CHARACTERIZATION OF THE DIURNAL EATING PATTERNS AND OF THEIR EFFECT ON OBESITY IN THE ITALIAN POPULATION: RESULTS FROM THE INRAI-SCAN SURVEY (2005/2006)

Laura Lopez Sanchez[1], Luigi Palla[1]

1 *Dipartimento Sanita' Pubblica e Malattie Infettive, Universita' La Sapienza Roma*

Introduction:

Chrononutrition is an emerging field that studies the relationship between Circadian rhythms, eating patterns, and their effect on health [1]. Circadian rhythms are cyclical endogenous processes, commonly referred to as the human body's internal clock, which dictate the schedule on which we function. Most organs including digestive ones have a local clock whose zeitgeber is the Superchiasmatic Nucleus (SCN), also known as the master clock, synchronized mainly as a response to sunlight, although food timing also plays a key role in the development and maintenance of our internal clocks [2]. Late main meals have been related to the risk of obesity, but main meals are often considered in isolation, rather than deriving overall eating patterns throughout the day. Whilst this has been be done for specific populations, e.g. adolescents [3] or adults [4] from the UK, it was never attempted on Italian data. Beside the timing of eating, another dimension studied within chrononutrition is the regularity of food intake. In order to study both timing and regularity of eating, we use data from the Italian National Food Consumption Survey INRAN-SCAI 2005–06 . A representative cross-sectional sample was collected on 3323 subjects from different regions throughout Italy. The survey consisted of a 3-day diet diary recording every eating and drinking occasion, indicating the time of consumption and quantity.

Objectives:

1. To derive diurnal and irregularity eating patterns (DIEPs) for the Italian population, using Principal Component Analysis.

2. To examine and describe the effect the derived DIEPs have on BMI/obesity in the Italian adult population (18-64 years of age).

Methods:

We derived the DIEPs by Principal Component Analysis (with covariance matrix) jointly on indices of average and irregularity of energy intake using the reduced 6 time intervals (breakfast 6-9am, morning snacks 9-12, lunch 12-15, afternoon snacks 15-19, dinner 19-22, night 22-06) corresponding to common eating time slots in Italy. A mixed-effect model with random intercept accounting for the correlation within household was applied including only adults (n=2313), with BMI as outcome, the main DIEPs as (orthogonal) exposures and a set of covariates identified as potentially related with BMI and with the outcome (age, sex, civil status, profession, smoking, alcohol, breakfast intake, amount of weekly physical activity, geographic area and rural/urban and total daily energy intake). We also adjusted for the number of weekend days included in the surveyed days as this varied from 0 to 2. The regression analysis was carried out both including all five PC scores in the same model and with each PC score as a separate exposure.

Results:

The first 5 DIEPs obtained for the 6 intervals explained 93% of the total variance, with the first DIEP score (47% of variance) increasing with energy intake at main meals, the second DIEP score (22% variance) being a contrast between lunch (negative) and dinner (positive), the third DIEP score (10% variance) increasing with snack time eating, the fourth (7.7% variance) with breakfast eating and the fifth DIEP (6.4% variance) score increasing mainly with night eating and to a lesser extent with irregular eating at night.

The mixed model (ICC=0.190, $p<0.0001$) including all PC scores resulted in a positive association of BMI with the first DIEP (b=0.41 per 100%score, p=0.011). A positive significant association also resulted between BMI and the third DIEP (b=0.51 per 100%score, p=0.016) while for the fifth DIEP there was some evidence that food and irregularity of intake at night was associated with increase in BMI (b=0.16 per 100%score, p=0.056). For the other two DIEPs the results were far from significant but were all in the same direction (positive association).

The mixed model including only one PC score (main exposure) at a time gave similar results only for the first two DIEPs, while for the next three, the only significant one became the fourth and changed direction (b=-0.17 per 100%score, p=0.001).

Discussion

The findings in the model including all the (uncorrelated) PC scores indicated that the principal component scores DIEP1 that increased by substantial lunch and dinner and DIEP3 that increased by substantial snack consumption in the morning and afternoon and DIEP5 that increased by substantial and/or irregular eating at night have some evidence of association with BMI. However, in the models including only one DIEP exposure at a time it appears that only DIEP1 significant effect is confirmed , DIEP3 is qualitatively confirmed but no longer significant whereas DIEP5 effect vanishes and additionally there appears a highly significant effect of DIEP4 and in a different direction, in that having large consumption of calories at breakfast determines a decrease in BMI.

However due to the nature of the dimensionally reduced variable (score) that is harder to interpret on a continuous scale, further investigation is warranted to enhance the causal interpretation of single PC regression models. In particular it may be worth to dichotomise the PC scores and explore the applicability of propensity score techniques to possibly achieve a better balance of covariates. Further use of causal inference theory and methods should be used to justify any causal interpretation.

Conclusions

This study indicates that in the Italian adult population BMI tended to increase with large energy intake at main meals and at snack times, independently of average total intake. This is in line with recent findings in the British population, indicating the relevance of deriving and modelling DIEPs, beside average daily intake, for obesity management. Further investigation is required to elucidate the role of early and late eating and of irregularity on BMI at population level.

References

1. Almoosawi, S., Vingeliene, S., Karagounis, L. G., et al (2016). Chrono nutrition: a review of current evidence from observational studies on global trends in time-of-day of energy intake and its association with obesity. Proceedings of the Nutrition Society, 75(4), 487–500. https://doi.org/10.1017/S002966511 6000306
2. Lax, P., Zamora, S., Madrid, J. A. (1999). Food-Entrained Feeding and Locomotor Circadian Rhythms in Rats Under Different Lighting Conditions. Chronobiology International, 16(3), 281–291. https://doi.org/10.3109/0742052990 9116858
3. Palla, L., & Almoosawi, S. (2019). 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), 422. https://doi.org/10.3390/nu1102042
4. Wang, C., Almoosawi ,S. , Palla, L. (2019). Day-time patterns of carbohydrate intake in adults by non-parametric multi-level latent class analysis. Results from the UK National Diet and Nutrition Survey (2008/09–2015/16). Nutrients, vol. 11, p. 1-16, ISSN: 2072-6643, doi: 10.3390/nu11102476