Mining relationships between food groups, eating time slots and diabetes status in adults from UK NDNS RP

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Introduction

- The timing of energy/nutrient intake has been previously shown to be associated with obesity and diabetes [1];
- Recently derived diurnal patterns of energy/carbohydrate intake suggested the potential interplay of circadian biology and social behaviour contributing to obesity [2];
- The relationship between food groups and the time when they are eaten is of interest, how such relationships vary by type 2 diabetes status are still left unknown.

Data and Methodology

- National Diet and Nutrition Survey Rolling Programme (NDNS RP, 2008-2017) included 6802 adults (2810 men and 3992 women) aged 19 or older in the UK, and their 749,026 food recordings collected by a 4-day-diary.
- Time of the day was categorized into 7 slots: 6-9 am, 9-12 noon, 12-2 pm, 2-5 pm, 5-8 pm, 8-10 pm and 10 pm-6 am.
- The derived contingency table between 60 food groups and the above 7 time slots were analyzed by Correspondence Analysis (CA). Biplots plotted separately for the foods for all adults combined and separately by diabetes status.

Table 1: Definition of Type 2 Diabetes (T2D).

Diabetes status	Self-reported	Glucose (mmol/L)	HbA1c (%)	n
No diabetes	No	< 6.10	< 6.5	2626
Pre-diabetes	No	$6.10 \sim 6.99$	--	133
Undiagnosed	No	$\geqslant 7.00$	$\geqslant 6.5$	99
Diagnosed	Yes	--	--	227
Missing	NA	NA	NA	3717

- The odds ratio estimate was derived of consuming unhealthy food groups later in the day compared to earlier in the day, by logistic regression models.

Results

Figure 1: Biplot for CA of food groups and time slots among non-diabetes.

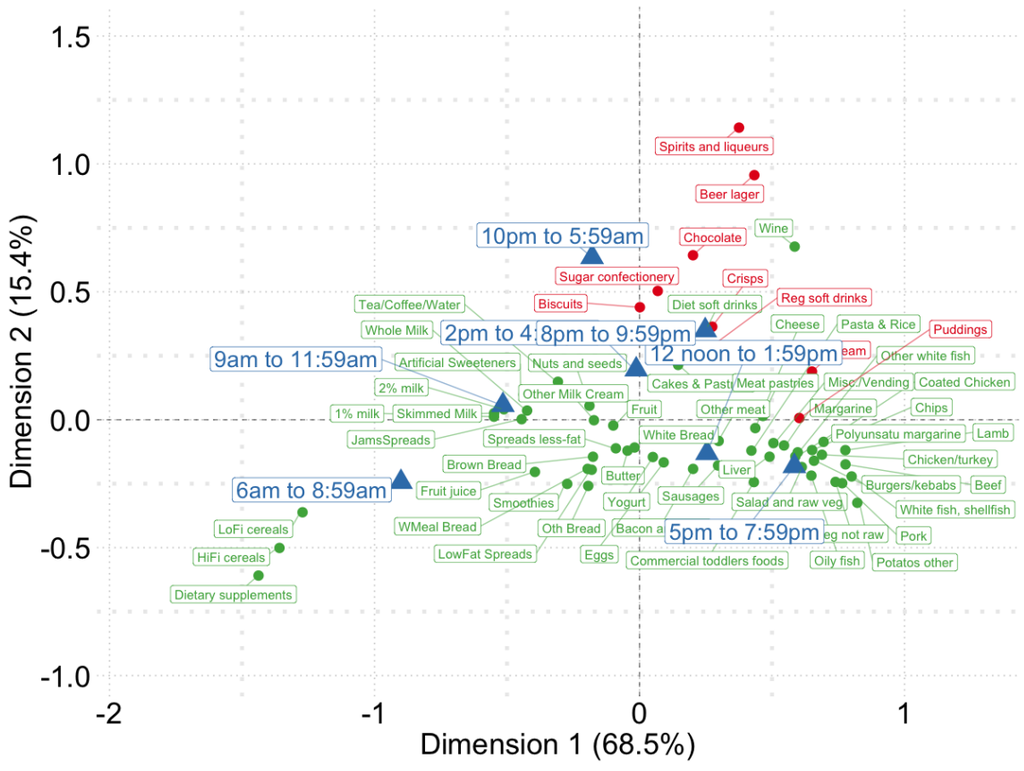

Figure 2: Biplot for CA of food groups and time slots among diabetes.

