energy (kcal)	2146.0	2.0	2144.0	1.7	0.14
Carbohydrate (g)	356.6	7.1	358.8	17.4	0.71
Carbohydrate (% E)	66.5	1.3	66.9	3.3	0.67
Protein (g)	64.9	3.8	61.7	4.0	0.22
Protein (% E)	12.1	0.7	11.5	0.8	0.23
Fat (g)	49.4	3.7	54.6	5.8	0.05
Fat (% E)	20.7	1.6	22.9	2.4	0.04
Dietary fibre (g/1000 kcal)	29.9	1.8	15.8	1.3	<0.01
Dietary glycaemic load	209.2	26.3	207.0	24.0	0.91

was identical on all the test diet days except for the WR and FM component (Table 1).

The macronutrient composition of the FM and WR iso-caloric (≈2100kcal/day) test diets was similar except that the dietary fibre content was higher in FM diets (30 g/1000 kcal) as compared to WR rice-based diets (16 g/1000 kcal) (Table 2).

Finger millet (whole grain) was procured from the local market, pre-cleaned using a destoner, grader and aspirator and used for the preparation of FM recipes. Minimally polished FM, FM flakes (roller flaked), FM vermicelli (vermicelli prepared from a blend of FM, defatted soy and resistant maltodextrin) and FM ready-to-eat snack (an extruded snack prepared from FM flour blended with fenugreek fibre, defatted soya flour, vegetable oil and spices) were also included in the CGM menu. The details of the products are published elsewhere (Shobana *et al.*, 2018). WR (raw, BPT variety), WR based vermicelli and commercially available flakes were procured from the local market and used for the study. All meals were prepared and served at the test kitchen of Madras Diabetes Research Foundation. The nutrient compositions of the meals for CGM are shown in Table 2.

Anthropometric measurements

Anthropometric measurements including height, weight and waist circumference were measured at baseline and in the end of the study in the fasting state using standardised techniques (Deepa *et al.*, 2003).

Measurement of interstitial glucose concentration

The iPro™2 continuous Glucose Monitoring System (CGM) (iPro™2 Professional CGM- Medtronic Mini med, Northridge, USA) sensor was inserted on the lateral aspect of the abdominal wall and was used to obtain continuous interstitial glucose readings that have been shown to correlate with plasma glucose values (Monsood *et al.*, 2002). The iPro 2™ was worn for five complete days after which the participants returned the iPro 2™ recorder for uploading the data to a web-based software, which provided a summary of the glucose responses. The iPro 2 CGM system records 24 h glucose values in a recorder every 5^{th} minute, giving a total of 288 readings over a 24 h period. The sensor was calibrated using finger prick capillary blood glucose and eight measurements taken at fasting, pre, post-meals and bedtime (breakfast, lunch and dinner) during the study period using a Hemocue 201^{+} glucose analyser (Hemocue Ltd, Angelholm,

Table 3. Baseline anthropometric and dietary profile of CGM study participants

Characteristics	*Value*
Female [n(%)]	7(50)
Age (years)	27.5±9.0
Weight (kg)	56.3±7.1
BMI (kg/m^2)	20.9±1.7
Waist circumference (cm)	76.1±6.8
Blood pressure (systolic)	108±16
Blood pressure (diastolic)	72±10
Energy (kcal)	1364±415
Carbohydrates (E%)	61.5±6.5
Protein (E%)	13.6±3.1
Total fat intake (E%)	26.6±4.3
Total dietary fibre (g)	14.9±4.7
Saturated fatty acid (E%)	9.2±2.2
Polyunsaturated fatty acid (E%)	8.1±1.3
Monounsaturated fatty acid (E%)	8.2±2.6
Trans fatty acid (E%)	0.003±0.005
Glycaemic load (GL)	101.2±23.9
Weighted GI	55.1±7.3
Refined cereals (g/day)	157.1±60.6
Whole cereals (g/day)	8.3±22.9
Legumes, dhal and whole (g/day)	47.3±26.4
Fruits and vegetables (g/day)	150.5±141.5
Tuber (g/day)	12.7±23.9
Milk and its products (g/day)	180.3±129.7
Non veg (g/day)	66.6±69.6
Fats edible oils (g/day)	26.6±4.3
Total added salt (g/day)	6.6±2.6
Total added sugar (g/day)	11.8±10.1

Sweden). A nine days wash out period was given between the two diets.

