

Supplementary Materials

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STUDY DESIGN AND METHODOLOGY– THE ICMR-INDIAB STUDY

Online Supplementary Material 1: ICMR INDIAB STUDY METHODOLOGY

Online Supplementary Material 1.1: Study Design:

The ICMR-INDIAB study is a cross-sectional, population-based study designed to collect data on prevalence of diabetes and related disorders/ risk factors (including diet and physical activity) from urban and rural areas across India. The current manuscript includes data from all 27 states, the National Capital Territory of Delhi and the Union Territories (UT) of Chandigarh and Puducherry (n= 30 states/UT). A truly representative sample of the population was obtained by using the Probability Proportional to Size (PPS) method with three-level stratification: (i) geography-all state/UT being divided into contiguous districts, similar to the approach adopted in National Family Health Survey - 3 (NFHS – 3); (ii) population size- participants chosen from each state irrespective of big/small was proportionate to their contribution to the total urban/rural population of the state to avoid bias; (iii) female literacy rate considered as a proxy indicator of socio-economic status, to ensure the sample chosen from each region was truly representative of the state/UT being studied.

The primary sampling units were census enumeration blocks and villages in urban and rural areas respectively. Using a systematic sampling method, 24 and 56 households were randomly chosen from urban and rural areas, respectively. Door-to-door assessment was done and from each household, one adult was randomly selected, in accordance with the World Health Organization (WHO) 'Kish method' [STEPwise approach to surveillance (STEPS) World Health Organization (WHO) <http://www.who.int/chp/steps/en/>] thereby avoiding selection bias with respect to sex and age.

Online Supplementary Material 1.2: Sample Size:

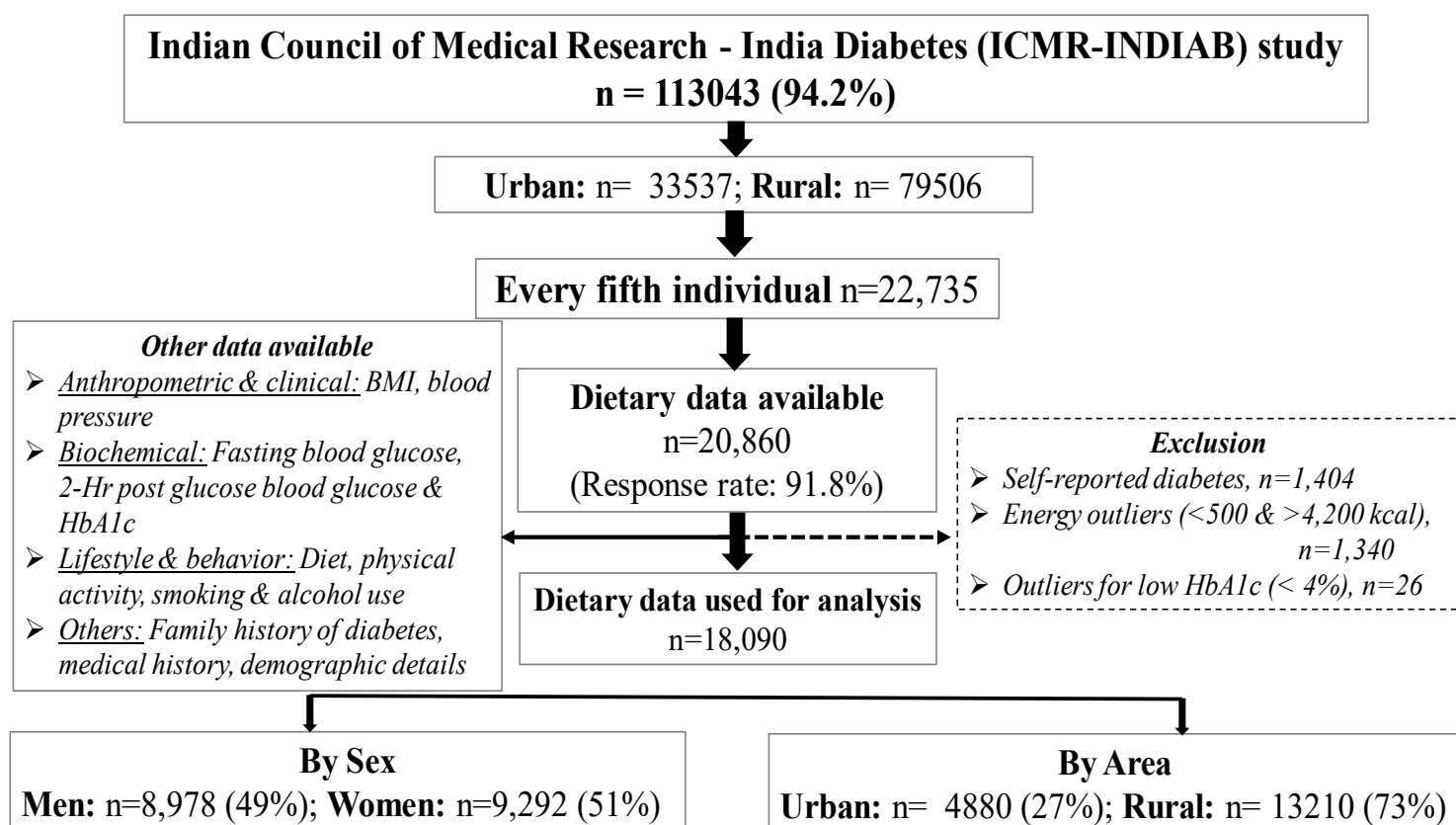
A sample size of 4000 adults (1200+2800 urban and rural respectively) per state/UT was estimated so as to provide 80% power and a 5% alpha error in each state, assuming a T2D prevalence of 10% in urban, 4% in rural and a 20% non-response rate. In addition, calculation was done for urban and rural areas independently, due to wide variations in the urban and rural prevalence rates of type 2 diabetes as reported by earlier studies.