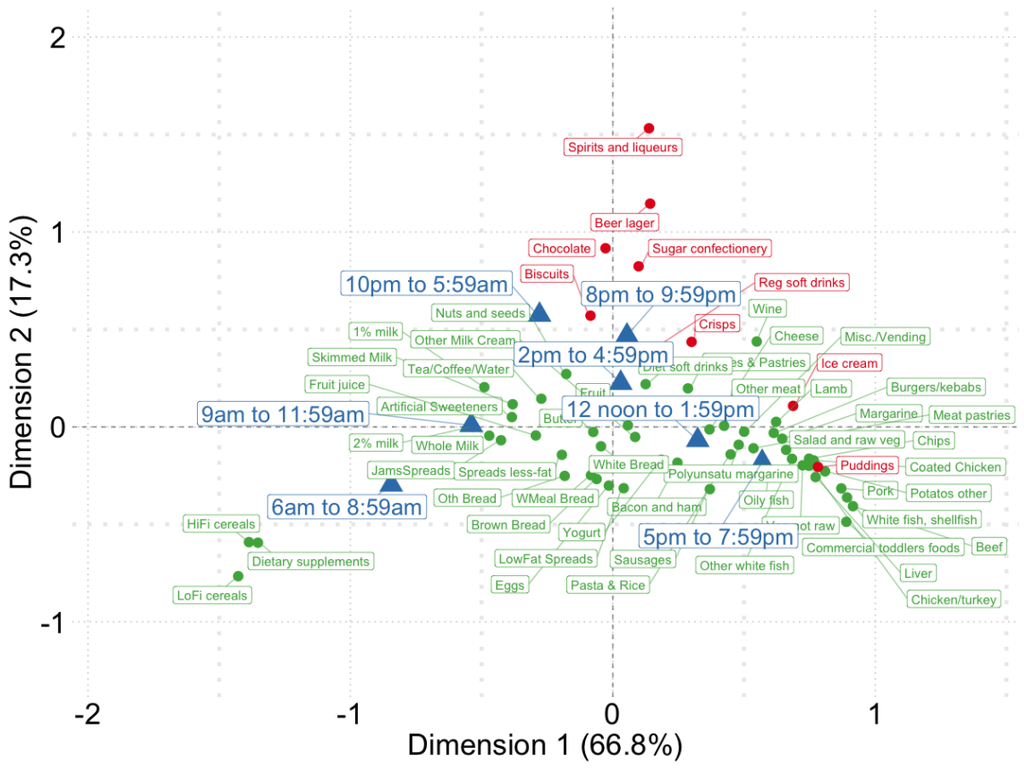

Figure 3: Biplot for CA of food groups and time slots among undiagnosed diabetes.

