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Published in:
E-artikel fra DTU Fødevareinstituttet

Publication date:
2020

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):
Nordman, M., & Matthiessen, J. (2020). Danes have most unhealthy eating habits on Saturdays and are least active on Sundays. *E-artikel fra DTU Fødevareinstituttet*, 2020(1), 1-8.

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Danes have most unhealthy eating habits on Saturdays and are least active on Sundays

By Matilda Nordman and Jeppe Matthiessen



ISSN: 2597-0526

The Danish population has consistently less healthy dietary intake on Fridays and weekends compared to the other weekdays. For instance, Danes have a higher intake of energy, added sugar, alcoholic beverages and discretionary foods, and a lower intake of fruit, vegetables and whole grain products on Fridays and weekends. Saturday is the least healthy day of the week in terms of dietary intake. Danes are also less physically active during weekends, and Sunday is the least active day of the week. On average, people take 2000 fewer steps on Sunday than they do on Monday through Thursday. These results indicate that weekends are especially challenging in terms of healthy eating and physical activity, making weekend days an obvious target for public health campaigns aiming to improve Danes' eating and activity behaviour.

Half of all adult Danes (51%) are currently overweight or obese (Jensen et al. 2018), while 10-25% of children and adolescents are overweight or obese (Tetens et al. 2018). Sufficient physical activity and a balanced, healthy diet are fundamental for prevention of overweight, obesity, and several lifestyle-related diseases.

Few people would claim that they maintain consistent eating and activity patterns across all days of the week. Concepts such as 'Friday candy' and weekend 'hygge' – the Danish concept of cosiness, often entailing sedentary activities – are familiar to many Danes.

The Danish National Survey of Diet and Physical Activity 2011-2013 (DANSDA) is the only national survey in Denmark, in which detailed and comprehensive data on both dietary intake and physical activity are collected (Pedersen et al. 2015). Data from DANSDA can be used to investigate weekday-weekend day differences in Danes' dietary intake and physical activity behaviour. Identification of such patterns in behaviour can help target public health campaigns to improve the population's health behaviour and long-term health.

This e-article discusses the main findings of a recently published study, which was carried out at the National Food Institute, Technical University of Denmark, in cooperation with University of Copenhagen: Nordman M, Matthiessen J, Biltoft-Jensen AP, Ritz C, Hjorth MF (2020). *Weekly variation in dietary intake and physical activity among 4-75-year-old Danes*. We refer to the scientific publication for complete results and discussion, and an accompanying extensive literature review on studies carried out in the field.

Methods

In DANSDA data are collected from a simple random sample of nearly 4000 individuals aged 4-75 years (Pedersen et al. 2015). Dietary intake is measured with pre-coded food diaries, in which participants record everything they eat and drink for seven consecutive days. To obtain objective measures of physical activity, participants wear pedometers (Yamax SW200) for seven days and record daily step counts in a step diary. In the step diary, participants also record cycling time, from which a daily cycling-adjusted step count can be calculated by multiplying the minutes spent cycling by 160 steps and adding it to the crude step count.

In the present analysis, researchers from the DTU National Food Institute and University of Copenhagen statistically compared Danes' dietary intake and physical activity on weekdays (Monday to Thursday) with diet and physical activity on Friday, Saturday and Sunday.

The researchers selected a variety of dietary variables based on their importance to overweight and public health, and to get a representation of dietary quality. Dietary variables included energy intake, energy density, macronutrients (i.e. added sugar and dietary fibers), and different foods and beverages (i.e. vegetables, fruit, fast food, whole grain products, discretionary foods, and alcoholic and sugar-sweetened beverages).

Energy density of foods and liquids indicates how much energy a set volume of different foods or beverages in the diet contains, and is provided in kilojoule per 100 g (kJ/100g). In the analysis,

energy density is calculated separately for all foods consumed (*energy density solids*) and all beverages consumed (*energy density liquids*).

Whole grain products include ryebread, oats and coarse wheat bread, as these are key whole grain products in Denmark.

Discretionary foods include both sweet and savoury snack foods, such as cakes, sweets, chocolate, chocolate spreads, chips and salted nuts.