For the current study, detailed dietary and biochemical assessment was done for every fifth participant from the main study (n=22,735). Of these, dietary data was available for 20,860 individuals with a response rate of 91.8%. Individuals with self-reported T2D (n=1,404), outliers for energy intake (n=1,340 with <500 and >4200 kcal) and those with very low HbA1c (<4%; n=26) suggestive of hemoglobinopathy were excluded from further analysis. The final dietary data included a total of 18,090 individuals (49% males; 27% urban) which is representative of the demography of the nation.

Online Supplementary Material 1.3: Period of Survey:

The study was conducted in a phased manner and included 5 phases. Phase I (2008 to 2010) covered four regions of India-Tamil Nadu, Chandigarh, Jharkhand and Maharashtra from the south, north, east and west respectively of the country. Phase II (2011-2020) consisted of undivided Andhra Pradesh (subsequently divided into Andhra Pradesh and Telangana), Bihar, Gujarat, Karnataka and Punjab (surveyed between, 2012–2013). Phase III (2017–2018)- Delhi, Madhya Pradesh, Rajasthan and Uttar Pradesh, Phase IV (during 2018-2019) included Kerala, Goa, Puducherry, Haryana and Chhattisgarh, North East Phase included Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura (survey period, 2011–2017) and last Phase V (2019–2020) covered Himachal Pradesh, Uttarakhand, Odisha and West Bengal.

Figure 1.1: Flow Diagram of Study Methodology



Online Supplementary Material 1.4: Assessments:

Online Supplementary Material 1.4.1: Anthropometry:

- Height was measured in centimeters using a stadiometer (SECA Model 214, SecaGmbh Co, Hamburg, Germany) with the participant standing upright with heels together while barefoot, with the back against the vertical back board and eyes directed forward.
- Weight (in kilograms) was recorded to the nearest 0.1kg using a weighing scale (SECA Model 807, SecaGmbh Co, Hamburg, Germany) positioned on a flat and firm surface with participants wearing light clothing,
- Body mass index (in Kg/m²): was obtained by dividing weight in kilograms by height in meters squared.
- Waist circumference (in centimeters): was measured twice using a non-stretchable measuring tape at the smallest horizontal girth between the costal margins and the iliac crest at the end of expiration. Participants were instructed to keep both feet together and stand erect during measurement.

Online Supplementary Material 1.4.2: Clinical Assessments

Blood pressure was recorded twice at an interval of 5 mins for each participant using the electronic OMRON machine (Omron Corporation, Tokyo, Japan). The participant was requested to sit in a comfortable position and blood pressure was measured to the nearest 1 mmHg on the right arm. The mean of the two readings was taken as the final BP value.

Online Supplementary Material 1.4.3: Biochemical Assessments

- Fasting and 2-hour glucose [after an 82.5 g oral glucose load (equivalent to 75 g of anhydrous glucose)] were estimated using a glucose meter (One Touch Ultra, Lifescan, Johnson & Johnson, Milpitas, CA).
- Fasting venous blood samples were drawn for assessment of glycosylated haemoglobin (HbA1c) in every 5th participant in this study. HbA1c was measured by Variant II Turbo machine (BIORAD, Hercules, CA) using high-pressure liquid chromatography (HPLC).

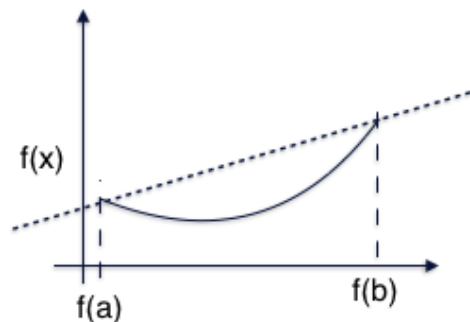
2. Optimization-Driven Recommendations for Macronutrients

2.1 Optimization:

Optimization is a decision-making tool for complex problems. Mathematical programming is an approach for solving the optimization models subject to certain constraints. Two broad class of optimization problems are: convex and non-convex. Convex problems minimize a convex objective over convex set.

A convex function is a real-valued function in which a line joining any two points on the function is always above the two points in the graph. Consider a function $f(x)$, and a line segment connecting two points $x = a$ and $x = b$ with $b > a$. Let the function values at these points be $f(a)$ and $f(b)$. For a convex function the line joining the points $f(a)$ and $f(b)$ always lies above the graph of the function $f(x)$ as illustrated in Figure below.

Figure 2.1: Convex Functions



A convex set is a set in which all the points on any straight line connecting two points is contained in the set. The convex problems can be solved in polynomial time and the solution obtained is global, i.e., the optimal solution obtained for the decision vectors is unique. Examples of convex optimization problems are: linear programming, quadratic programming, second order cone programs, semidefinite programs, and cone programs. In particular, minimizing linear and quadratic objectives with linear constraints are optimization problems widely used in least-squares, portfolio optimization, risk analysis etc.