Biochemical measurements

A fasting venous blood sample was drawn and analysed for serum insulin concentration (enzyme-linked immunoassay; Dako, Glostrup, Denmark) at the beginning (Day 1) and end (Day 6) of the test and control diets (Figure 1).

Statistical analysis

Statistical analysis was performed using SAS software, version 9.0 (SAS Institute Inc., Cary, NC). Change in glucose concentration over five days measured as average 24 h glucose response was considered for analysis. The positive Incremental Area under the Curve (IAUC) was calculated geometrically by applying the trapezoidal rule. The average positive glycaemic response of individuals fed with two different test diets was measured as the change in sensor glucose concentration from baseline over a period of 24 h (7 am to next day 7 am) on each test day. Out of the 14 volunteers, data was completely missed during the 1st diet in 2 volunteers. Hence, the data from 12 volunteers were included for further analysis. The difference in glycaemic responses between FM diet and WR was assessed using a mixed

Table 4. Metabolic effects of finger millet based diet compared with white rice diet

Outcome	*Number of observations (number of participants)*	*FM*	*WR*	*FM vs WR*	*p-value*
Daily IAUC (mg-5 min/dL)	58(12)				
5-day [*M*(95% CI)]		72.3(50.9,93.7)	72.7(54.6,90.9)	-0.4	0.57
Fasting interstitial blood glucose (mg/dl)				0.8	
Day 0	58(12)	86.7±13.1	87.1±12.9		0.78
Day 6		79.7±15.1	79.1±15.0		0.99
Postprandial glucose (mg/dl)		100.1±16.4	100.8±15.0		0.88
Fasting insulin (µIU/mL)					
Baseline mean		9.8(7.1-12.5)	9.4(7.3-11.4)		
End of respective diet mean	48(12)	7.6(5.0-10.2)	8.8(6.2-11.4)		
Change from baseline		-2.2[(-4.3-(-0.14)]	-0.6(-2.7-1.5)		0.06 (NS)
Absolute difference in % change from baseline				-13.5	

linear model. Paired samples *t*-test was used to assess the differences in the insulin responses from the baseline for the 2 diets. *P*<0.05 was considered to be statistically significant.

RESULTS

Table 1 shows the detailed menu for the both diets used in the study. Equivalent preparations (the difference was only the cereal component) with similar accompaniments were present in both the diets. The mean BMI and waist circumference of the volunteers were 20.9±1.8 kg/m^2 and 75.8±6.7 cm respectively. The average blood pressure of the participants was 108.4±16.1 mmHg (systolic) and 72.8±9.9 mmHg (diastolic). The percentage energy derived from carbohydrate, protein and fat were 61.5%, 13.6% and 26.6% respectively on average (Table 3).

Table 2 shows the average nutrient composition of both the diets. The diets were iso-caloric (2146 kcal/day and 2144 kcal/day for FM and WR based diets respectively) with similar carbohydrate content. The dietary glycaemic load (GL) was similar between the two diets (FM diet GL 209±26.3; WR diet GL 207±24.0) despite the FM diet having higher dietary fibre content (g/1000 kcal) compared to WR diet (29.9±1.8 g vs 15.8±1.3; *p*<0.01) g in WR based diets). The 5-day average glucose response to FM diet [Mean (95% CI) = 73.6(62.1-85.1) mg*min/dl] was similar to that of WR [Mean (95% CI) = 78.3(67.9-88.7) mg*min/dl] diet [*p*=0.617] (Table 4).

The cumulative change in interstitial glucose values from the baseline (average positive incremental area under the curve) is shown in Figure 2. There was no significant difference between the average postprandial glucose response of FM and WR diet (FM=100.1±16.4 vs WR=100.8±15.0; *p*=0.880). Further, we also observed no significant % change in fasting blood glucose at the end of the experiment between FM and WR (0.8). The average Δ insulin response for FM was -2.2[(-4.3-(-0.14)] µIU/ml and that of WR was -0.6(-2.7-1.5) µIU/ml. Though the % change in fasting insulin over the 5-day study period was 18% lower for FM-based diet compared to WR-based diet, this was only marginally significant.