Sugar-sweetened beverages include soda, non-alcoholic cider, ice tea and sugar-sweetened fruit drinks.

Beer and wine are the most consumed alcoholic beverages in Denmark and are therefore used a proxy for alcohol consumption.

It should be mentioned that foods and beverages were analysed for both the *amounts consumed* and the *probability* that someone will consume a specific food or beverage on a given day. In this e-article, the probabilities of consumption are not reported, and mean intakes of foods and beverages are based on consumption days only.

To see if weekday-weekend day patterns in diet and activity vary between different ages, analysis were also carried out in four different age groups, representing different life stages:

- *children* 4-13 years old
- *adolescents and young adults* 14-24 years old
- *adults* 25-59 years old, and
- *elderly* 60-75 years old.





Unhealthy eating habits dominate the weekend

When the average intakes of selected foods and beverages on Friday, Saturday and Sunday are compared to intakes on weekdays, it is evident that the dietary habits of Danes fluctuate substantially during the week and dietary quality on weekends is poorer. As seen in Figure 1, the average intakes of vegetables, fruits and whole grain products were significantly lower on Friday, Saturday and Sunday, compared to weekdays. Mean intakes for the whole population are provided in Table 1 (see p. 6). The intake of beer and wine was higher on Friday and Saturday, while the intake of discretionary foods was substantially higher on Fridays and weekend days compared to weekdays.

There was no difference in the *amount* of sugar-sweetened beverages consumed on different days of the week and fast food consumption even appeared to be lower on Saturdays. However, the probability of consumption was higher in the weekend for both food groups, i.e. the proportion of people consuming these products was substantially higher in the weekend. For instance, people were twice as likely to consume sugar-sweetened beverages on Saturday, compared to weekdays (data not shown). We refer to the scientific publication for complete results (Nordman et al. 2020).

