ABSTRACT Although diet is a crucial component of managing diabetes, it has generally been disregarded by both patients and doctors. Most doctors believe giving patients a straightforward diet chart based on scientific data is difficult. The majority of textbooks fall short of meeting this need for diabetic management. They simply advise consuming the necessary amount of calories from protein, fat, and carbohydrates. The most challenging step is converting the necessary calories into the majority of food items that are readily available in our nation. Typically, doctors recommend dieticians to their patients or give them a list of general dos and don’ts. Unfortunately, there is a dearth of skilled dieticians, particularly at district-level healthcare facilities. Therefore, an effort has been made to contrast the Indian diet with the advice given in the textbooks. Finally, a straightforward method has been developed to quickly create a diet chart without a dietician’s assistance. The information in this study is taken from literature on nutrition and medicine; neither human subjects nor animals have been used in any experiments.

KEYWORDS Indian foods, Diabetes, Dietician, Calorie value of foods, Diet chart, carbohydrates, Protein, and Fat.

Introduction

The three pillars of managing diabetes are diet, exercise, and medication. Among them, nutrition is just as crucial as medication. According to studies, following a good diet can lower HbA1c by 1-2 percent [1], which is comparable to the benefits of several oral hypoglycemic medications. But regrettably, the doctor’s advice on diet is the most frequently disregarded. The majority of the patients hate it. Many doctors are unfamiliar with the process of planning a diet, thus they frequently refer patients to a dietician. The majority of dieticians produce lengthy charts with a schedule, creating the idea that people were created just for the purpose of eating. In addition, dietitians are few in smaller communities.

In observational epidemiological research, high saturated fat intake has been linked to higher fasting glucose and insulin levels and a higher risk of impaired glucose tolerance. Higher fasting insulin, less insulin sensitivity, and a larger risk of type 2 diabetes have been linked to higher proportions of saturated fatty acids in serum lipid or muscle phospholipid. Conversely, a lower incidence of type 2 diabetes and lower fasting and 2-hour glucose readings have been linked to higher levels of polyunsaturated and unsaturated fatty acids from vegetable sources. In addition, greater insulin sensitivity has been linked to skeletal muscle phospholipids with larger amounts of long-chain polyunsaturated fatty acids.

In research, including human intervention, switching from saturated to unsaturated fatty acids improves insulin sensitivity and glucose tolerance. However, compared to monounsaturated fatty acids, long-chain polyunsaturated fatty acids do not seem to offer any significant benefits in intervention studies. In observational studies, a high intake of total fat has also been shown to predict the development of impaired glucose tolerance and the progression of impaired glucose tolerance to type 2 diabetes. When total fat intake is high (greater than 37% of total energy), changing dietary fat quality appears to have little impact. High total fat consumption has also been linked to poorer insulin sensitivity and increased fasting insulin readings.

Two things have to be considered while making a diet chart. The first is what to eat, and the second is how much to eat. Besides these two food preferences, habits and cultural customs must also be considered. Forcing a diet plan foreign to the
taste may result in noncompliance. Regarding food quantity, most textbooks have fractionalized the diet into carbohydrate, protein and fat. Besides, the amount of food is recommended in terms of calorie value, not grams. Unfortunately, Mother Nature is not producing cereals, pulses or fruits containing exclusive carbohydrates, protein or fat. Secondly, they are not quantified in terms of calories. This review aims to integrate the information hidden in books on nutrition and medicine and design diet charts for diabetic patients so that any physician can do the same while issuing his prescription. No need to refer the patient to a dietician.

Methods and Discussion

The diet recommendations by the physicians and diabetologists in the textbooks during the last four decades were scanned, and the results are depicted in tables 1, 2, and 3. A simple analysis of these tables shows no unanimity among the various recommendations. Secondly, they are changing from edition to edition. Besides, no reason has been provided to explain the recommended percentage of the constituents of the food.

In this confusion, a new concept in dietary management in medical diseases, including diabetes, has been advanced by American Diabetes Association, known as Medical Nutrition Therapy. This concept is not accepting the straitjacket approach to the distribution of calories among carbohydrates, protein and fat in a diet. This stresses that the diet should be individualised according to co-morbidities and the patient’s food preferences. The assertion of some of the authors that the optimal percentage of carbohydrate, protein and fat in the diabetic diet is not known, has created more confusion than it solves. After all, the patient must be given concrete and simple dietary advice by his physician.