2.2 Linear Regression for NDD, PD, NGT

The first step to provide optimization-driven recommendations is to fit a linear regression model for the HbA1c, the output variable for each of the target glycemic category. The INDIAB diet data with dietary and non-dietary covariates and their influence on the HbA1c% is modeled using the linear regression model. The following variables were determined as a priori potentially affecting HbA1c -: age, sex, BMI, family history of T2D, systolic and diastolic blood pressure, PAL, fasting and 2hr post glucose load blood glucose, the main cereal staple (rice/wheat/ millet), type of diet (vegetarian/non-vegetarian etc.), total energy, and macronutrients (g and %E) – carbohydrate, dietary fibre, protein, total fat and fatty acids. Denoting the non-dietary variables by $x_1 \dots x_n$ and the macronutrients as $z_1 \dots z_4$, the linear regression optimizer aims to compute the parameters $a_1 \dots a_n$ and $b_1 \dots b_4$ by solving the following optimization model:

$\mathcal{P1}$:

$$\begin{aligned}
 & \min_{a_1, \dots, a_n, b_1, \dots, b_4, \epsilon} \|y - HbA1c_{est}\|_{\ell_2} + \epsilon \\
 & \text{s. t.} \\
 & HbA1c_{est} = a_1^i x_1 + a_2^i x_2 + \dots + a_n^i x_n + b_1^i z_1 + b_2^i z_2 + b_3^i z_3 + b_4^i z_4 : x \in X, z \in Z, i \\
 & \quad \in \{NDD, PD, NGT\} \\
 & z_{min} \leq z \leq z_{max} \\
 & HbA1c_{est}^{min} \leq HbA1c_{est} \leq HbA1c_{est}^{max}, \\
 & HbA1c_{est} - HbA1c \leq \epsilon \\
 & HbA1c_{est} - HbA1c \geq \epsilon \\
 & 0 \leq \epsilon \leq d
 \end{aligned}$$

where $y_{max}, y_{min}, z_{max}$ and z_{min} are the minimum and maximum values of the non dietary and dietary factors. In addition, the error in prediction is limited by a bound given by ϵ . The error bound limits the deviations of the estimates from the actual value and is found to improve the accuracy of the predictions. The error bound ϵ is limited by an upper bound d and is non-negative. This constraint helps handling noise in the input data and also makes it possible to limit the error. By solving the problem $\mathcal{P1}$, the model coefficients $a_1^i \dots a_n^i$ and $b_1^i, b_2^i, b_3^i, b_4^i$ are obtained. In addition, X and Z represent the vector of dietary and non-dietary vectors for specific glycemic categories NDD, PD and NGT, respectively. Once the linear regression model is solved and the linear model parameters for different glycemic categories is obtained, the macronutrient recommendations can be obtained using the optimization routine:

$\mathcal{P2}$:

$$\begin{aligned}
 & \min_{z_1, z_2, z_3, z_4} \|HbA1c_{est} - Target^i\|_{\ell_2} \\
 & \text{s. t.} \\
 & HbA1c_{est} = a_1^i x_1 + a_2^i x_2 + \dots + a_n^i x_n + b_1^i z_1 + b_2^i z_2 + b_3^i z_3 + b_4^i z_4 : x \in X, z \in Z, i \\
 & \quad \in \{NDD, PD, NGT\} \\
 & z_{min} \leq z \leq z_{max}, \\
 & HbA1c_{est}^{min} \leq HbA1c_{est} \leq HbA1c_{est}^{max}, \\
 & \sum z = 100, \\
 & \sum HbA1c_{est} \leq r * \text{sum}(HbA1c)_{actual},
 \end{aligned}$$

The optimization model $\mathcal{P2}$ aims to move the HbA1c% closer to the target value determined by the glycemic category. In our analysis, the target value for NDD, PD and NGT are given by 6.4,

5.4, and for the NGT category the objective is to minimize the total HbA1c for diabetes remission. The objective is to move the $HbA1c_{est}$ closer to the target value and penalize both negative and positive deviations from the target. The constraints on the problem are: the linear regression model capturing the $HbA1c_{est}$ for the different glycemic categories. The macronutrient limits, $HbA1c_{est}$ estimation limits, and total percentage of the macronutrients to be equal to 100 are the constraints. In addition, to recommend a range of the macronutrients, a reduction factor r is introduced and by varying the factor the number of people who are with diabetes risk can be reduced or increased. This provides a range of macronutrient percentages and the direction of the movement away from risk. Similarly, for the prevention to progression, the target is selected to be 6.5 and the objective here is to avoid them from progressing to the NDD. The constraints used for the macronutrient composition based on the data are shown in **Table 2.1**.