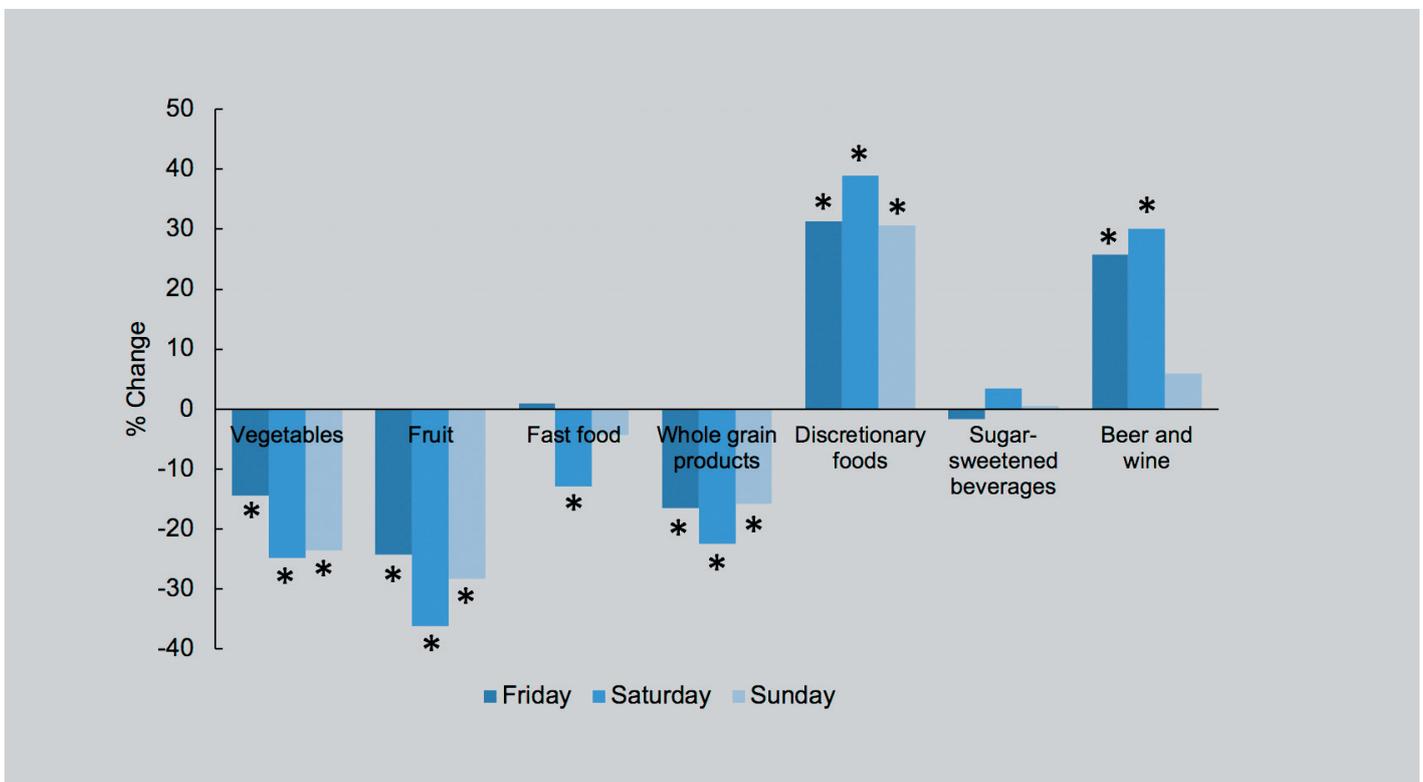


Figure 1 Differences in intakes of selected foods and beverages on Friday, Saturday and Sunday compared to weekdays (Monday-Thursday). The solid horizontal line represents Monday-Thursday and a larger bar indicates a larger relative difference in intake, with the asterisk (*) indicating a statistically significant difference at $p < 0,001$.

