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Relationships between food groups and eating time slots according to diabetes status in adults from the UK National Diet and Nutrition Survey (2008–2017)

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ABSTRACT

Time of eating has been shown to be associated with diabetes and obesity but little is known about less healthy foods and specific time of their intake over the 24 hours of the day. In this study we aimed to identify potential relationships between foods and their eating time, and see whether these associations may vary by diabetes status. The National Diet and Nutrition Survey (NDNS) including 6802 adults (age $\geq$ 19 years old) collected 749,026 food recordings by a 4-day-diary. The contingency table cross-classifying 60 food groups with 7 pre-defined eating time slots (6-9am, 9am-12pm, 12-2pm, 2-5pm, 8-10pm, 10pm-6am) was analyzed by Correspondence Analysis (CA). CA biplots displaying the associations were generated for all adults and separately by diabetes status (self-reported, pre-diabetes, undiagnosed-diabetes, and non-diabetics) to visually explore the associations between food groups and time of eating across diabetes strata. For selected food groups, odds ratios (OR, 99% confidence intervals, CI) were derived of consuming unhealthy foods at evening/night (8pm-6am) vs. earlier time in the day, by logistic regression models with generalized estimating equations. The biplots suggested positive associations between evening/night and consumption of puddings, regular soft drinks, sugar confectioneries, chocolates, spirits, beers, ice cream, biscuits, and crisps for all adults in the UK. The OR (99% CIs) of consuming these foods at evening/night were respectively 1.38 (1.03, 1.86), 1.74 (1.47, 2.06), 1.92 (1.38, 2.69), 3.19 (2.69, 3.79), 11.13 (8.37, 14.80), 7.19 (5.87, 8.82), 2.38 (1.79, 3.15), 1.91 (1.67, 2.16), 1.55 (1.27, 1.88) vs. earlier time in the day. Stratified biplots found that sweetened beverages, sugar-confectioneries appeared more strongly associated with evening/night among un-diagnosed diabetics. Foods consumed in the evening/night time tend to be highly processed, easily accessible, and rich in added sugar or saturated fat. Individuals with undiagnosed diabetes are more likely to consume unhealthy foods at night. Further longitudinal studies are required to ascertain the causal direction of the association between late-eating and diabetes status.

Keywords: Chrononutrition, time of eating, correspondence ananlysis, NDNS RP

INTRODUCTION

RESULTS

Subsection 1

You can use R chunks directly to plot graphs.

```
x <- 0:100
set.seed(999)
y <- 2 * (x + rnorm(length(x), sd = 3) + 3)
plot(x, y)
```

Subsection 2

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1 DISCUSSION

DISCLOSURE/CONFLICT-OF-INTEREST STATEMENT

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

AUTHOR CONTRIBUTIONS

The statement about the authors and contributors can be up to several sentences long, describing the tasks of individual authors referred to by their initials and should be included at the end of the manuscript before the References section.

ACKNOWLEDGMENTS

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2 SUPPLEMENTAL DATA

Supplementary Material should be uploaded separately on submission, if there are Supplementary Figures, please include the caption in the same file as the figure. LaTeX Supplementary Material templates can be found in the Frontiers LaTeX folder

3 REFERENCES

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FIGURES

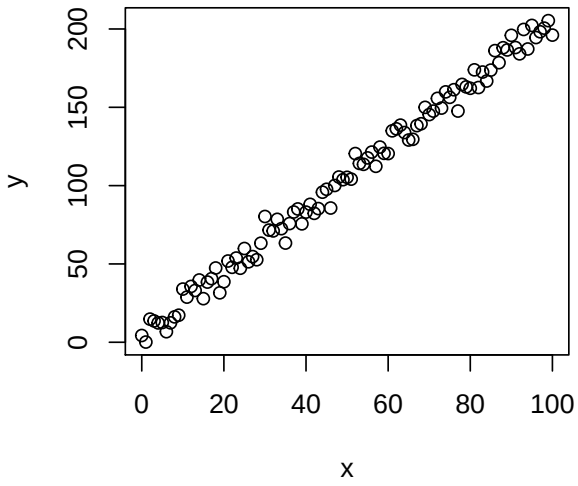

Figure 1. Figure caption