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Article

How Do French Adults Consume Their Dairy Foods? A Characterisation Study Using the INCA3 Database

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Abstract

Dairy foods are rich in nutrients and typically have a lower environmental impact than other animal-based products. Despite these benefits, in France, dairy consumption is lower than recommended. This study sought to understand where in the diet dairy foods are consumed, with a view to identifying opportunities for increasing consumption. A characterisation study was conducted using the INCA3 database (n=783 adults, aged 18–44 years). All eating episodes containing dairy products were classified by product type, and five dimensions to characterise consumption: 1) intakes; 2) eaten or drunk; 3) sweet or savoury; 4) in combination with other foods or by itself; 5) time of day. A sixth dimension, meal or snack, was based on a time-of-day approach. Results showed that (1) an average of 246g, 1126kJ of dairy is consumed per person, per day; (2) dairy is more eaten than drunk; (3) in sweet and savoury dishes depending on the type of product; (4) in proper meals in combination with other foods, rarely by itself; (5, 6) and is mostly consumed at traditional mealtimes and rarely as a mid-day snack. Various suggestions can be made for increasing dairy consumption among French adults, based on product type, eating occasion, and eating context.

Keywords: dairy; dairy consumption; France; manner of consumption; contexts of consumption; patterns of consumption

1. Introduction

Dairy is a good source of vitamins, calcium, and other minerals, proteins, and healthy fats [1–4]. A regular intake has been associated with lower risk of metabolic and cardiovascular diseases [5,6] and better gut health [7,8]. Its consumption promotes bone density [9], maximising bone mineral content and peak bone mass in late adolescence [9,10], and reducing the risk of developing osteoporosis in later life [11]. Moreover, contrary to popular belief, many dairy products are low-lactose or lactose-free, making them suitable for consumption by those who are lactose intolerant or have digestive sensitivities [12–14].

Dairy fits the need to migrate to a more sustainable lifestyle, as it has, on average, a lower impact on natural resources compared to other animal-based products, especially meats [15–18]. Furthermore, products from non-cattle milk, e.g., goat's dairy, are considered more environmentally friendly than cow's dairy, as less demanding in usage of natural resources [19,20].

The dairy group includes many different products from different milks and production processes [21,22], and can be considered an extremely versatile food group, suitable for countless recipes and for consumption in a range of contexts [21,23–27]. Moreover, as occasions for and consumption contexts are not only determined by the product *per se*, but are also influenced by other factors, such as individual preferences, social norms, or market-related aspects [25,28–35], dairy products may have a different place in the meal and the diet for different diners, communities, or cultures [29,32,36–41]. Similarities and common aspects also allow some dairy products to be

replaced with each other, in dishes or on occasions [29,31,42–44]. For instance, yoghurt can be used to replace fattier products, or in different meals and on daily occasions [29,45,46]. Thus, while some products may differ in raw ingredients, production processes, and sensory characteristics, they can be consumed in the same manner or on similar occasions and still impact diet, cost, and environment differently [46–49].

However, despite the health and environmental benefits related to dairy consumption and the wide variety of products available, dairy intake in Western countries is lower than recommended [5,50,51]. Several Western countries recommend a daily consumption of two to three portions of dairy products a day [5,52]; however, in the last two decades, the consumption of milk and dairy products has decreased [50]. For instance, in Europe, milk consumption went from 206.89 kg/y per capita in 2000 to 196.49 kg/y per capita in 2020, while in North America it went from 199.49 kg/y per capita in 2000 to 173.94 kg/y per capita in 2020, without considering potential household waste [50]. In France, milk consumption went from 263 kg/y per capita in 2000 to 250 kg/y per capita in 2020 [50]. While public health campaigns often focus on dairy intakes among children and adolescents [53], intakes often also decrease and stall in late adolescence and adulthood [51]. Adults should also be encouraged to consume dairy, as its intake in adulthood has been associated with healthier body weights, lower risks of developing metabolic syndrome, and a good daily protein and vitamin intake [11,54–56].

To enable the development of tailored strategies, it is necessary to know how adults consume dairy products. This study was conducted to explore intakes and potential patterns in dairy consumption among French adults aged 18–44 years old. Several types of dairy products were considered. Previous studies have often focused on characterising the consumption of a single type of product, e.g., milk, or a specific product, e.g., cow's milk [57,58]. However, exploring the consumption of different products in the dairy group could aid in identifying not only current patterns, but also potential substitution of high sugar/high fat dairy foods, e.g., dairy-based desserts, with healthier products consumed in the same recipes or food combinations.