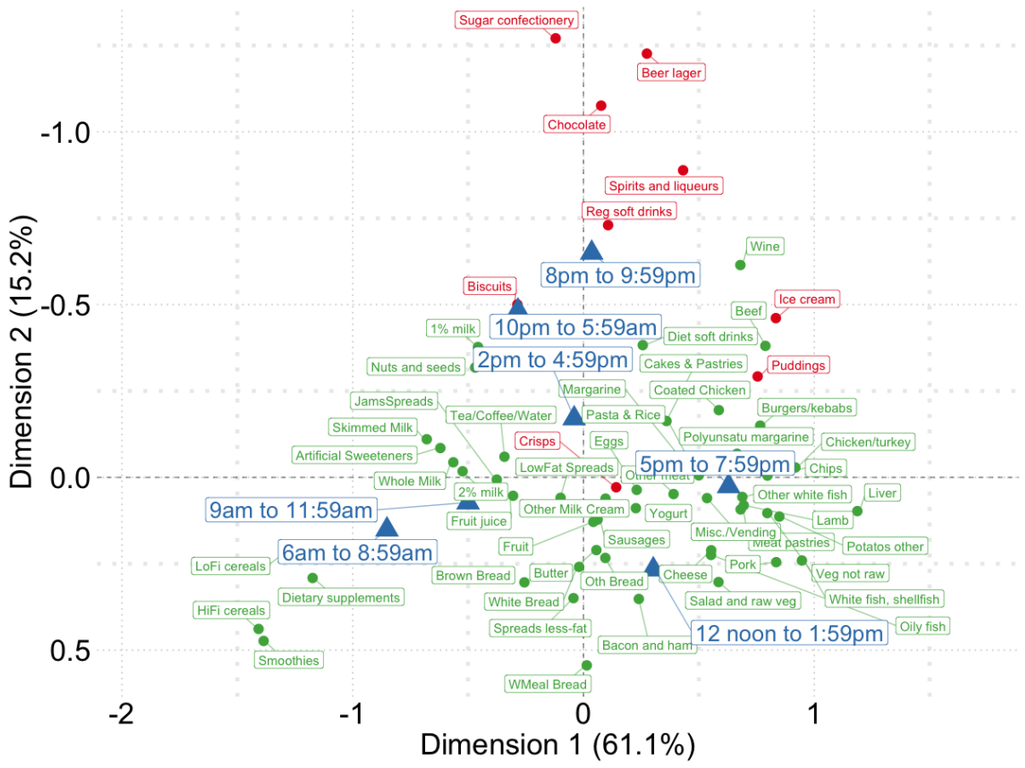

Figure 4: Biplot for CA of food groups and time slots among pre-diabetes.