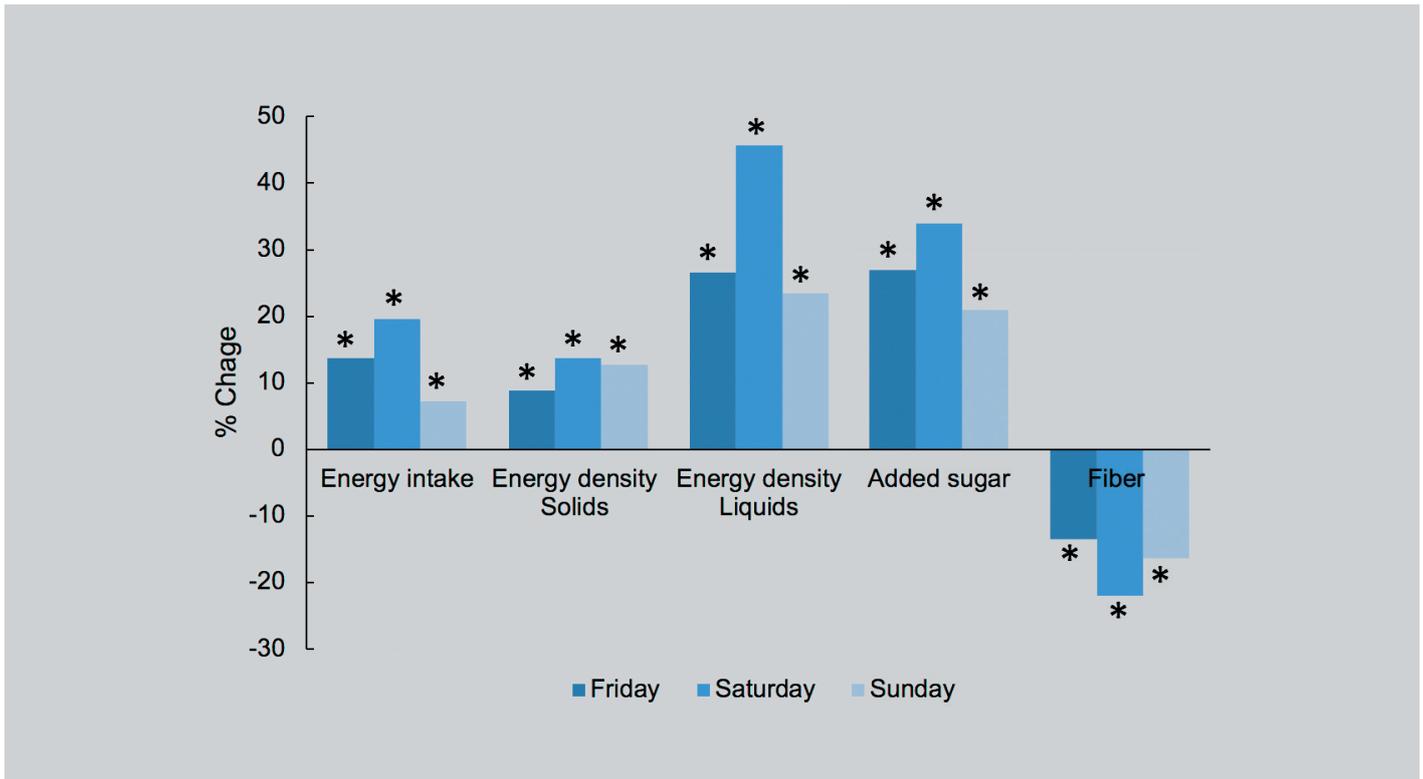


Figure 2 Differences in intakes of energy, macronutrients and energy density on Friday, Saturday and Sunday compared to weekdays (Monday-Thursday). The solid horizontal line represents Monday-Thursday and a larger bar indicates a larger relative change in intake, with the asterisk (*) indicating a statistically significant difference at $p < 0,001$.

Changes in the consumption of foods and beverages are also reflected in changes in energy and nutrient intakes on different days of the week. Figure 2 shows that intake of energy from the diet was 14%, 20% and 7% higher on Friday, Saturday and Sunday, respectively, compared to weekdays. On Saturdays, this corresponds to an approximate 1.7 MJ increase in energy intake compared to weekdays. On weekends, the consumption of added sugar was higher, while the intake of dietary fiber was lower compared to weekdays.

Energy density of both foods and drinks in the diet increased during the weekend. The energy density of drinks was 46% higher on Saturdays compared to weekdays, likely due to higher consumption of alcohol and a higher proportion of the population consuming sugar-sweetened beverages. Energy density is an important indicator of dietary quality, since a diet with higher energy density has been associated with overall poorer dietary quality (Patterson et al. 2010) and with a higher risk of overweight and obesity (Perez-Escamilla et al. 2012).

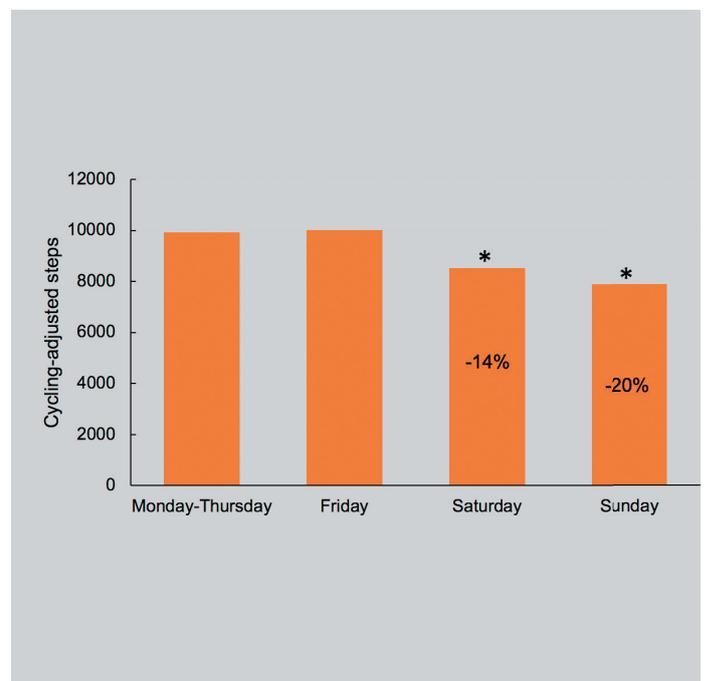


Figure 3 Cycling-adjusted steps on Monday-Thursday, Friday, Saturday and Sunday. The amounts of cycling-adjusted steps on Saturdays and Sundays were 14 and 20% lower compared to Monday-Thursday, respectively. Asterisk (*) indicates statistically significant difference at $p < 0,001$ compared to Monday-Thursday.