It is seen here that all the dietary recommendations are made in terms of calories. To convert the calorie into food items, it is pertinent to know the calorie value of Indian foods. Table 4, adapted from the book” Nutritional value of Indian foods” published by the Indian Institute of Nutrition, Hyderabad, shows the same.

The table shows that the fat content of rice, atta and pulse is almost negligible. The calorie content of carbohydrates and protein is the same, i.e. 4 cal per gram. So it is easy to calculate the calorie value of rice, atta or dal. Simply we have to multiply the weight in grams into four, giving the calorie value whether it is rice, atta or dal. Green vegetables have almost no calorie value. If we omit potatoes, a reasonable amount of green vegetables will add nothing to the calorie value of the diet. To cook a vegetable, we need visible fat, i.e. oil. It has been seen that if a person takes a normal amount of green vegetables, he will need just 5 gm of oil per meal. If he takes three meals daily, he will consume approximately 15 gm of fat amounting to 15x9=135cal. If he takes 250 gm of cow’s milk or skimmed milk daily, the calorie value will be 67x250/100=167.5cal or 167cal. If more cooking oil is required, its calorie value may be calculated accordingly. With this much information, one can easily make a diet chart. For example, a diet chart of 1800 calories is here being made. Let us presume that the person will take 250gms of cow’s milk and green vegetables with all three meals daily. The calorie value of oil and milk is 135+167=302cal or 300 calories. Let us subtract 300 from 1800, and we get 1500. A searching glance at the food value table shows that rice, atta (wheat), and dal (pulse) contain, on average, 345 calorie per 100 gm of dry weight (i.e. before cooking). If we divide 1500 with 345 and multiply by 100, we get 434.7or 435gm, which is the cereal’s weight and pulse equivalent to 1500 calories. As one takes three meals per day, 435 is divided by 3, and we get 145 gm which is the actual dry wt of the cereal and pulse per meal per day. Now, this 145 gm is distributed in rice and pulse or atta and pulse (according to the patient’s choice) so that the ratio between rice and pulse or between atta and pulse is or near 4:1. This ratio is the standard ratio practiced in India. In this case, the distribution is presented in table -5.

Let’s compare pulse and fish/meat (fat-free). We find that the calorie value of fish and meat per 100gm is approximately three times the calorie value of uncooked pulse (114x3=342 or 345). If somebody takes nonveg food, he can substitute meat or fish for a pulse. Only the amount of fish or meat (uncooked) will be three times the weight of the pulse allotted. If he takes chicken or duck should take 2.6 times the pulse allotted to him (130x2.6=338). A different calculation will apply if somebody takes exotic meat, such as a snail or turtle.

The calorie value of an average-sized egg (50 gm) is equivalent to 22 gm of cereal or pulse. The equivalent amount of cereal or pulse can be substituted if somebody favours an egg. Green vegetables contain a very small amount of carbohydrate and protein and a negligible amount of fat. Hence their calorie value has not been considered while designing the diet chart. People with diabetes should avoid potatoes for its high caloric value among vegetables (70 calories per 100gm) and high glycemic index. Regarding fruits, 50-calorie equivalents of fruits are given in Table 7.

Adapted from Diet and Diabetes, TC Raghuram, Swaran Pasricha, RD Sharma, National Institute of Nutrition, Hyderabad -500007, India, Second edition-1993, reprinted-2000.

One can take fruits of his/her choice after adjusting the calories from cereal or pulses. Some individuals want evening snacks. They can take the same in exchange for the pulse prescribed in the night meal. Please note that the roasted cereals or pulses are highly dried-up food items. 30 gm of roasted rice (murhi), beaten rice (chura), gram (sattu) is equivalent to 50 gms of uncooked rice, beaten rice or gram, respectively.

This style of making a diet chart is possible only because the eating habits of a common Indian are different from those of different parts of the world. Here the individual takes the raw materials and cooks the same as a daily routine. So what we have discussed are raw food items. So a diet chart can easily be made.