Table 2.1: Constraint limits used for macro nutrients in optimization models

S. No	Macro nutrients	Minimum limit % E	Maximum limit % E
1	Carbohydrate	40	70
2	Protein	14	20
3	Fat	20	30
4	Fibre	3	6

Figure 2.2: Linear model HbA1c Prediction versus Actual Value for NDD category

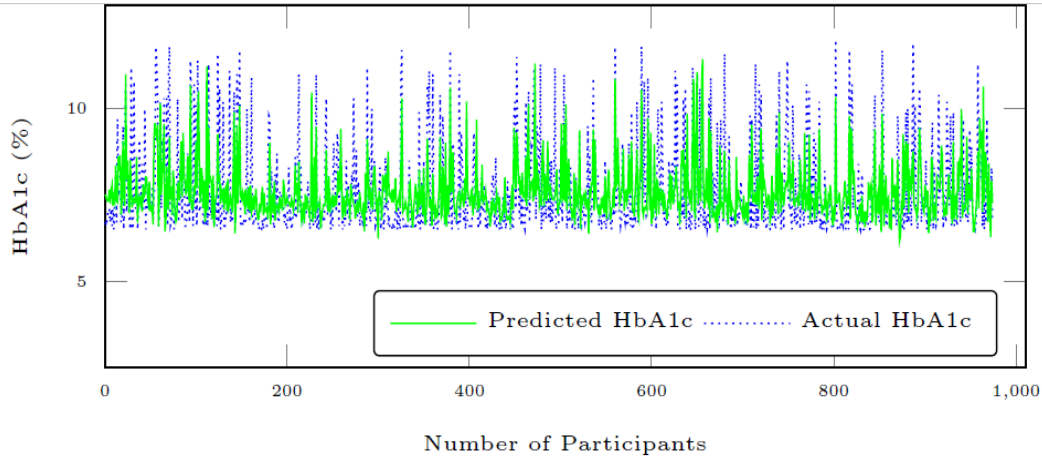


Figure 2.3: Linear model HbA1c Prediction versus Actual Value for PD category

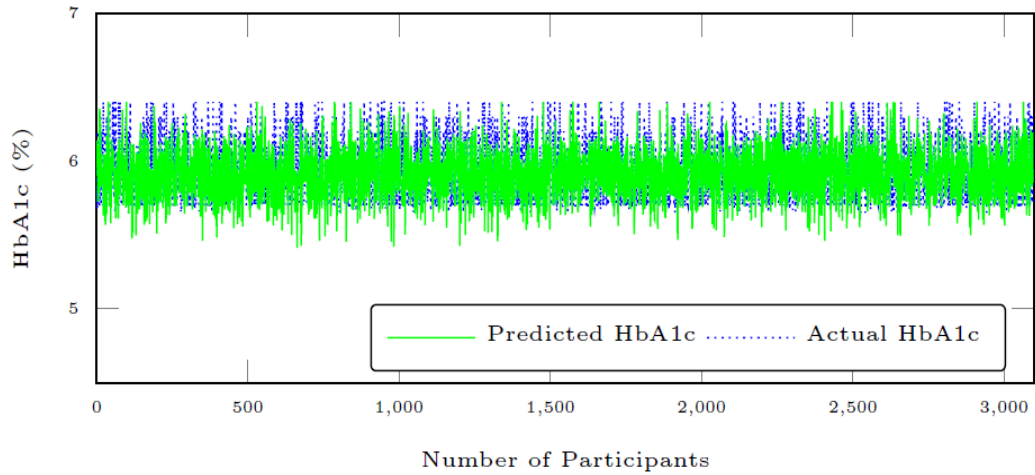
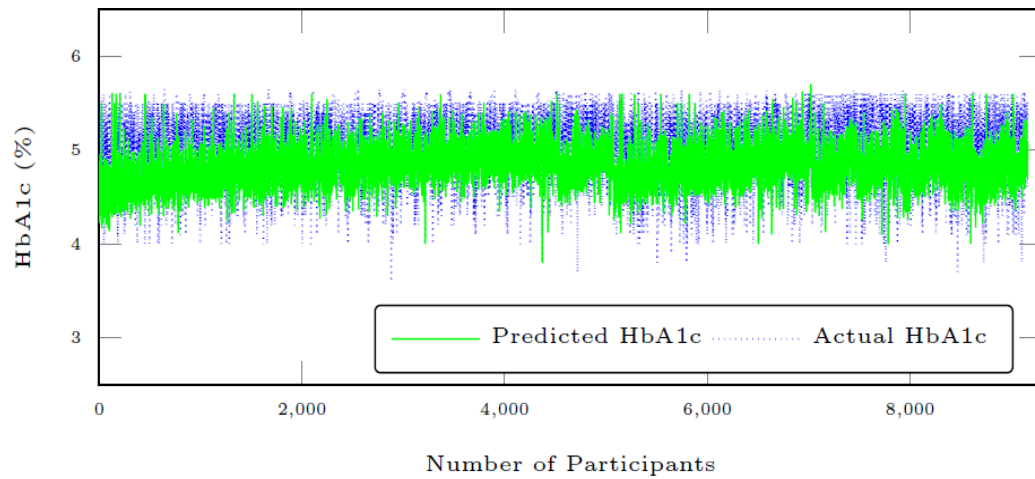


Figure 2.4: Linear model HbA1c Prediction versus Actual Value for NGT category



The linear model fit results with actual measured HbA1c for NDDs, PDs and NGTs is shown in Figure 2.3, 2.4, and 2.5, respectively. From figures one can see that linear regression model provided more accurate HbA1c predictions with respect to the actual HbA1c measurements and the root mean square error (RMSE) values for the linear regression models is shown in Table 2.2. The RMSE values indicate that the linear regression model accuracy and that the estimation error is within acceptable bounds for the different glycemic categories.