Less physical activity during weekend days

As Figure 3 indicates, Danes are substantially less physically active on Saturdays and Sundays compared to Monday-Friday. Sunday was the least active day of the week, yielding approximately 2000 steps less than Monday-Thursday, when cycling is taken into account. Mean crude step counts and cycling-adjusted steps for the whole population are presented in Table 1.

It has previously been observed that engagement in sedentary leisure activities, such as screen time, is higher during the weekends in Danish children (Hjorth et al. 2013).

Overall, Danes' eating habits appear to be the least healthy on Saturdays. Friday is traditionally considered to be a weekday, but in terms of dietary intake it resembles a weekend day. On the other hand, physical activity on Fridays did not significantly differ from Monday-Thursday. Friday is a transition day into the weekend, with the first half of the day being lived as a weekday and the second half of the day being lived as a weekend day.

Patterns differ between age groups

The difference between weekday and weekend day eating and physical activity behaviour differs among Danes of different ages (Figure 4).

Generally, elderly people (60-75-year-olds) have the smallest weekly variation in both dietary intake and physical activity.

Conversely, children have the largest week-day-weekend day difference in several key factors, such as intake of added sugar, discretionary foods and physical activity (i.e. steps per day). A Danish study looking at parents' motives for giving their children sugar-rich foods, found that parents try to limit children's sugar intake during weekdays, and thereby, sugar-rich food are "reserved" for the weekend (Iversen et al. 2011).

Among older adults, retirement brings an obvious change to the structure of the week and likely to explain the smaller weekly variation among these individuals.

