Medical Nutrition Therapy of Pediatric Type 1 Diabetes Mellitus in India:
Unique Aspects and Challenges

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Key words – Medical nutrition therapy, Type 1 Diabetes Mellitus, Indian diets

Running title – Medical nutrition therapy in Indian children

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**Background**

Medical Nutrition therapy (MNT) is a vital aspect of management of type 1 diabetes mellitus (T1DM) and should be tailored to ethnic and family traditions and the socioeconomic and educational status of the patient.

**Objectives**

In this article, we discuss the unique aspects of MNT in children and adolescents with T1DM in the Indian setting, with focus on the challenges faced by patients, dieticians and physicians and how these can be overcome.

**Methods**

The authors reviewed the available literature on MNT in T1DM from India and prepared the document based on their vast collective clinical experience in treating patients with T1DM from different regions in India.

**Results**

Indian diets are predominantly carbohydrate-based with high glycemic index (GI) and low protein content. Various methods are available to increase the protein and fiber content and reduce the GI of food in order to limit glycemic excursions. Insulin regimens need to be tailored to the child’s school timings, meal schedule and the availability of a responsible adult to supervise/administer insulin. All patients, irrespective of economic and education background, should be taught the broad
principles of healthy eating, balanced diet and carbohydrate counting. There are various barriers to dietary compliance including joint family system, changing lifestyles and other factors which need to be addressed.

**Conclusion**

There is a need to customize dietary management according to patient characteristics and needs and develop standardized patient educational material on principles of healthy eating in various regional languages.

**Medical Nutrition Therapy of Pediatric Type 1 Diabetes Mellitus (T1DM) in India: Unique Aspects and Challenges**

India is home to the second largest number of children and adolescents with Type 1 diabetes mellitus (T1DM) in the world, with approximately 171,300 patients in the age group 0-19 years.(1) Due to its large population, India adds the highest number of children with T1DM per year in the age group 0 to 14 years (15900 as estimated by the IDF in its 2019 atlas).(1) Medical Nutrition Therapy (MNT) is an essential component of the management of T1DM.(2) In a country as large and diverse as India, with a variety of diets (3), traditional meal practices(4, 5), and regional, cultural, religious, socio-economic and agriculture differences(6), dietary management of T1DM can be a challenge for health care professionals.(5) There is need for a personalized therapeutic care regime with evidence-based medicine for each patient.(7)

In this article, we discuss the unique aspects and challenges of MNT in the Indian setting, with focus on healthy eating practices, insulin regimes to match meal plans, components of nutrition education and issues related to dietary compliance.
Healthy eating in the Indian setting

Indian cuisine varies from one region to another and from season to season reflecting cultural pluralism. The Starch study documented that diets across all regions in India contain 65-70 percent of calories from carbohydrates, mostly from refined sources like polished white rice, or refined wheat and its products. Only 10-12% of calories are derived from protein, chiefly from milk and vegetarian sources. This high carbohydrate, low fibre diet results in higher post prandial glycaemic values. This data is mainly gathered from patients with Type 2 Diabetes Mellitus (T2DM) as limited information is available in these aspects among individuals with T1DM.

Improving the glycemic index (GI) and protein content of diet: Low GI foods may be beneficial by blunting the glycaemic excursions after meals. The recipes of traditional Indian foods could be modified to increase the fibre and protein content and lower the GI. This can be done without affecting the palatability and without making major changes in the patient’s eating preferences (Table 1).

Fibre content of Indian diets can be increased by consuming whole grains (whole wheat, barley, broken wheat), millets, whole pulses (green gram, red gram, chickpea, and kidney beans), vegetables, salads and fibrous fruits. Addition of dairy products (curd, cottage cheese or paneer), pulses, soybean and egg can augment the protein content especially in those who cannot afford / do not eat meat, fish or poultry.

Traditional main meals in India comprise of a flat bread with vegetables and / or a non-vegetarian item, dal/whole pulses/sprouts with rice, and a dairy product (curd/buttermilk).