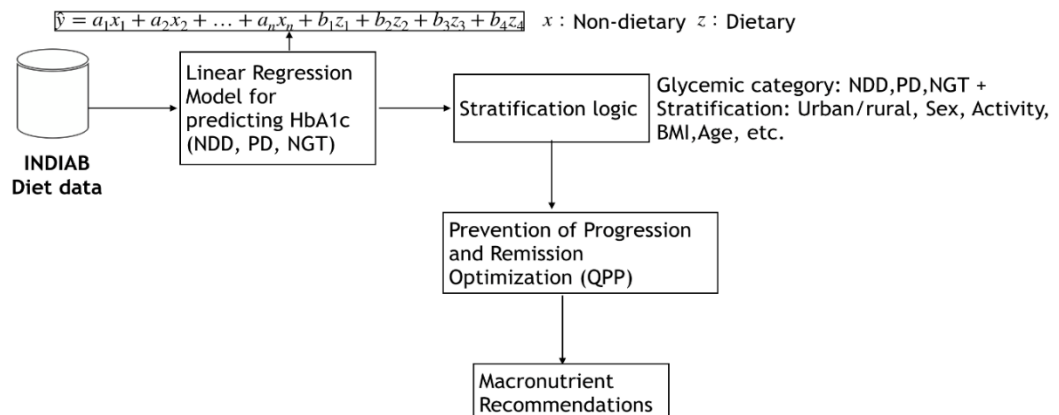


Figure 2.5: Optimization Work Flow

Table 2.2: Linear model HbA1c Prediction vs Actual values RMSE for NDD, PD, and NGT

S. No	Glycemic Categories	RMSE (Root Mean Square Error)
1	NDD (Newly Diagnosed diabetes)	0.26
2	PD (Pre-Diabetes)	0.24
3	NGT (Normal Glucose Tolerance)	0.35

Table 3.1: Nutritional profile of Asian Indians Stratified by glycemic category and place of residence (urban/rural) (n=18090) (27 States & 3 Union Territories)

Energy adjusted nutrient intake per day	Adults with NDD (n=1594)		Adults with PD (n=7336)		Adults with NGT (n=9160)	
	Urban (n=551)	Rural (n=1043)	Urban (n=2075)	Rural (n=5261)	Urban (n=2254)	Rural (n=6906)
Total Energy (Kcal)	2139 (1052)	2030 (983)*	2154 (986)	2030 (968)**	2148 (1035)	2010 (990)**
Carbohydrates (g)	321 (39)	326 (40)**	322 (41)	325 (43)**	320 (45)	328 (45)**
Carbohydrates (%E)	60.7 (7.9)	61.8 (7.9)**	61.0 (7.8)	62.0 (8.6)**	60.5 (8.9)	62.0 (9.4)**
Glycemic Load (g)	160 (45)	167 (49)**	163 (47)	169 (52)**	160 (49)	172 (55)**
Glycemic index (%)	60 (9)	62 (10)**	61 (9)	62 (10)**	61 (9)	63 (10)**
Total Dietary Fibre (g)	37 (12)	37 (12)	37 (12)	37 (12)	37 (13)	37 (12)*
Total Dietary Fibre (%E)	3.4 (1.2)	3.5 (1.2)	3.5 (1.2)	3.5 (1.3)	3.4 (1.3)	3.5 (1.3)*
Protein(g)	63 (10)	63 (10)	63 (11)	63 (10)	64 (13)	63 (11)**
Protein(%E)	11.8 (2.0)	11.8 (2.1)	11.8 (2.1)	11.8 (2.1)	12.1 (2.6)	12.0 (2.3)**
Total Fat(g)	62 (15)	59 (16)**	61 (16)	59 (17)**	61 (17)	58 (18)**
Total Fat(%E)	25.6 (7.0)	24.9 (7.2)**	25.6 (7.1)	24.8 (8.1)**	25.9 (7.3)	24.1 (8.4)**
Total SFA (g)	23 (11)	22 (10)	22 (11)	21 (10)**	22 (11)	20 (11)**
Total SFA (%E)	9.6 (4.9)	9.2 (4.8)	9.4 (4.6)	8.8 (4.9)**	9.2 (5.0)	8.3 (5.0)**
Total MUFA (g)	15 (6)	14 (5)**	15 (6)	15 (6)**	15 (6)	14 (6)**
Total MUFA (%E)	6.4 (2.4)	6.1 (2.4)**	6.3 (2.4)	6.1 (2.6)**	6.3 (2.6)	5.8 (2.7)**
Total PUFA (g)	19 (7)	18 (7)*	19 (7)	19 (7)*	18 (8)	18 (8)**
Total PUFA (%E)	8.1 (3.1)	7.7 (3.2)**	7.9 (3.0)	7.8 (3.5)*	7.5 (3.5)	7.3 (3.6)**
PUFA n6 (g)	17 (7)	17 (7)*	17 (7)	17 (7)*	16 (8)	16 (8)**
PUFA n6 (%E)	7.2 (3.2)	7.2 (3.7)	7.1 (3.2)	7.0 (3.6)**	7.1 (3.4)	7.0 (3.6)
PUFA n3 (g)	0.5 (0.3)	0.5 (0.3)	0.5 (0.4)	0.5 (0.3)	0.6 (0.5)	0.5 (0.4)
PUFA n3 (%E)	0.21 (0.14)	0.20 (0.13)	0.21 (0.16)	0.20 (0.15)	0.23 (0.22)	0.21 (0.19)

Data presented as Median (IQR).

NDD-Newly diagnosed diabetes, PD- Pre diabetes, NGT- Normal glucose tolerance.

*p-value <0.05 considered as significant using Mann-Whitney U test in within group analysis comparing urban vs rural in each glycemic status category.