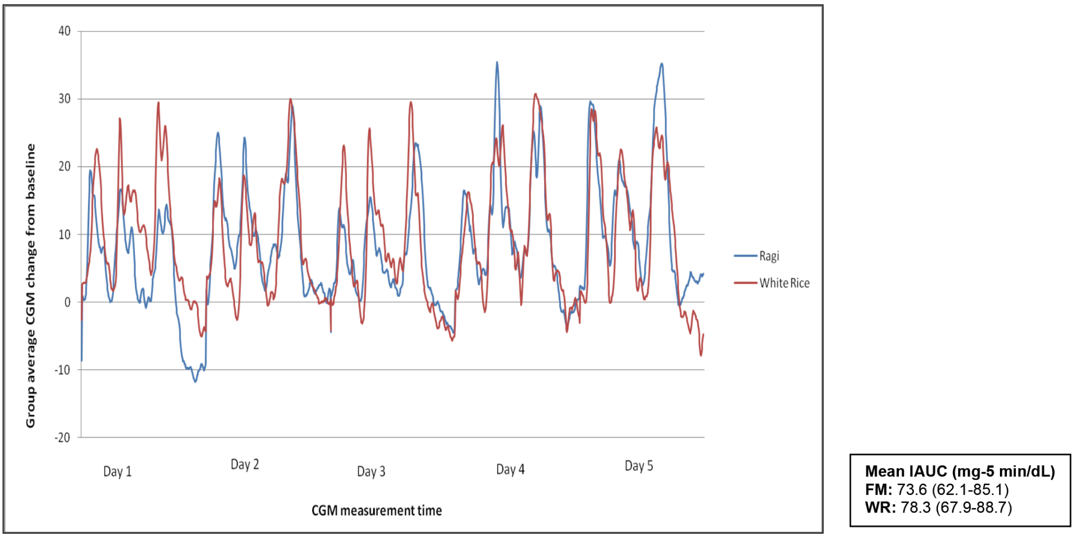

Figure 2. Average change in interstitial glucose concentrations from baseline of participants fed with finger millet and white rice based diets (n=12)

DISCUSSION

This study is to the best of our knowledge, the first of its kind to report on the 24 h interstitial glucose response to FM and WR based diets using CGM. We have examined beyond the 2 h blood glucose value to the glycaemic response of the whole using CGM. This gives us more holistic information about the two diets and their differences.

Despite higher fibre content, FM diet showed similar glycaemic response to iso-caloric WR diets among healthy Asian Indians. Dietary glycaemic load between FM and WR diets were also very similar. Fasting insulin was marginally decreased post-FM diet intervention.

Previous studies have demonstrated the usefulness of CGM in food research (Mohan *et al.*, 2014). Previous studies (Henry *et al.*, 2006; Mohan *et al.*, 2014) have demonstrated a lower 24 h IAUC for low-GI diets (lower in GL) compared to high-GI diets (higher GL) using CGM. In the present study, both the GI and GL were similar between FM and WR diets and this could be one of the explanations for similar 24 h glycaemic response.

WR contributes to nearly half of the daily calorie intake in south India. The high dietary glycaemic load and glycaemic index (GI) contributed by refined grains have been linked to an increased risk for metabolic syndrome and type 2 diabetes (Radhika *et al.*, 2009; Mohan *et al.*, 2009). Conversely, low GI and GL diets are known to be beneficial in lowering glycaemic and insulinaemic responses. Several studies have presented the beneficial effects of wholegrain consumption on the risk of diabetes, cardiovascular disease, and weight gain.