Main meals can be started with some protein and fibre. Patients can be advised to have carrot, cucumber or radish sticks with curd, buttermilk or raita (an Indian side dish with curd, chopped vegetables and spices). Besides improving post prandial glucose control this also helps achieve early satiety.
Low carbohydrate snacks (table 2): are recommended when it is not practical to administer a pre-snack insulin bolus. These do not have a significant impact on blood glucose levels provided they are consumed in prescribed amounts. These snacks should be selected cautiously as snacks that are low in carbohydrates could be high in fats especially trans fats and saturated fats which can be detrimental to health (21, 24, 25). Patients are encouraged to select those snacks which are also good sources of protein, healthy fats and fibre. A few examples of low carbohydrate snacks/foods (0 to 5 g carbohydrate per serving) that contain less than 10g total fat and 5 g saturated fat per serving are listed in Table 2.

Fats in diet: There should be emphasis on both quantity as well as quality of cooking oil used. The National Institute of Nutrition (NIN), India, recommends rotation of oils or use of commercially available blended oils to acquire the right balance of fatty acids in the diet. Depending on the region, one could choose between groundnut/sesame/rice bran oil and mustard/soybean oil. (26) Ghee (clarified butter) and coconut oil have been used traditionally as a part of the Indian diet. Intake of these and other sources of saturated fat should ideally not exceed the recommended amount of 7-10% daily calorie intake from saturated fats.

Nuts are a good source of monounsaturated fatty acids as well as protein, fibre and antioxidants. They are low in carbohydrates. Walnuts are a good source of omega-3 fatty acids. When carbohydrate and saturated fat in a snack are partially replaced with raw unsalted nuts such as pistachios, walnuts and almonds it could lead to improved glycemic control and blood lipids. This has been studied in individuals with T2DM and may also hold good in patients with T1DM. (27, 28)

Micronutrients: A significant proportion of India’s population has dietary deficits in protein and micronutrients. The key micronutrient deficiencies reported in the Indian population include Vitamin A, B and C, iron, calcium, zinc, copper, magnesium, selenium and chromium. (29) This is further compounded in patients with T1DM due to the additional dietary restrictions levied on them. A nutritionist can suggest wholesome recipes to enhance micronutrient composition without adversely affecting the energy intake or glycaemic load (GL). These recipes can be made from low GI and low-medium GL whole grains, millets, pulses, sprouts,
soybean, nuts, seeds (pumpkin seeds, sesame seeds, popped amaranth seeds), and seasonal local fruits (in particular apple, pear, sweet lime, orange) and vegetables (such as red amaranth, fenugreek, spinach and radish). (30, 31)

Salt intake needs to be reduced in most Indian diets. Pickle and papad (a thin, crisp, round flatbread made from lentils, either fried in oil or cooked with dry heat) are common examples of high salt items in India. Salt adjuncts unique to India are lemon, tamarind, kokum (garcinia indica), vinegar, onion, garlic powder and dry mango powder which can supplement well known spices and herbs like oregano, basil, mint and cilantro. (32)

Food labelling in India leaves much to be desired. Products with tag lines like sugar free, low sugar and fat free are easily available at stores in India. Terms used for added sugars include corn syrup, high-fructose corn syrup, fruit juice concentrate, dates, jaggery, honey, and maple syrup and these are often marketed as “low sugar/sugar free” products. Patients must be made aware that “sugar free” need not mean that the item is carbohydrate or calorie free.

Anthropometric indicators in India: Similar to patients with T2DM, anthropometric indicators play an important role in determining dietary recommendations of a given child. (33) There has been a rapid increase in obesity across the country and this is further compounded by the ethnicity specific risk attributed by the unique thin-fat Indian phenotype. (34, 35) The Indian Academy of Paediatrics (IAP) 2015 growth charts (36) were developed using 33148 children from 13 different centres and have been further validated in another population. (37, 38) These are currently most representative of the Indian population but it is important to understand their development, utility and limitations, before prescribing dietary recommendations based on them. For children below the age of 5 years the IAP recommends the WHO growth charts.