†p-value <0.001 considered as significant using Mann-Whitney U test in within group analysis comparing urban vs rural in each glycemic status category

Table 3.2: Nutritional profile of Asian Indians stratified by glycemic category and sex (n=18090) (27 States & 3 Union Territories)

Energy adjusted nutrient intake per day	Adults with NDD (n=1594)		Adults with PD (n=7336)		Adults with NGT (n=9160)	
	Men (n=774)	Women (n=820)	Men (n=3503)	Women (n=3833)	Men (n=4521)	Women (n=4639)
Total Energy (Kcal)	2196 (1091)	1969 (888)**	2203 (1082)	1962 (905)**	2171 (1102)	1928 (935)**
Carbohydrates (g)	323 (40)	325 (37)	325 (46)	324 (40)	326 (48)	325 (42)
Carbohydrates (%E)	61.2 (8.1)	61.6 (7.7)	61.5 (8.4)	61.4 (8.3)	61.8 (9.3)	61.7 (9.2)
Glycemic Load (g)	164 (52)	164 (44)	168 (54)	165 (48)	170 (56)	169 (52)
Glycemic index (%)	61 (10)	61 (10)	62 (9)	61 (10)*	63 (10)	63 (10)
Total Dietary Fibre (g)	37 (13)	38 (12)	37 (13)	37 (12)*	37 (13)	37 (12)**
Total Dietary Fibre (%E)	3.4 (1.2)	3.5 (1.2)	3.4 (1.2)	3.5 (1.2)**	3.4 (1.3)	3.5 (1.2)**
Protein(g)	63 (11)	63 (10)	63 (12)	63 (10)**	64 (12)	63 (11)**
Protein(%E)	11.9 (2.0)	11.8 (2.0)	11.9 (2.2)	11.7 (2.0)**	12.0 (2.3)	11.9 (2.4)**
Total Fat(g)	60 (17)	60 (15)	59 (19)	60 (16)**	58 (18)	59 (17)**
Total Fat(%E)	25.3 (7.1)	25.1 (6.9)	24.7 (8.0)	25.4 (7.6)**	24.3 (8.2)	24.8 (8.3)**
Total SFA (g)	22 (12)	23 (9)	21 (11)	22 (10)**	20 (11)	21 (10)**
Total SFA (%E)	9.2 (4.9)	9.6 (4.6)	8.7 (4.8)	9.2 (4.8)**	8.4 (4.9)	8.7 (5.2)**
Total MUFA (g)	15 (6)	14 (5)	15 (6)	15 (5)*	14 (6)	14 (6)
Total MUFA (%E)	6.2 (2.4)	6.1 (2.4)	6.1 (2.6)	6.2 (2.5)**	5.9 (2.7)	5.9 (2.7)
Total PUFA (g)	19 (8)	18 (6)	18 (8)	19 (6)**	17 (8)	18 (7)
Total PUFA (%E)	7.9 (3.3)	7.8 (3.0)	7.7 (3.4)	8.0 (3.2)**	7.3 (3.7)	7.4 (3.5)
PUFA n6 (g)	17 (7)	17 (6)	17 (8)	17 (6)*	16 (8)	16 (7)
PUFA n6 (%E)	7.2 (3.5)	7.2 (3.5)	7.0 (3.5)	7.1 (3.5)	7.0 (3.5)	7.1 (3.5)
PUFA n3 (g)	0.5 (0.3)	0.5 (0.3)	0.5 (0.4)	0.5 (0.3)	0.5 (0.5)	0.6 (0.4)
PUFA n3 (%E)	0.20 (0.13)	0.20 (0.13)	0.21 (0.15)	0.20 (0.15)	0.22 (0.20)	0.21 (0.20)

Data presented as Median (IQR).

NDD-Newly diagnosed diabetes, PD- Pre diabetes, NGT- Normal glucose tolerance.

*p-value <0.05 considered as significant using Mann-Whitney U test in within group analysis comparing urban vs rural in each glycemic status category.

† p-value <0.001 considered as significant using Mann-Whitney U test in within group analysis comparing urban vs rural in each glycemic status category

Table 3.3: Nutritional profile of Asian Indians Stratified by glycemic category and physically activity levels (n=18090) (27 States & 3 Union Territories)