Moderate to high GI of FM foods may be due to the fragile endosperm which is typical to FM (Balasubramanian & Viswanathan, 2010). Unlike rice and other millets, cooked whole FM in the grain form is uncommon as it has very poor sensory qualities due to which the millet based preparations were flour-based since ancient days. Hence, FM-based food preparations (with fragile endosperm and finer particle size flour based) have higher digestibility characteristics as compared to other cereal grain/flour- based preparations. In this study decorticated millet as a grain was used mainly during lunch in the FM diets. Earlier studies have also shown that the decorticated FM, either plain, cooked or served with '*dhal*' (lentil sauce), elicits a higher GI response similar like white rice (refined grain) (Shobana, 2009; Shobana *et al.*, 2011; Shobana *et al.*, 2018). These results are in agreement with our previous study on the glycaemic indices of minimally polished brown rice (MPR) and 24 h glycaemic responses of both brown and minimally polished rice diets (Mohan *et al.*, 2014; Shobana *et al.*, 2017) wherein even MPR showed glycaemic responses similar to that of WR. This indicates the detrimental effects of polishing of cereals/millets.

In the CGM menu, apart from decorticated millet, other millet-based preparations such as *adai* (pancake), *roti* (flattened bread, GI=104), dumplings (steamed FM balls, GI=68), preparations from the millet showed upper medium or higher glycaemic response, GI in earlier studies reported by several others (Urooj, Rupashri & Puttaraj, 2006).

The glycaemic response of cereal based preparations may depend on the nature of fibre present. There are studies which report that soluble fibres are more efficient in reducing the glycemic responses of foods (Brennan, 2005) such as beta glucans in oats and barley. FM dietary fibre is predominantly insoluble in nature (Devi *et al.*, 2014). Insoluble fibres are non-viscous and may protect the starch from digestive enzymes when they are intact. Any processing that disrupts its intactness, such as pulverising and grinding, may lead to loss in the functionality of insoluble fibre and thus allow rapid digestion of starch as in the case of bran flakes, breakfast cereals (Björck, Liljeberg & Östman, 2000). This could possibly explain the similar glycaemic response between FM and WR diets observed in the study despite the higher fibre content in FM-based diets.

Although prospective epidemiological studies have also shown that insoluble fibre can reduce incidence of type 2 diabetes, Jenkins *et al.* (2008) has shown that a low–glycaemic index diet was more effective than a high–cereal fibre diet in lowering HbA1C levels in subjects with type 2 Diabetes.

Several studies indicate that dietary polyphenols (from tea and cinnamon) are involved in insulin regulation (Anderson, 2008; Cameron *et al.*, 2008). Such studies are not available on the millet phenolics. FM seed coat is known to be a rich source of polyphenols and studies on these lines may throw light on the effect of FM phenolics on insulin regulation. However, in our present study, we found non-significant decrease in fasting insulin levels post five days of feeding FM diets and this warrants further evaluation with longer duration of feeding with FM diets.

Limitations of the study include the short duration of exposure with FM diets and small sample size. Studies with larger sample sizes with longer duration of feeding are needed to assess the long-term health effects of FM consumption, including among type 2 diabetic subjects. The strengths of our study include the randomised crossover and iso-caloric study design in which two diets were given to the participants in a random order, which enables us to fully control for within -subject differences in responses. The experimental kitchen at the centre where the study was performed had all the required facilities and well-trained research dietitians for standardising the test diet meals. CGM system (iPro2 model) is a minimally invasive glucose monitoring tool, thereby the participants were able to continue their day-to-day activities while wearing the CGM device; hence the results are more representative of a real-life situation.

CONCLUSION

The use of several kinds of traditional South Indian preparations of FM allows us to examine the overall glycaemic response of commonly consumed finger millet foods as compared to that of WR-based preparations. The result suggests that use of FM flour-based food preparations and decorticated FM grains to replace WR in the Indian diets offer no significant benefit with regards to 24 h glycaemic response. However, studies of longer duration with larger sample size are needed to verify our findings.

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Authors' contributions

SS conceived the concept and initiated the first draft of the manuscript. RG and BRM conducted the CGM study and interpreted the data. CA and NL analysed the data and led the statistical analysis. VK and NG assisted in CGM study. MM incorporated the edits from different authors. VS, NGM, RU, RMA, CJKH, KK and VM reviewed the manuscript and helped with the interpretation of data. All authors contributed to their vision and finalization of the manuscript.

Conflict of interest

All authors do not have any conflict of interest. All authors declared that they have no duality of interest associated with this manuscript. No competing financial interests exist.

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