A step towards precision nutrition in participants with Type 2 Diabetes: A self-completed questionnaire-based study.

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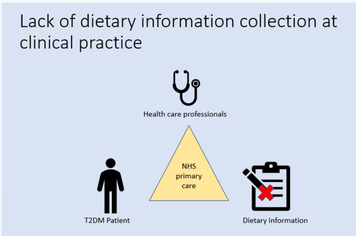
Introduction

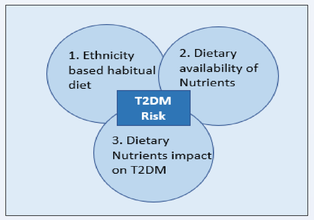
Type 2 diabetes (T2DM) is a global public health concern accounted for 90% of cases. Diet is primary modifiable risk factor for T2DM. Yet, there is little or no provision available at NHS primary-care to obtain dietary information from general population and T2DM patients. When, even modest attention could be effective not only for management but prevention T2DM.



Study Hypothesis

- Leicester city, UK is a melting pot of various ethnicities and has highest diabetes incidence rates in the country of 8.98 %, which are well above the national average of 6.4%.
- People from South Asian origin (Indian, Pakistani, and Bangladeshi descent) form the largest ethnic minority group.
- The possibility of the high incidences of T2DM in Leicester could be due to consumption of certain ethnicity-based food, which could be pro or anti-diabetic is an issue which has not been previously studied.

Therefore, this study was designed to understand a three-dimensional cause and effect relationship among, ethnicity based dietary habit, availability of nutrients specific to T2DM and its association on development of T2DM.

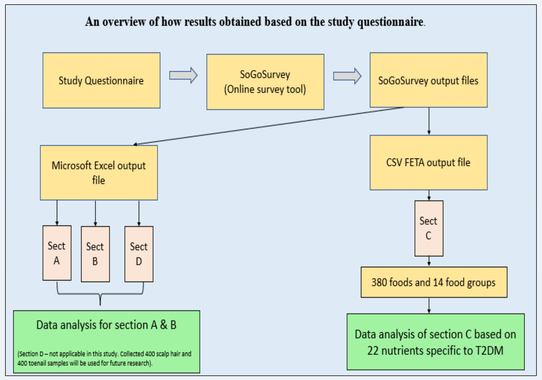


Objective

To investigate the relationship between dietary nutrients and development of T2DM among varied ethnic groups living in Leicester city, UK.

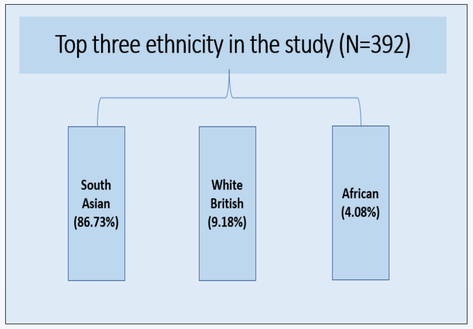
Methods

- A culturally sensitive web-based dietary questionnaire was developed (using SoGoSurvey tool) based on EPIC-Norfolk FFQ.
- Recruitment was carried out at multiple community services & NHS primary care GP practices.
- T2DM status was confirmed by participants (for community recruitment) and participant's clinical team at NHS primary care GP practices.
- Study questionnaire was deployed among 400 with and without T2DM participants to assess demographics, body measurements, health & lifestyle information along with multi-ethnic daily dietary intake (using FETA software (v 2.46)).
- Data analysis was carried out within 392 (with=184 and without T2DM=208) participants, aged 18 to 80 years using study based inclusion and exclusion criteria.
- Dietary output was obtained in 22 nutrients (specific to T2DM) and 14 food groups by accessing 380 foods at individual participant level.
- Dietary output was then compared with UK Government Dietary Nutrition Recommended values (as reference standard) set by Public Health of England to get nutrient status in terms of 'high, low, or as per recommended level'.
- Descriptive statistics was carried out using Microsoft Excel (version 10).
- Chi Square test & odds ratio was used to find statistical significance and chances of T2DM using SPSS IBM (version 26).



Results

The top three ethnicity participated in this study were South Asian (Indian, Pakistani & Bangladeshi), White British and African.