Energy adjusted nutrient intake per day	Adults with NDD (n=1594)		Adults with PD (n=7336)		Adults with NGT (n=9160)	
	Physically active(n=477)	Physically inactive (n=1117)	Physically active(n=2462)	Physically inactive (n=4874)	Physically active(n=3287)	Physicallyinactive (n=5873)
Total Energy (Kcal)	2135 (1030)	2021 (1007)	2154 (977)	2030 (1007)**	2085 (1024)	2014 (996)**
Carbohydrates (g)	329 (40)	322 (38)**	327 (44)	323 (48)**	329 (48)	324 (43)**
Carbohydrates (%E)	62.5 (7.6)	61.0 (8.0)**	61.8 (8.5)	61.2 (8.0)**	62.3 (9.8)	61.3 (9.0)**
Glycemic Load (g)	172 (54)	162 (45)**	169 (53)	165 (45)**	173 (60)	168 (51)**
Glycemic index (%)	62 (10)	61 (10)*	62 (10)	61 (10)*	63 (10)	63 (10)
Total Dietary Fibre (g)	38 (12)	37 (12)*	37 (12)	37 (12)	37 (12)	37 (13)**
Total Dietary Fibre (%E)	3.5 (1.2)	4.1 (1.2)*	3.5 (1.2)	3.5 (1.2)	3.4 (1.2)	3.5 (1.3)**
Protein(g)	63 (11)	63 (10)	63 (11)	63 (10)	64 (13)	63 (11)*
Protein(%E)	11.9 (2.1)	11.8 (2.0)	11.8 (2.2)	11.8 (2.0)	12.1 (2.6)	11.9 (2.2)*
Total Fat(g)	58 (16)	61 (15)**	59 (18)	60 (17)**	57 (19)	60 (17)**
Total Fat(%E)	24.3 (7.2)	25.5 (6.9)**	24.6 (8.0)	25.3 (6.9)**	23.9 (8.6)	24.9 (8.0)**
Total SFA (g)	21 (12)	23 (10)*	21 (11)	22 (10)**	20 (11)	21 (11)**
Total SFA (%E)	8.9 (5.2)	9.5 (4.6)*	8.7 (4.7)	9.1 (4.6)**	8.3 (5.0)	8.7 (5.0)**
Total MUFA (g)	14 (6)	15 (5)**	15 (6)	15 (6)*	14 (6)	14 (6)**
Total MUFA (%E)	6.0 (2.4)	6.3 (2.4)*	6.1 (2.5)	6.2 (2.4)*	5.9 (2.7)	5.9 (2.7)**
Total PUFA (g)	18 (7)	19 (7)**	18 (8)	19 (7)*	17 (8)	18 (7)**
Total PUFA (%E)	7.5 (3.3)	7.9 (3.0)**	7.7 (3.5)	7.9 (3.0)**	7.0 (3.7)	7.6 (3.5)**
PUFA n6 (g)	16 (7)	17 (6)**	17 (8)	17 (7)*	15 (8)	17 (7)**
PUFA n6 (%E)	7.1 (3.6)	7.2 (3.4)	7.0 (3.5)	7.0 (3.4)	7.0 (3.4)	7.1 (3.6)
PUFA n3 (g)	0.5 (0.4)	0.5 (0.3)*	0.5 (0.4)	0.5 (0.3)	0.6 (0.6)	0.5 (0.4)**
PUFA n3 (%E)	0.22 (0.16)	0.19 (0.12)**	0.22 (0.18)	0.20 (0.12)	0.24 (0.25)	0.20 (0.17)**

Data presented as Median (IQR).

NDD-Newly diagnosed diabetes, PD- Pre diabetes, NGT- Normal glucose tolerance.

*p-value <0.05 considered as significant using Mann-Whitney U test in within group analysis comparing urban vs rural in each glycemic status category.

†p-value <0.001 considered as significant using Mann-Whitney U test in within group analysis comparing urban vs rural in each glycemic status category

Table 3.4: Nutritional profile of Asian Indians Stratified by glycemic category and age (<60- ≥60 years)(n=18090) (27 States & 3 Union Territories)

Energy adjusted nutrient intake per day	Adults with NDD (n=1594)		Adults with PD (n=7336)		Adults with NGT (n=9160)	
	≥60 Age (n=417)	< 60 Age (n=1177)	≥60 Age (n=1448)	< 60 Age (n=5888)	≥60 Age (n=986)	< 60 Age (n=8174)
Total Energy (Kcal)	1922 (944)	2127 (991)**	1941 (1003)	2100 (971)**	1907 (930)	2056 (1025)**
Carbohydrates (g)	323 (40)	324 (39)	324 (43)	324 (42)	324 (44)	326 (45)
Carbohydrates (%E)	61.4 (8.2)	61.4 (7.8)	61.4 (8.7)	61.0 (8.3)	61.6 (9.7)	61.8 (9.2)
Glycemic Load (g)	164 (46)	164 (48)	167 (50)	166 (50)	169 (54)	169 (54)
Glycemic index (%)	61 (10)	61 (9)	61 (10)	61 (10)	62 (11)	63 (10)
Total Dietary Fibre (g)	37 (11)	37 (12)	37 (11)	37 (12)	37 (12)	37 (13)
Total Dietary Fibre (%E)	3.4 (1.3)	3.5 (1.2)	3.5 (1.2)	3.5 (1.2)	3.5 (1.3)	3.4 (1.3)
Protein(g)	63 (10)	63 (10)	63 (11)	63 (10)	64 (12)	64 (11)
Protein(%E)	11.8 (2.1)	11.8 (2.0)	11.8 (2.3)	11.8 (2.0)	12.0 (2.6)	12.0 (2.3)
Total Fat(g)	60 (16)	60 (16)	60 (17)	60 (17)	59 (17)	59 (18)
Total Fat(%E)	24.9 (7.3)	25.3 (6.8)	25.1 (8.4)	25.1 (7.7)	24.5 (8.1)	24.6 (8.2)
Total SFA (g)	23 (11)	22 (10)	22 (11)	21 (10)	21 (11)	21 (11)
Total SFA (%E)	9.6 (5.2)	9.2 (4.6)	9.2 (5.4)	8.9 (4.7)*	8.7 (5.5)	8.5 (5.0)*
Total MUFA (g)	15 (5)	15 (5)	15 (6)	15 (6)*	14 (6)	14 (6)
Total MUFA (%E)	6.1 (2.5)	6.2 (2.4)	6.1 (2.6)	6.2 (2.5)	5.8 (2.9)	5.9 (2.7)
Total PUFA (g)	18 (6)	19 (7)*	18 (7)	19 (7)*	17 (7)	18 (8)*
Total PUFA (%E)	7.6 (3.2)	7.9 (3.1)*	7.7 (3.5)	7.9 (3.3)*	7.3 (3.6)	7.4 (3.6)*
PUFA n6 (g)	17 (6)	17 (7)*	17 (7)	17 (7)*	16 (7)	16 (8)*
PUFA n6 (%E)	7.1 (3.4)	7.2 (3.5)	7.0 (3.4)	7.0 (3.5)	6.8 (3.5)	7.1 (3.5)*
PUFA n3 (g)	0.5 (0.2)	0.5 (0.3)	0.5 (0.3)	0.5 (0.3)	0.6 (0.4)	0.5 (0.5)
PUFA n3 (%E)	0.19 (0.11)	0.21 (0.14)*	0.20 (0.15)	0.21 (0.15)	0.20 (0.19)	0.22 (0.20)