Celiac disease (CD)
The prevalence of CD in India among children with T1DM, ranges between 8 to 18%.(39) There is a higher reported prevalence of celiac disease from north India as compared to southern states.(40, 41) This could be attributed to differences in the genetic make-up further compounded by a very different dietary pattern. Wheat is one of the most important constituents of almost every meal in north India while rice is the staple cereal in the south and north-east. A typical north Indian diet contains about 25–30 g of gluten per day; whereas average gluten intake in west India varies from 10 to 20 g/day. (42, 43).

Strict adherence to gluten free diet is essential (Table 3). Even small amounts of gluten (50 mg/day) can be immunogenic, hence all food items and drugs that contain gluten and its derivatives must be eliminated completely from the diet.(44) Gluten is used in thickeners, stabilizing agents, fillers and binders and also in a number of medicines, cosmetics, toothpastes, and malted beverages.(45) Food contamination can occur during harvesting, storage and packaging.

Earlier there was lack of awareness that the easily available millets are gluten free. The production of gluten free foods in India is a small-scale industry, with limited choices and the products are expensive. A study carried out in India, on various breakfast products, flours, and batters made from grain that are naturally gluten free, showed a likelihood of gluten contamination in products that are sourced from local retailers and millers.(46) Nutritionists in India often advise families with celiac disease to have their own small flour grinder at home.

**The Indian school systems-their impact on insulin regime and meal plan**

The insulin prescription should be finalized only after knowing the convenient times when child can eat and whether it will be possible to administer insulin prior to eating. This would depend on the school schedule and also on the availability of a responsible adult to administer or supervise insulin shots and blood tests in school and at home. Indian schools, with the exception of few elite ones, do not have a nurse nor, in many instances, are the teachers prepared to supervise insulin injections or SMBG. Hence, if insulin has to be taken in school, one would have to rely on the child’s cooperation and skill. Children are often reluctant to monitor blood glucose
or inject in school. Further, the duration of the breaks (10-15 minutes and 30-35 minutes, or a single break of 30-45 minutes); may be too short for the child to inject and eat. The likelihood of snack box sharing is very high. In some schools, a home snack box is not permitted and meals are provided by the school. All these factors together can make it difficult to have consistent good control during school hours.

Based on the school timings, school schedules in India could be categorized into three broad groups:

Group A- Early riser: these children leave for school around 7 am barely an hour after waking up and are back home by about 2 pm. They generally eat a very light snack at home, followed by breakfast during the recess in school between 9.30-10 am and then return home for lunch by 2 pm, often snacking on the way home.

Group B- Afternoon commencer: these children are in school between 12 noon and 6 pm. They wake up late, have breakfast on waking up, a snack before leaving home for school and lunch during the school break, followed by another snack on returning home at 6 pm.

Group C- Mid-day scholar: this category leaves for school at 8-8.30 am and returns by 4 pm. They have breakfast at home and a mid-morning snack and lunch in school.

Dinner time in India varies from 8 pm to 10 pm and hence many children do not take a bedtime snack.

The bolus insulin could be a rapid acting analogue but human regular insulin being nearly 4 times cheaper, is preferred if affordability is an issue. It is also preferred in groups A and B prior to the light snack consumed before leaving for school if injecting insulin is not possible for the first snack / meal in school a few hours later. However, when breakfast is heavy and the school snack is several hours after leaving home, one may suggest either low carb items for the snack or use pre-mixed insulins before starting from home to cover school hours when injecting insulin is not an option.
In the very poor, meal choices are limited and meals are likely to remain constant from day to day. In this group, if an afternoon dose of insulin is not practical the 2-injections-a-day regimen using regular and NPH insulins can be prescribed.