Average daily consumption of 22 nutrients among studied cohort

Average daily nutrient intake, Odds ratio (OR), & statistical significance

Nutrients	With T2DM (n=184)	Average reference values	Without T2DM (n= 208)	Average reference values	OR (95% CI)	p* (<0.05)
Macronutrients						
Carbohydrate (g)	281 (Low)	290.75	296 (High)	284.88	0.998 (0.993 to 1.005)	p =0.048
Engkyst Fiber (g)	36 (High)	30	38 (High)	30	1.002 (0.987 to 1.017)	p = 0.253
Protein (g)	81.6 (High)	49.79	93.1 (High)	48.57	1.023 (0.989 to 1.058)	p = 0.184
Fat-total (g)	87.2 (High)	84.75	98.03 (High)	83.08	0.979 (0.926 to 1.035)	p = 0.013
Saturated fatty acids (SFA)(g)	36.22 (High)	26.64	39.15 (High)	25.99	1.032 (0.960 to 1.110)	p =0.355
Polyunsaturated fatty acids (PUFA)(g)	11.72 (Low)	15.64	11.43 (Low)	15.23	1.016 (0.982 to 1.051)	p= 0.103
Monounsaturated fatty acids (MUFA)(g)	25.09 (Low)	31.6	30.29 (Low)	30.96	0.990 (0.917 to 1.070)	p = 0.006
Micronutrients						
Sodium (g)	2.38 (Low)	2.4	2.55 (High)	2.4	1.563 (1.056 to 2.312)	p = 0.101
Potassium (mg)	3516.63 (High)	3500	3897.46 (High)	3500	1.000 (0.999 to 1.001)	p = 0.005
Calcium (mg)	901.34 (High)	700	994.3 (High)	700.96	0.999 (0.997 to 1.001)	p =0.237
Magnesium (mg)	293.35 (High)	283.69	330.45 (High)	280.53	0.999 (0.990 to 1.008)	p = 0.013
Copper (mg)	1.53 (High)	1.2	1.71 (High)	1.2	1.278 (0.659 to 2.477)	p = 0.040
Iodine (mcg)	143.2 (High)	140	162.78 (High)	140	1.004 (0.996 to 1.011)	p =0.027
Iron (mg)	9.55 (High)	9.3	10.67 (High)	10.51	1.037 (0.846 to 1.273)	p =0.970
Selenium (mcg)	50.39 (Low)	66.85	61.15 (High)	65.12	0.998 (0.980 to 1.016)	P = 0.022
Zinc (mg)	7.8 (Low)	8.14	8.9 (High)	7.85	0.789 (0.563 to 1.105)	p = 0.000
Phosphorus (mg)	1251.55 (High)	550	1428.36 (High)	550.72	1.000 (0.996 to 1.005)	p = 0.072
Vitamin- A (Retino)(mcg)	515.59 (Low)	645.65	589.94 (At recommended level)	589.94	1.000 (0.999 to 1.001)	p = 0.325
Vitamin-B12 (mcg)	5.5 (High)	1.5	7.4 (High)	1.5	1.000 (0.847 to 1.181)	p =0.778
Vitamin C (mg)	118.34 (High)	40	127.57 (High)	40	1.001 (0.994 to 1.008)	p = 0.717
Vitamin D (mcg)	2.72 (Low)	10	3.86 (Low)	10	0.809 (0.658 to 0.994)	p = 0.182
Folate (mcg)	263.48 (High)	200	292.07 (High)	200	0.998 (0.992 to 1.003)	p = 0.026

Note: *Chi-Square test for statistical association was used to test the association between T2DM status and 22 nutrients. Average Reference values were derived using UK Government Dietary Recommendation Document 2016.

1) Ten out of twenty-two nutrients were statistically significant ($p<0.05$).
2) None of the participants were consuming selected twenty-two nutrients specific to T2DM at daily recommended levels, except Vitamin A among without T2DM participants.

Average daily consumption of 14 food groups among studied cohort

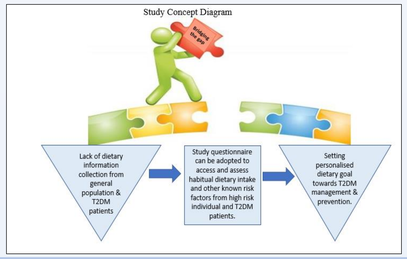
1. Higher consumption of Cereals & Cereals products (such as rice, chapati, pasta, bread, wraps tortilla , pizza, noodles and more) were reported among T2DM Indian and White British participants.
2. Sugars, Preserves & Snacks were consumed at elevated levels among T2DM Indian, Bangladeshi, White British participants as compared to their non-diabetes counterpart.
3. Non-alcoholic Beverages consumed at higher levels among T2DM Pakistani, Bangladeshi, White British and African participants, except Indian.
4. Low levels of Milk & Milk product consumption was prominent among all T2DM participants.
5. T2DM white British participants were observed to consume higher levels of Fish & Fish products and Meat &Meat products as compared to their non-diabetes counterpart.
6. Lower consumption of carbohydrate, Monounsaturated fatty acids, selenium, zinc, vitamin A, & vitamin D was highlighted among T2DM participants.

Discussion

1. This digital questionnaire asks simple questions to participants who can fill the questions without any technical understanding.
2. Information collected as 'dietary information' can easily interpreted at micro and macro nutrient levels for each individual.
3. The macro and micronutrient levels obtained can be compared with established guidelines to gain status in terms of high/low/at recommended levels.
4. This personalised approach enables healthcare staff to provide precision nutrition guidance for specific individuals based on their diet.
5. Since this is a web based digital tool, the data collection, interpretation, analysis and result presentation can be done as a seamless activity to provide on-screen feedback for next steps and hence this can be developed as a fully automated tool for mass roll out.

Conclusion

A study questionnaire could be adopted as a non-invasive screening tool to set personalised dietary goal for not only management but prevention of T2DM.



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Acknowledgement

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Conclusion

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