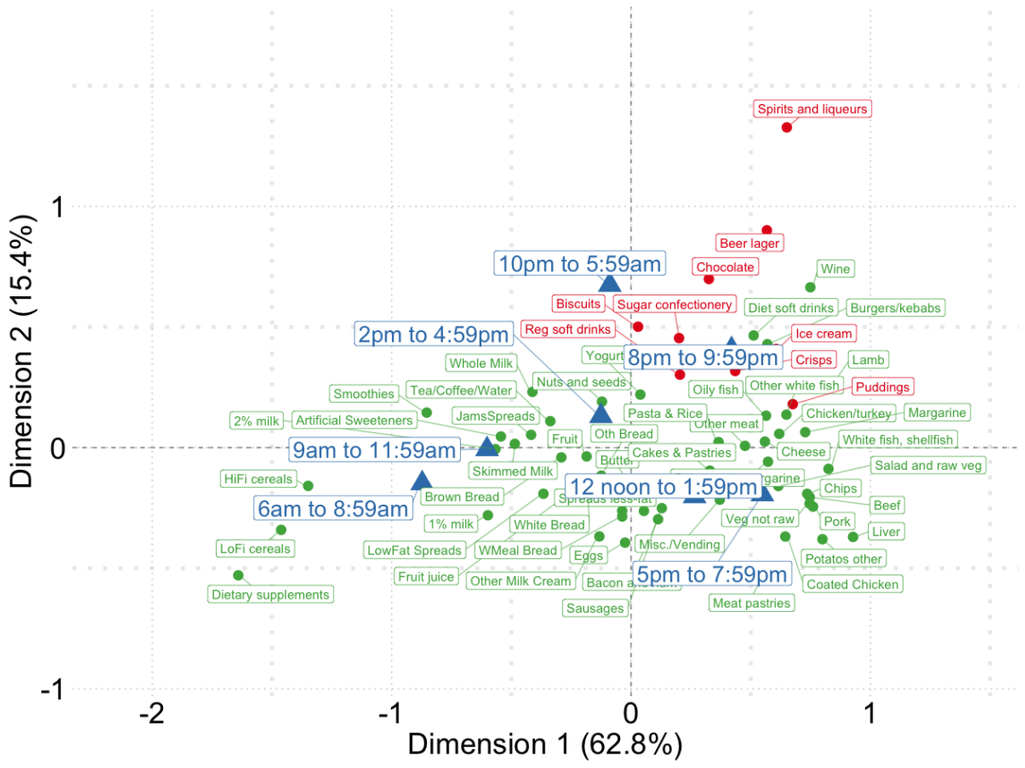

Table 2: OR (99%CI) for food groups eaten at night (8pm -) vs. earlier time, among total and according to different T2D status, NDNS RP 2008-2017.

Food group	Overall	Non-DM	Pre-DM	Undiag-DM	DM
Pudding	1.38 (1.03, 1.86)	1.50 (1.10, 2.07)	0.89 (0.16, 4.87)	1.81 (0.41, 7.98)	0.58 (0.14, 2.43)
Sweetened Soft drink	1.74 (1.47, 2.06)	1.72 (1.43, 2.06)	1.87 (0.97, 3.57)	2.72 (1.44, 5.14)	1.38 (0.65, 2.96)
Sugar Confectionery	1.92 (1.38, 2.69)	1.63 (1.14, 2.32)	2.10 (0.52, 8.46)	13.07 (4.59, 37.24)	5.10 (2.15, 12.09)
Chocolate	3.19 (2.69. 3.79)	3.10 (2.57, 3.73)	4.07 (2.58, 3.73)	2.52 (0.95, 6.66)	5.13 (2.55, 10.30)
Spirit	11.13 (8.37, 14.80)	10.86 (8.01, 14.73)	8.48 (2.26, 31.79)	7.51 (1.99, 5.21)	36.8 (7.36, 183.66)
Beer	7.19 (5.87, 8.82)	7.49 (6.02, 9.34)	4.05 (2.00, 8.20)	7.87 (3.51, 17.63)	6.32 (2.29, 17.47)
Ice cream	2.38 (1.79, 3.15)	2.45 (1.82, 3.31)	3.32 (0.75, 14.62)	0.98 (0.14, 7.00)	1.65 (0.54, 5.07)
Biscuit	1.91 (1.67, 2.16)	1.78 (1.55, 2.03)	3.51 (2.16, 5.71)	2.75 (1.35, 5.59)	2.44 (1.54, 3.88)
Crisp	1.55 (1.27, 1.88)	1.56 (1.27, 1.92)	1.95 (0.79, 4.78)	1.37 (0.37, 5.12)	1.16 (0.49, 2.75)

Mixed effect logisitic regression models were adjusted for age, sex, and social-economic status.

Discussion

- Assessing the relationships between less healthy foods and timing of eating is a first step towards identifying specific public health targets for behaviour change/modification.
- Potentially alcoholic/sweetened beverages, chocolates and foods rich in added sugars, saturated fats might had higher odds of being consumed at later time in the day.
- Food and drinks consumed in the evening/night time slot tend to be highly processed and easily accessible.
- Undiagnosed T2D patients might be in higher risk of worsening their condition as they had higher tendency to consume less healthy foods.
- The survey cross-sectional nature warrants further investigations by longitudinal cohort studies.

[1] S. Almoosawi, S. Vingeliene, F. Gachon, T. Voortman, L. Palla, J. D. Johnston, R. M. Van Dam, C. Darimont, L. G. Karagounis, Chronotype: Implications for Epidemiologic Studies on Chrono-Nutrition and Cardiometabolic Health, Advances in Nutrition 10 (1) (2018) 30–42.

[2] L. Palla, S. Almoosawi, Diurnal patterns of energy intake derived via principal component analysis and their relationship with adiposity measures in adolescents: Results from the national diet and nutrition survey rp (2008–2012), Nutrients 11 (2) (2019) 422.