Data presented as Median (IQR).

NDD-Newly diagnosed diabetes, PD- Pre diabetes, NGT- Normal glucose tolerance.

*p-value <0.05 considered as significant using Mann-Whitney U test in within group analysis comparing urban vs rural in each glycemic status category.

† p-value <0.001 considered as significant using Mann-Whitney U test in within group analysis comparing urban vs rural in each glycemic status category

Table 3.5: Nutritional profile of Asian Indians stratified by glycemic category and BMI categories (< 23 kg/m² - ≥23 kg/m²) (n=18090) (27 States & 3 Union Territories)

Energy adjusted nutrient intake per day	Adults with NDD (n=1594)		Adults with PD (n=7336)		Adults with NGT (n=9160)	
	≥23 kg/m ² BMI (n=980)	< 23 kg/m ² BMI (n=614)	≥23 kg/m ² BMI (n=3629)	< 23 kg/m ² BMI (n=3707)	≥23 kg/m ² BMI (n=3059)	< 23 kg/m ² BMI (n=6101)
Total Energy (Kcal)	2099 (1015)	2022 (969)	2083 (961)	2051 (1005)*	2124 (989)	2001 (1019)**
Carbohydrates (g)	322 (37)	327 (44)*	322 (40)	326 (44)**	323 (44)	327 (45)**
Carbohydrates (%E)	61.0 (7.5)	62.0 (8.5)*	61.0 (8.0)	61.9 (8.9)**	61.2 (8.6)	62.0 (9.5)**
Glycemic Load (g)	162 (46)	168 (51)**	163 (47)	170 (53)**	164 (49)	173 (56)**
Glycemic index (%)	60 (9)	62 (10)**	61 (9)	62 (10)**	62 (9)	63 (10)**
Total Dietary Fibre (g)	37 (12)	38 (13)*	37 (12)	37 (12)*	37 (13)	37 (12)
Total Dietary Fibre (%E)	3.4 (1.2)	3.5 (1.4)*	3.4 (1.2)	3.5 (1.2)*	3.4 (1.2)	3.4 (1.3)
Protein(g)	63 (10)	62 (11)	63 (11)	63 (11)	64 (12)	63 (11)
Protein(%E)	11.9 (2.0)	11.8 (2.2)	11.8 (2.0)	11.8 (2.2)	12.1 (2.5)	12.0 (2.3)*
Total Fat(g)	61 (15)	59 (16)**	61 (16)	58 (18)**	60 (17)	58 (18)**
Total Fat(%E)	25.5 (6.7)	24.7 (7.6)**	25.6 (7.3)	24.5 (8.2)**	25.2 (7.7)	24.1 (8.5)**
Total SFA (g)	23 (10)	21 (10)**	22 (10)	21 (10)**	22 (11)	20 (11)**
Total SFA (%E)	9.7 (4.6)	8.8 (4.8)**	9.3 (4.6)	8.6 (4.8)**	9.1 (5.0)	8.3 (5.0)**
Total MUFA (g)	15 (5)	14 (6)**	15 (6)	14 (6)**	15 (6)	14 (6)**
Total MUFA (%E)	6.4 (2.3)	5.9 (2.4)**	6.3 (2.4)	6.0 (2.6)**	6.2 (2.6)	5.7 (2.7)**
Total PUFA (g)	19 (7)	18 (7)**	19 (7)	18 (8)**	18 (8)	17 (8)**
Total PUFA (%E)	8.0 (2.9)	7.5 (3.4)**	8.0 (3.1)	7.7 (3.5)**	7.6 (3.6)	7.3 (3.6)**
PUFA n6 (g)	17 (6)	16 (7)**	17 (7)	17 (7)**	17 (8)	16 (7)**
PUFA n6 (%E)	7.2 (3.4)	7.0 (3.6)	7.0 (3.4)	7.0 (3.5)	7.1 (3.5)	7.0 (3.5)
PUFA n3 (g)	0.5 (0.3)	0.5 (0.3)	0.5 (0.3)	0.5 (0.3)	0.6 (0.5)	0.5 (0.4)
PUFA n3 (%E)	0.20 (0.13)	0.21 (0.14)	0.21 (0.15)	0.20 (0.15)	0.22 (0.21)	0.21 (0.19)**

Data presented as Median (IQR).

NDD-Newly diagnosed diabetes, PD- Pre diabetes, NGT- Normal glucose tolerance.

*p-value <0.05 considered as significant using Mann-Whitney U test in within group analysis comparing urban vs rural in each glycemic status category.

† p-value <0.001 considered as significant using Mann-Whitney U test in within group analysis comparing urban vs rural in each glycemic status category