2. Materials and Methods

2.1. Data Collection

Dairy consumption was explored using the data collected in 2014–2015 during the third French Individual and National Survey Consumption INCA (études Individuelles Nationales des Consommations Alimentaires). The INCA takes place every seven years, and the INCA3 was, at the time of this study, the most recent dataset [59]. This dataset is considered representative of the French population living in France, i.e., excluding French overseas departments and territories and Corsica, in terms of diet, physical activity, and other health-related aspects [59–61], and it was used as a reference by the Ministry of Health and Social Services (Ministère du travail, de la santé, des solidarités et de la famille) for the development of the fourth French National Nutrition and Health Program PNNS (Programme National Nutrition Santé), in force from 2019 to 2024 [62].

A sample of 5855 participants completed the INCA3, of which 3157 (54%) were adults. Among them, n=783 (males n=324, 41.3%) were aged 18–44 years and so considered in this study. Most of them (52.4%) had a higher education. The sample had an average (SD) BMI of 24.7 (4.77) kg/m², and the average daily energy intake of 2190 kcal (9,167 kJ). All data from the INCA3 database is publicly available online as .csv files, and can be downloaded for free at <https://www.data.gouv.fr/fr/datasets/donnees-de-consommations-et-habitudes-alimentaires-de-leurope-inca-3/#/resources>, the French website for data collected by public agencies. Each .csv file gives information about different dimensions, e.g., demographics, food journals, and a thesaurus is available on the website.

Only the data necessary for this study were downloaded. Dairy consumption was explored through the file named “conso-compo-alim-vf-mad-datagouv2021”, reporting three non-consecutive 24h food journals per participant, and “description-indiv”, reporting demographic details.

Participants were already grouped based on their age, i.e., for adults, 18-44 years old, and no other information was disclosed about their age.

Dietary data were collected along with many additional data, including the time of day that the consumption took place, the location, and the event. The degree of detail depended on the individual. Only diary entries that included dairy consumption were used for this study. No detail about the overall diet was considered, and foods other than dairy were considered only in relation to dairy consumption, to explore eating habits. Data were also not trimmed for implausible dietary intakes, under- or over-reporting.

2.2. Data Analysis

Once downloaded, the data were organised and analysed in Microsoft Excel.

Each dairy entry was classified manually. Sub-groups, i.e., milk, yoghurt, fermented dairy, soft cheese, hard cheese, desserts, cream, sauces, plant-based dairy alternatives (PBDA), or other, were created considering the health and environmental impacts of each product, e.g., their production process [23], their greenhouse gas emissions [kg CO₂ kg⁻¹] [48,49], and their presence in the dataset, to ensure all dairy products were classified. Each food journal was checked, and then a search per product was run to ensure all entries were associated with one of the ten sub-groups. Besides being both fermented dairy, yoghurt, and other fresh fermented products, i.e., crème fraîche, fromage blanc, Petit Suisse, quark, cottage cheese, cultured milks, were classified into two different sub-groups, as they are often associated with different types of consumption due to different sensory characteristics [63]. Flavoured products were included in the reference product sub-group, e.g., flavoured milks in the milk sub-group, flavoured yoghurts in the yoghurt sub-group. The *Cream* sub-group included whipped creams, double creams, and heavy creams; the *Sauce* sub-group included all dairy entries named as such by individuals. The *Other* sub-group was created to classify dairy products when specified in recipes, e.g., cheese as pizza topping, without detailed information about quantities. This sub-group was considered only while exploring potential eating patterns, not intakes. Butter was not considered as it has a different nutritional composition and use in the kitchen compared to other milk-based products [64,65]. Plant-based dairy alternatives (PBDA) were also considered. All relevant products were classified into a single PBDA sub-group, no specific sub-group was made for each type of PBDA, e.g., PBDA milk, PBDA cheese. These products were not common in the INCA3 dataset.

Six dimensions were explored for each dairy entry. Intakes were explored in terms of quantities. Dairy consumption was characterised considering eating paradigms such as patterning, e.g., frequency, and format, e.g., food combination [66], and in terms of number of entries in the dataset.

i) First dimension: intakes.