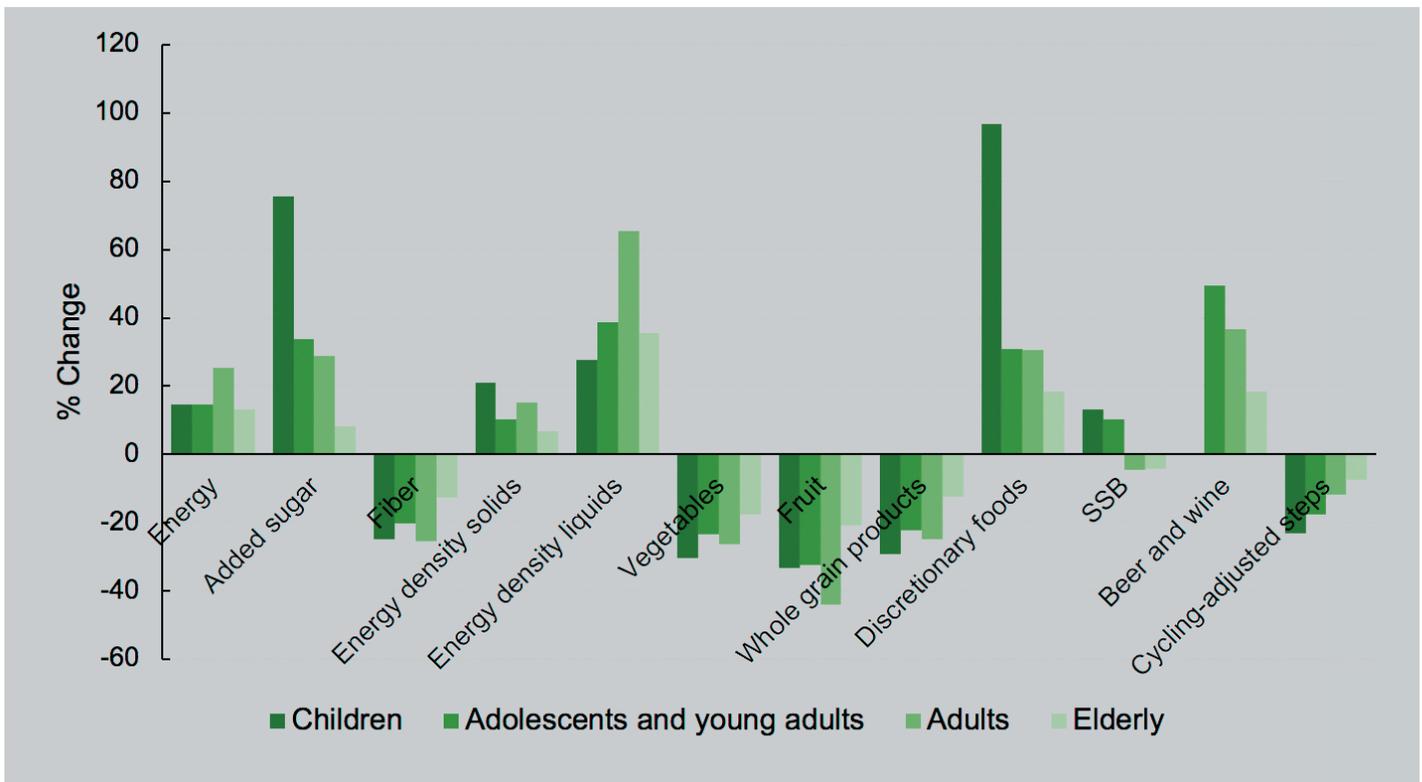


Figure 4 Comparison of weekday-weekend day patterns in dietary intake and physical activity between different age groups. Bars in all age groups represent the difference between Saturday and weekdays (Monday-Thursday).

Table 1 Means of different variables of diet and physical activity on weekdays (Monday-Thursday), Friday, Saturday and Sunday. Intakes of macronutrients, foods, and beverages are adjusted to energy intake (E% and g/10MJ) to enable comparison of intakes between adults and children.

	Monday-Thursday	Friday	Saturday	Sunday
Energy, MJ/day	9.0	10.2	10.7	9.6
Energy density solids, kJ/100g	724	788	823	816
Energy density liquids, kJ/100g	55	70	80	68
Added sugar, E%	8.0	10.1	10.7	9.6
Fiber, g/10MJ	26.1	22.5	20.3	21.8
Vegetables, g/10MJ	155	133	117	119
Fruit, g/10MJ	137	104	88	99
Fast food, g/10MJ	196	197	170	187
Whole grain products, g/10MJ	120	100	93	101
Discretionary foods, g/10MJ	69	91	96	90
Sugar-sweetened beverages, g/10MJ	399	392	413	401
Beer and wine, g/10MJ	341	429	444	361
Steps/day	8767	8965	7861	7303
Cycling-adjusted steps/day	9926	10007	8525	7902



Health implications of weekly variation in diet and physical activity

Previous studies in Denmark have demonstrated that risk markers of cardiovascular disease and diabetes are 28-35% higher on Mondays immediately after the weekend, compared to Fridays, right before the weekend (Jaskolowski et al. 2017; Hjorth et al. 2015). The authors attribute these findings to less healthy diet, physical activity and sleep behaviours in the weekend.

However, potential health impacts of weekly fluctuations in health behaviour and metabolic health markers are largely unknown. It is important to consider possible health implications of weekly rhythms in dietary intake and physical activity when evaluating the health relevance to such patterns. It is particularly interesting to consider how the transition into consistently less healthy habits during weekends might affect overweight and related diseases.



A positive energy balance during the weekend (i.e. an energy intake larger than energy expenditure), without a negative energy balance during the weekdays to compensate for it, will lead to weight gain in the long term. Previous studies have been able to demonstrate weekly fluctuations in body weight, with a slight weight increase during the weekend (Racette et al. 2008; Orsama et al. 2014).

In terms of dietary intake, Saturday was the least healthy day of the week and the day on which energy intake was the highest. We estimated the potential yearly body weight impact for an average Danish adult, if Saturday was replaced with a weekday in terms of energy intake. These calculations show that the average Dane could lose 1.5 kg over the course of a year if energy intake on Saturday was replaced with energy intake on a weekday (Monday-Thursday).

The weekend should be a target for future public health campaigns

Weekend days display health behaviour patterns that involve poorer dietary quality and less physical activity. Improving health behaviour during the weekend could be effective in preventing overweight and improving the populations' overall health, as highlighted by the estimated weight loss if Saturday was replaced with a weekday. It is not realistic to expect a complete eradication of weekday-weekend day differences. However, even decreasing such differences could have important implications for public health. Weekends should therefore be the target of future public health interventions to improve the population's overall health.

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Edited by Miriam Meister and Heidi Kornholt