**Imparting nutritional advice and education**

Nutrition education plays a pivotal role in the management of diabetes in the young. The literacy level, comprehending capacity, affordability, family composition, school / college schedule, academic pressures, peer pressures, location of residence and accessibility to the medical care team, are influencing factors to be deliberated upon while laying out the diet plan.

Nutritional advice should be practical, tailored to the patients’ needs and provided in the mother tongue of the patients. There are 22 major languages in India. Resource constrained medical teams can take the help of trained “parent-educators”. Frequent contact with the patient on mobile phone or whatsapp is helpful. Mobile phones are used extensively in India and mobile calls and data are inexpensive.(47, 48)

In India, most people have a routine meal pattern which generally remains the same throughout the week. Carbohydrate exchanges are easy to teach and can be used by the patient when consuming the routine diet. Knowledge of carbohydrate counting and insulin adjustment for selected foods / snacks gives additional flexibility in making food choices. It is the experience of the authors that even parents with primary school education are able to make successful insulin dose adjustments and in motivated patients, age of the child has not been a deterrent in adopting a carbohydrate counting method. The Indian Food Composition Tables (IFCT-2017)(21), published by NIN, India, is a reliable reference for computing the carbohydrate content of foods. Standardized educational modules from basic to advanced must be developed as this is lacking in our country.

**Issues in adherence with MNT**

Adherence to dietary therapy is the most challenging part of diabetes management.(49) The biggest problem in a resource-poor setting is the lack of
trained dieticians and lack of physician time for adequate nutritional counseling. An individualized approach may be difficult to follow in a busy outpatient setting and families are often given a printed chart of a sample diet which deters compliance.\(^{(50, 51)}\)

There are various other challenges in ensuring adherence to MNT that should be anticipated and addressed in problem-solving sessions.

- **Economic barriers:** A systematic review of the possible barriers affecting good diabetes management found that besides attitude, beliefs and knowledge, finance resources is an important factor.\(^{(52)}\) A study from south India noted that over 50% of patients attending an integrated diabetes clinic were daily wage earners who had to travel long distances to seek medical care, incurring travel costs besides loss of income.\(^{(53, 54)}\) A study from north India revealed that the mean direct cost of diabetes management per patient per year was 18.6% of annual family income. Patients from lower income bracket spend a larger proportion of the family income (32.6%) on diabetes care.\(^{(48)}\) Many state governments, NGOs, pharmaceutical companies and diabetes support groups provide free glucometers, strips, and insulin. However, food costs are mostly borne by the patients. The Public Distribution System (PDS) was established by the Government of India to provide essential food items (rice, wheat, oil and sugar) to India’s needy. Policy change is necessary to include fiber rich grains, millets, pulses, and eggs in the PDS in place of cheaper high carb foods. The kitchen garden concept (growing vegetables in the backyard/terrace) can be initiated wherever possible.

- **Lack of support by family, peers and at the work place:** Many patients live in a joint family setting with grandparents, uncles, aunts and cousins and share a common kitchen. A study on young diabetes patients in India showed that not all patients get positive support from their family, workplace or their peers and on the contrary are often excluded by them.\(^{(55)}\) Only 50% of patients followed nutritional advice quoting work related responsibilities and academic pressures as major deterrents to nutritional compliance.\(^{(55)}\) Members of the joint family may be resistant to changes in their existing
dietary patterns. Elders in the family should be made to understand that diet for T1DM is based on the principles of healthy eating and would also benefit them. Peer support groups have shown promising results in optimizing diabetes care in India and this can be considered as a cost effective model in both patients with T1DM and T2DM.(56, 57) The role of a counsellor, especially in adolescent age group, is of prime importance in correcting non-compliant behaviour.(58)

- **Educational level of the patients/caregiver:** A study from south India found that nutritional advice was not clearly understood by patients despite regular hospital visits.(55) Similar findings have been reported in north Indian patients with T2DM, where knowledge, attitude, and practices with respect to diabetes management were found to be unsatisfactory.(59) There is evidence that academic knowledge does not always translate into positive action. (54)

- **Lack of supervision:** Communication with school authorities about providing a nurse or other responsible staff to supervise procedures / meals and having a responsible adult at home do the same (in an unobtrusive manner) can improve compliance.