Intakes were explored in terms of weight consumed (grams) and energy intake (kcal, kJ). Average daily intakes were computed for each sub-group, for 'all dairy', i.e., all sub-groups except PBDA, and 'all soft dairy', i.e., milk, yoghurt, fermented dairy, and soft cheese.

ii) Second dimension: "eaten" vs "drunk".

All fluid products, whose texture is liquid, that can be consumed alone or with other liquid products, e.g., coffee, were classified as "drunk". Products whose texture does not allow them to be consumed as a beverage, but instead are "spoonable", or whose consistency is solid, were classified as "eaten".

iii) Third dimension: "savoury" vs "sweet".

All entries were checked one by one and classified according to the foods they were consumed with. They were classified as "savoury" if consumed with other savoury foods, e.g., pasta; they were classified as "sweet" if the other foods were sugary, e.g., jam. A third label was added to classify dairy entries when not paired with any food or paired with food neither 'savoury' nor 'sweet', i.e., coffee, cocoa, tea. In these cases, entries were classified as "neither".

iv) Fourth dimension: "combined with other foods" vs "by itself".

Each dairy entry was classified based on the foods it was paired with. When the dairy was consumed by itself in a standalone meal, it was classified as “by itself”; when the dairy was consumed in a meal and the accompanying foods were specified, it was classified according to those foods, e.g., “with fruit”. When dairy was consumed as part of a meal, but no details on the accompanying foods were stated, it was classified as “in a meal”.

- v) Fifth dimension: time of day of the consumption (in hours, from 0 to 23). Time of day was explored for total dairy, soft dairy, and each soft dairy product individually, hard cheese, and desserts.
- vi) Sixth dimension: “meal” vs “snack”. This dimension was derived from dimension v) time of day, where meals and snacks were defined based on the time of consumption, considering traditional mealtimes in France. Notably, the daily meal structure is shared by most of the population and includes three main meals (i.e., breakfast, lunch, and dinner) at the same hours of the day [67]. A snack was defined following consumption at any other time [66,68,69].

This study was approved by the Research Ethics Committee of Bournemouth University, UK (ID: 45760). The INCA3 database is public, already anonymised, and has obtained appropriate ethical approval before its data collection.

3. Results

3.1. First Dimension: Intakes

Table 1 shows the average daily intake in terms of weight consumed (grams) and energy content (kcal and kJ). Figure 1 shows the weight consumed (a) and energy content (b) per dairy sub-group. These graphs highlight the differences in energy content of differing dairy sub-groups and make it evident that highly consumed dairy products based on weight do not necessarily also impact the diet in terms of energy, e.g., the average daily consumption of soft cheese was 19g vs yoghurt 63g, however, their impact in terms of energy intake is the same (227 kJ). A total average consumption was computed for all dairy and all soft dairy, i.e., milk, yoghurt, fermented dairy, and soft cheese, both excluding PBDA. It is interesting to note that soft dairy covers 87% of total dairy consumption. The sub-group Other was not considered due to a lack of details.

Table 1. Average weight consumed and energy content of overall dairy, overall soft dairy, and each dairy sub-group intake. Energy content has been reported in kcal and kJ. 1kcal = 4.186 kJ.

N=783	Average weight consumed [g/day]	Average energy intake [kcal/day]	Average energy intake [kJ/day]
All dairy	246	269	1,126
Soft dairy	215	187	783
Milk	118	60	252
Yoghurt	63	54	227
Fermented dairy	15	18	75.3
Soft cheese	19	54	227
Hard cheese	12	45	187
Dessert	19	36	151
Cream	0.2	0.6	2.5
Sauce	0.5	0.6	2.5
PBDA	3	2	7