Discussion

The calorie value of Indian foods has made making a diet chart for people with diabetes an easy task. But it has to be seen where this confirms the contribution of calories from carbohydrates, protein and fat as recommended by the textbooks. As a test case, let us compare the recommendation of the latest edition (23rd) of Davidson’s principle and practice of medicine. The textbook recommends 50% of calories from carbohydrates, 10%-15% of calories from protein and <35% of calories from fat. Table 8 shows the contribution of calories from different constituents of an 1800-calorie diet.

It is seen here that the average Indian mixed diet has a predominance of carbohydrates, i.e., about 18% more than the highest recommended of 50%. Fat percentage is about 19% lower than the highest recommended of 35%. Interestingly the contribution of calories from protein is similar. Can we manipulate
### Table 1: Dietary recommendations in Diabetes by Davidson’s Principles and Practice of Medicine

| Edition | Year | Carbohydrate | Protein | Fat | Comments |
|---------|------|--------------|---------|-----|----------|
| 13th    | 1981 | 45%-50%      | 15%-20% | 30%-35% |
| 15th    | 1987 | 50%          | 15%     | 35%  |
| 16th    | 1991 | 50-60%       | 10%-15% | 30%-35% |
| 17th    | 1995 | Do           | Do      | Do   |
| 18th    | 1999 | 50%-55%      | Do      | Do   | Fat-saturated-<10% monounsaturated-10%-15% Népolyunsaturated ted-<10% |
| 19th    | 2002 | Do           | Do      | Do   |
| 20th    | 2006 | 45%-60%, sucrose Up to 10% | 10%-15%-1gm/kg Body wt. | <35% | Do |
| 21th    | 2010 | Do           | Do      | Do   |
| 22nd    | 2014 | Do           | Do      | Do   |
| 23rd    | 2018 | 50%, sucrose up to 10% | Do      | Do   | Do |

### Table 2

| Textbook                                                       | Edition | Year | Recommendation                                                                 |
|---------------------------------------------------------------|---------|------|--------------------------------------------------------------------------------|
| Joslin’s Diabetes Mellitus                                    | 14th    | 2005 | Carbohydrate-<40% of total calorie, Protein-30% of total calorie, Fat-30%       |
| Textbook of Diabetes by I.G. Holt and others                  | 5th     | 2017 | Carbohydrate-optimal not known Protein-15%-20%, Saturated fat-7% Other fats-not specified |
| Williams Textbook of Endocrinology                            | 13th    | 2016 | Optimal not known                                                              |
| Endocrinology Adult and Pediatric J. Larry Jameson & others   | 7th     | 2016 | Medical Nutrition Therapy                                                      |
| RSSDI Textbook of Diabetes Mellitus                           | 3rd     | 2014 | Medical Nutrition Therapy                                                      |

### Table 3: Dietary Recommendations in Diabetes by Harrison’s Principles of Internal Medicine

| Edition | Year | Carbohydrate | Protein | Fat | Comments |
|---------|------|--------------|---------|-----|----------|
| 9th     | 1980 | 40%-50%      | 0.9gm/kg wt. | Remaining portion | Carbohydrate Up to 85% has been given |
| 10th    | 1983 | Do           | Do      | Do  | Do       |
| 11th    | 1987 | 40%-60%      | Do      | Do  | Do       |
| 12th    | 1991 | Do           | Do      | Do  | Do       |
| 13th    | 1994 | Do           | Do      | Do  | Do       |
| 14th    | 1998 | Remaining Portion | Do      | 30% | Concept of Medical Nutrition Therapy introduced |
| 15th    | 2001 | Rest to be parted between CHO and Monounsaturated fat | 10%-20% | Saturated 10%, Polynaturated<10 |
| 16th    | 2005 | 60%-70% to be parted between CHO and Monounsaturated fat | Do | Do |
| 17th    | 2008 | 45%-65%      | 10%-35% | 20%-35% | High protein diet Not recommended |
| 18th    | 2012 | Concept of Medical Nutrition Therapy                   |       |     |          |
| 19th    | 2015 | Optimal not known | Optimal not known | Minimal trans-fat intake | Medical Nutrition Therapy |
| 20th    | 2018 | Do           | DO      | Optimal not known | Do |
### Table 4 (Value per 100 Gms)