- **Widespread availability of junk food:** Unhealthy packaged foods are freely available in Indian markets.(60) In urban areas, adolescents consume junk food regularly for between-meal snacks.(61) Mothers should be taught how to prepare healthy homemade snacks with locally available ingredients.(31)

- **Food fads:** Patients may be misled by the media or by relatives/friends and adopt fad food diets including low carbohydrate or fruit only diets. Parents may hold myths that calorie restriction is required to achieve glycemic control. These diets can negatively affect growth, energy, and well-being and should be discouraged.(31)

- **Festivals and special occasions:** As many as 37 festivals are celebrated through the year in India! Festive food is high in sugar and fat. Severe restrictions on these foods may not work and hence patients should receive
clear instructions regarding the need for moderation and amount of additional insulin required to cover these items.

- **Fasting**: Fasts are a part of many religions and cultures in India. Markedly altered food and fluid intake during fasts can lead to complications including hypoglycemia, dehydration, electrolyte imbalance and DKA. Fasting is to be discouraged in pediatric patients with T1DM. Indian guidelines for management of diabetes during fasts have been published. (62)

In this article we have discussed the unique features and challenges with MNT in pediatric T1DM in the Indian setting. The cultural practice of having unprocessed home-made meals offers an advantage. At the same time, rapid modernization and changing lifestyles with increased consumption of junk food poses a challenge. Moderation of carbohydrate intake with increase in protein and fibre content of traditional meals can improve glycemic control. MNT has to be catered to the socio-economic background and educational level of the family. There is a need to develop educational tools on principles of healthy eating in various vernacular languages taking regional differences into account.

**References**

32. Association AH. Shaking the salt habit to lower high blood pressure. 2017.


42. Price S. Understanding the importance to health of a balanced diet. Nursing times. 2005; 101:30-1.

43. Ramakrishna BS. Celiac disease: can we avert the impending epidemic in India? The Indian journal of medical research. 2011; 133:5-8.


46. Raju N, Joshi AKR. Gluten contamination in labelled and naturally gluten-free grain products in southern India. 2020; 37:531-8.


**Table 1: Common Indian meals and methods of lowering glycaemic index (GI)**

<table>
<thead>
<tr>
<th>Staple food and it’s description</th>
<th>Modifications to lower GI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Most parts of India</strong></td>
<td></td>
</tr>
</tbody>
</table>
| Chapatti (homemade flat bread made from ground refined or whole wheat flour and cooked on a griddle) | Add soya flour or bengal gram flour to whole wheat flour  
Do not sieve the flour to retain the bran  
Serve with curd/pulse/cottage cheese and vegetables |
| Steamed rice  
Polished white rice | Stored rice preferred as amylose content increases during the process of aging  
Use long grain rice or unpolished, brown rice as it has a lower GI. |
| Rice, potato, pasta | Cook and keep in refrigerator for 24 hours to cool.  
Do not reheat at high temperature. This results in formation of resistant starch which has lower GI |

Khichdi (commonly made with rice and dal mixed in various proportions which varies from region to region)  
Recommended proportion is 4:1  
Use millets, broken wheat (daliya) or unpolished rice combined with any pulse  
Increase the proportion of dal  
Add vegetables or consume raita) or kadhi (gravy made from curd and bengal gram flour).  
<p>| <strong>Region - North India</strong> | |</p>
<table>
<thead>
<tr>
<th>Indian Bread</th>
<th>Additional Ingredients</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paratha (shallow fried chapatti)</td>
<td>Add soya flour or bengal gram flour to whole wheat flour. Serve with curd/ pulse/ cottage cheese and vegetables</td>
<td>West India</td>
</tr>
<tr>
<td>Puri (deep fried chapatti made from refined wheat flour)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Makai ki roti (maize flour chapatti)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aloo paratha (stuffed with potato)</td>
<td>Stuff with paneer (cottage cheese)/ sattu (chickpea flour) and variety of vegetables - green leafy vegetable like fenugreek leaves, spinach, radish, cabbage, cauliflower</td>
<td>West India</td>
</tr>
<tr>
<td><strong>Region - West India</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bhakri (Thick flat bread made from millets or rice flour and cooked on a griddle)</td>
<td>Add pulse flour to the millet flour or serve with curd/ pulse and vegetables</td>
<td></td>
</tr>
<tr>
<td>Thepla (thin flatbread made from fresh fenugreek leaves and whole-grain flours)</td>
<td>Add bengal gram flour to the flour and serve with curd</td>
<td></td>
</tr>
<tr>
<td>Dhokla (fermented and steamed savoury cake made from Bengal gram flour and curd)</td>
<td>Add finely chopped vegetables/ vegetable puree to the batter Use a combination of millet flour/ buckwheat (kuttu) flour and bengal gram flour/ green gram flour</td>
<td></td>
</tr>
<tr>
<td>Khakhra (thin cracker made from wheat flour and oil)</td>
<td>Make khakhra from pulse flour instead of wheat flour Consume vegetables, curd, curd dip or buttermilk along with it</td>
<td></td>
</tr>
<tr>
<td>Poha (rice flakes)</td>
<td>Add peanuts, vegetables or curd</td>
<td>South India</td>
</tr>
<tr>
<td>Upma (salted wheat semolina pudding (also eaten in south India))</td>
<td>Add vegetables and sprouts or consume a protein source (curd, buttermilk or boiled egg) with it</td>
<td></td>
</tr>
<tr>
<td>Snack</td>
<td>Details</td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>-------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Idli</strong></td>
<td>(soft &amp; fluffy steamed cake made of fermented rice &amp; lentil batter)</td>
<td></td>
</tr>
<tr>
<td><strong>Dosa</strong></td>
<td>(pancake made from fermented batter of cereal flour and ground pulses)</td>
<td></td>
</tr>
<tr>
<td><strong>Paniyaram</strong></td>
<td>(ball shaped dumplings made by steaming fermented batter of cereal flour and ground pulses using a mould)</td>
<td></td>
</tr>
<tr>
<td><strong>Puttu</strong></td>
<td>(steamed rice flour and coconut log)</td>
<td></td>
</tr>
<tr>
<td><strong>Ragi Kanjee</strong></td>
<td>(finger millet porridge)</td>
<td></td>
</tr>
<tr>
<td><strong>Ragi Dosa</strong></td>
<td>(finger millet dosa)</td>
<td></td>
</tr>
<tr>
<td><strong>Ragi mudde</strong></td>
<td>(finger millet steamed balls)</td>
<td></td>
</tr>
</tbody>
</table>

**Vegetable stuffed idli/mixed dal idli/millet idli**

**Pesarattu dosa (made with green gram flour)** OR **mixed dal dosa (made with mixed pulse flour)**

Idli and dosa are served with sambhar. Sambhar made with plenty of vegetables improves the GI

**Make the batter from pulses and add vegetables and buttermilk to the batter.**

Use unpolished rice or **ragi** flour. Consume with **kadala kari** (black chickpeas curry) to add protein.

**Add curd to the **ragi** to improve the protein content and lower the GI**

Make a **ragi-urad dal** (black gram) **dosa**. Add butter milk to prepare dosa batter.