| Items       | Moisture | Protein | Fat  | Carbohydrate | Calories average | Minerals | Fiber |
|-------------|----------|---------|------|--------------|------------------|----------|-------|
| Rice        | 13% (12.6-13.5) | 7.5 (6.8-8.5) | 0.5 (0.4-1) | 77.5 (77.4-78.2) | 345 | 0.6 | 0.2 |
| Wheat Flour | 12.5% (12.2-13.3) | 12 (11.8-12.1) | 1.5 (1.5-1.7) | 70 (69.4-71.2) | 345 | 2.7 | 1.9 |
| Dal         | 10.5% (9.9-10.9) | 23 (20.8-25.1) | 1.5 (1.4-1.7) | 58 (57.6-59.9) | 345 | 2.7 | 1.2 |
| Cow’s milk  | 87.5%     | 3.2     | 4.1  | 4.4          | 67  | 0.8 | Nil |

Source: Nutritional Value of Indian Foods published by Indian Institute of Nutrition, ICMR, Hyderabad-500007, India, Revised edition-1989, Reprinted-2000.

### Table 5 (1800 calorie)

| Meal time | Atta | Rice | Dal |
|-----------|------|------|-----|
| Morning   | 115gm | 30gm | 30gm |
| Noon      | 65gm  | 50gm | 30gm |
| Night     | 115gm | 30gm |

Milk : 250gm in 24 hours
Green vegetables : as desired
Cooking oil : 15gm in 24 hours

Now let us consider meat and fish. Please go through table 6.

### Table 6 (value per 100 gms)

| Item             | Moisture | Protein | Fat  | Carbohydrate | Calorie |
|------------------|----------|---------|------|--------------|---------|
| Goat meat        | 74.2gm   | 21.4gm  | 3.6gm | Nil          | 118     |
| Pork muscle      | 77.4gm   | 18.7gm  | 4.4gm | Nil          | 114     |
| Beef muscle      | 74.3gm   | 22.6gm  | 2.6gm | Nil          | 114     |
| Duck             | 72.3gm   | 21.6gm  | 4.8gm | 0.1gm        | 130     |
| Pulse            | 10.5gm   | 23gm    | 1.5gm | 58gm         | 345     |
| Egg, hen         | 73.7 gm  | 13.3 gm | 13.3 gm | Nil      | 173     |

Adapted from Nutritive value of Indian foods, National institute of nutrition, ICMR, Hyderabad, India

### Table 7 All items are equivalent to 50 Calories

| Fruit         | Quantity in grams | Number or size      |
|---------------|-------------------|---------------------|
| Apple         | 75                | 1 small             |
| Banana        | 30                | ¼ medium            |
| Dates         | 30                | 3                   |
| Grapes        | 105               | 20                  |
| Guava         | 100               | 1 medium            |
| Mango         | 70                | 1 small             |
| Orange        | 90                | 1 small             |
| Papaya        | 120               | 2 medium            |
| Pineapple     | 90                | 1-1/2 slices (round) |
| Pomegranate   | 75                | 1 small             |
| Strawberry105 | 105               | 40                  |
| Sweet lime    | 150               | 1 medium            |
| Watermelon    | 175               | ¼ small             |
Table 8 (1800 calorie)

| Food Items | Total Weight | Calories from Carbo | Calories from Protein | Calories from Fat |
|------------|--------------|---------------------|----------------------|------------------|
|            | Weight Calories | Weight Calories | Weight Calories | Weight Calories |
| Atta       | 295gm 206.5gm 826 | 35.4gm 141.6 | 4.4gm 39.6 |
| Rice       | 50gm 38.75gm 155 | 3.75gm 15 | 0.25gm 2.25 |
| Dal        | 90gm 52.2gm 208.8 | 20.7gm 82.8 | 1.35gm 12.15 |
| Cooking oil| 15gm          |                |                      | 15gm 135         |
| Milk       | 250gm 11gm 44 | 8gm 32 | 10.25gm 92.25 |
| Total Calories | 1233.8 Calories | 271.4 Calories | 281.25 Calories |
| Percentage of total calories | 68.5% | 15.07% | 15.6% |