**Use variety of millet flour along with dal flour to make the balls and serve with sambhar**

**Low to moderate GI millets** such as **sanwa** (barnyard millet), **kangni** (foxtail millet), **bajra** (pearl millet), **kodon** (kodu), **sama** (little millet) and **jowar** (sorghum) must be included in the diet

**Region – East India**
<table>
<thead>
<tr>
<th>Recipe</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Chuda Santula:</em> Roasted rice flakes upma with mixed veggies</td>
<td>Add more vegetables</td>
</tr>
<tr>
<td><em>Chura Dahi:</em> Curd, rice flakes and nuts mix</td>
<td>Avoid sugar</td>
</tr>
<tr>
<td><em>Savoury Paani pitha:</em> Pancake of wheat flour, salt and onion</td>
<td>Add vegetables to the batter</td>
</tr>
<tr>
<td><em>Kathi roll:</em> kabab/cottage cheese/vegetables/egg wrapped in paratha</td>
<td>Use whole wheat flour for making the paratha. Use less oil. Add vegetables along with the protein source such as kabab, cottage cheese or egg</td>
</tr>
</tbody>
</table>

Ref: (10, 12-21)
### Table 2: Low Carbohydrate snacks/foods (0 to 5 g carbohydrate less than 10g total fat and 5 g saturated fat per serving)

<table>
<thead>
<tr>
<th>Low carbohydrate snacks/foods</th>
<th>Serving Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg: boiled, scrambled, poached or omelette</td>
<td>1 no.</td>
</tr>
<tr>
<td>Chicken: salad, grilled, sautéed, baked or tikka without cornflour/ flour/ breadcrumbs</td>
<td>100 g</td>
</tr>
<tr>
<td>Fish: rohu, Indian salmon <em>(ravas)</em>, kingfish <em>(surmai)</em> or pomfret tikka, baked without cornflour/ flour/ breadcrumbs</td>
<td>100 g</td>
</tr>
<tr>
<td>Cottage Cheese: tikka, grilled, scrambled <em>(burjee)</em>, sautéed</td>
<td>50 g</td>
</tr>
<tr>
<td>Curd/Unflavoured Yogurt</td>
<td>½ cup (100 g)</td>
</tr>
<tr>
<td>Cheddar Cheese, Mozzarella cheese, Parmesan cheese</td>
<td>25 g</td>
</tr>
<tr>
<td>Tofu</td>
<td>100 g</td>
</tr>
<tr>
<td>Unflavoured Soymilk</td>
<td>200ml</td>
</tr>
<tr>
<td>Unflavoured Almond milk</td>
<td>200ml</td>
</tr>
<tr>
<td>Non-Starchy Vegetables, Salads, Stir fry vegetables</td>
<td>100-150 g</td>
</tr>
<tr>
<td>Vegetable Soup <em>(unstrained)</em></td>
<td>1 cup</td>
</tr>
<tr>
<td>Soy nuts</td>
<td>30 g</td>
</tr>
<tr>
<td>Nuts and Seeds <em>(almonds, pistachios, walnuts, cashew nuts, peanuts, pine nuts, pumpkin seeds, sunflower seeds, watermelon seeds)</em></td>
<td>16g</td>
</tr>
</tbody>
</table>

Ref: (21)
### Table 3. Gluten free food options in India.

<table>
<thead>
<tr>
<th>Foods to include</th>
<th>Foods to exclude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice, rice flakes, jowar, bajra, ragi, corn, amaranth, jowar, quinoa, buckwheat, gluten free rolled or steel cut oats.</td>
<td>Wheat and wheat products, rye, barley.</td>
</tr>
<tr>
<td>Whole pulses and legumes, soybean</td>
<td>Semolina (<em>rava</em>), <em>dalia</em> (broken wheat), wheat vermicelli</td>
</tr>
<tr>
<td>Dairy products such as milk, <em>paneer</em> (cottage cheese), curd, buttermilk.</td>
<td>Refined flour and products made from it like white bread, multigrain bread, pasta, biscuits, bakery products, crackers, toast, croutons, cake, cookies, pizza, burger etc</td>
</tr>
<tr>
<td>Egg &amp; poultry, fish</td>
<td>Soy products.</td>
</tr>
<tr>
<td>Fruits and vegetables</td>
<td>Beer</td>
</tr>
<tr>
<td>Nuts and seeds</td>
<td>Spices may be contaminated with gluten for eg: asafoetida (<em>hing</em>)</td>
</tr>
</tbody>
</table>

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