this diet to conform to the diet recommended by Davidson’s textbook? Yes, it can be done by increasing the amount of milk or using more oil in the cooking. As total calorie is constant, the contribution from carbohydrate will fall, and that from fat will rise. High fat may not be suitable for fear of atherosclerosis. Suppose we reverse the ratio of cereal and pulse, which is 4:1, to reduce the contribution from carbohydrates, as pulse has fewer carbohydrates than cereals. In that case, the diet will be insipid and rejected by the patients.

Is it necessary to modify the Indian diet to alter the carbohydrate and fat ratio? Some studies show that that is unnecessary, and diabetes can be controlled with varying percentages of macronutrients [2]. Even the well-known textbook Harrison’s principles of internal medicine, in its latest editions (19th-2015) and (20th, 2018), opine that the optimal percentage of carbohydrate and protein is not known. The same textbook, in its edition from 9th to 13th, opined that carbohydrates up to 85% had been given. Hence Indian diet having mild to a moderate preponderance of carbohydrates is as good as any diet. In special situations, this chart can be modified accordingly. For example, rice or atta can substitute meat, fish and dal in renal failure. In obese patients, calories may be restricted, and fat intake can be reduced.

Diet, nutrition, and physical activity should be covered in the training of all health professionals (including doctors, nurses, dentists, and nutritionists) as they are important factors in both medical and dental health, according to the WHO Technical Report from 2003. The social, economic, cultural, and psychological factors influencing food and physical activity decisions must be considered essential components of public health initiatives. To properly implement these initiatives, developing and strengthening existing training programmes is urgently necessary. Through the extensive reach of contemporary media, information about fat quality, salt and sugar contents, and energy density should be incorporated into nutrition and health promotion messages as well as necessary in food labelling tailored to different populations, including disadvantaged populations. Information and communication methods aim to guarantee access to physical activity, healthier eating options, and a more informed global community.

Conclusion

It is simple to create a diet chart for a diabetic patient. The patient does not require a referral to a dietitian, who may not be available everywhere. It takes only a few minutes to create a logical diet chart. It is easy to use and may be adjusted to the patient’s eating preferences.

Acknowledgements

Funding

No funding has been provided by any agency for writing this article.

Disclosures

The author has nothing to disclose.

Compliance with ethics guidelines

This review is based on information provided by a few journals and books. No human or animal trials have been performed.

References

1. Christensen NK, Steiner J, Whalen J, Pfister R. Contribution of medical nutrition therapy and diabetes self-management education to diabetes control as assessed by haemoglobin A1c. Diabetes Spectr. 2000; 13:72.
2. Milne RM, Mann JI, Chisolm AW, William SM: Long-time comparison of three dietary prescriptions in the treatment of NIDDM. Diabetes Care 17:74-80, 1994
3. Nutritive Value of Indian Foods by C. Gopalan, B.V. RamaSastri and S.C. Balasubramanian, revised and updated by B.S. Narasinga Rao, Y.G. Deosthale and K.C. Pant, 1989 (reprinted -2000)
4. Diet and Diabetes, T.C. Raghuram, Swaran Pasricha, R.D. Sharma, 1993 (reprinted- 2000)
5. Davidson’s Principles and Practice of Medicine, 13th edition (1981) to 23rd edition(2018)
6. Harrison’s Principles of Internal Medicine, 9th edition(1980) to 20th edition(2018)
7. Joslin’s Diabetes Mellitus, 14th edition, 2005.
8. Textbook of Diabetes by I.G. Holt and others, 5th edition 2017.
9. Williams Textbook of Endocrinology, 13th edition, 2016.
10. Endocrinology Adult and Pediatric, J.Larry Jameson & others, 7th edition, 2016.
11. RSSDI Textbook of Diabetes Mellitus, 3rd edition, 2014, Editors- Hemraj B Chandalia, Gumpeny Ramchandra Sridhar, Ashok Kumar Das, Sri Venkat Madhu, Viswanathan Mohan, Puturi Vishnupria Rao.