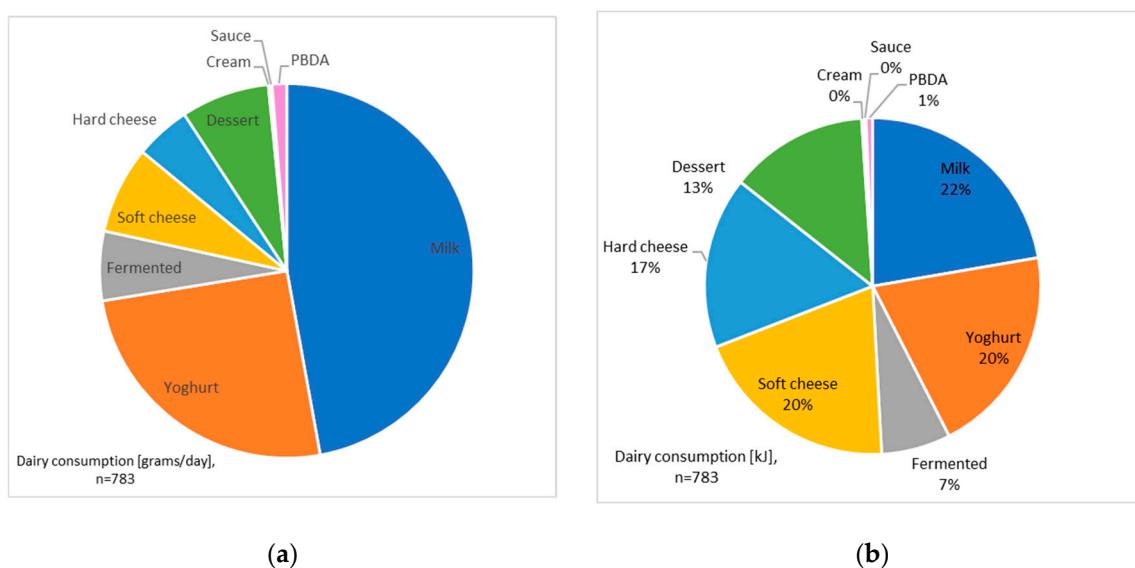


Figure 1. Average weight consumed (a) and energy content (b) for each dairy sub-group. Percentage of energy content are shown to highlight the impact of the different products compared to the total intakes.

3.2. Eating Patterns

3.2.1. Second Dimension: “Eaten” vs “Drunk”

Figure 2 shows that dairy products are more likely to be eaten than drunk, except for milk and PBDA. The eaten ratio in the milk sub-group refers to milk eaten with cereals, or milk in recipes, e.g., crepes.

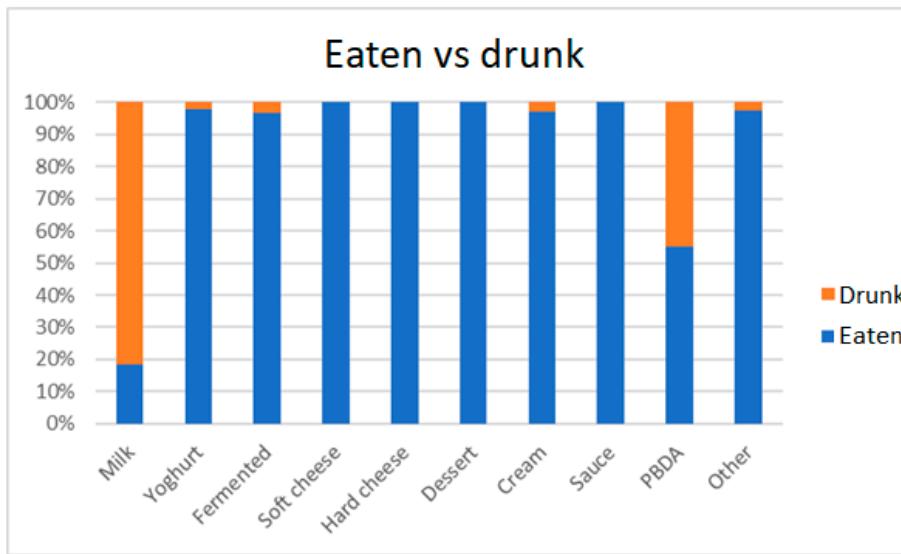


Figure 2. How dairy sub-groups are consumed [%]. Dairy is mostly “eaten”, except for milk and PBDA.

3.2.2. Third Dimension: “Savoury” vs “Sweet”

As shown in Figure 3, dairy is more likely to be consumed in sweet or savoury dishes according to its sub-group. For instance, while some products are consumed either in savoury or sweet dishes, e.g., cheeses vs desserts, respectively, others are suitable for both, e.g., fermented dairy products. Milk and yoghurt were also found to be consumed in neither sweet nor savoury dishes, e.g., Greek yoghurt by itself without other foods. The most diverse sub-group is the PBDA. However, it is important to remember that this group includes different types of dairy alternatives, e.g., milks, cheeses, that are usually consumed in different ways.

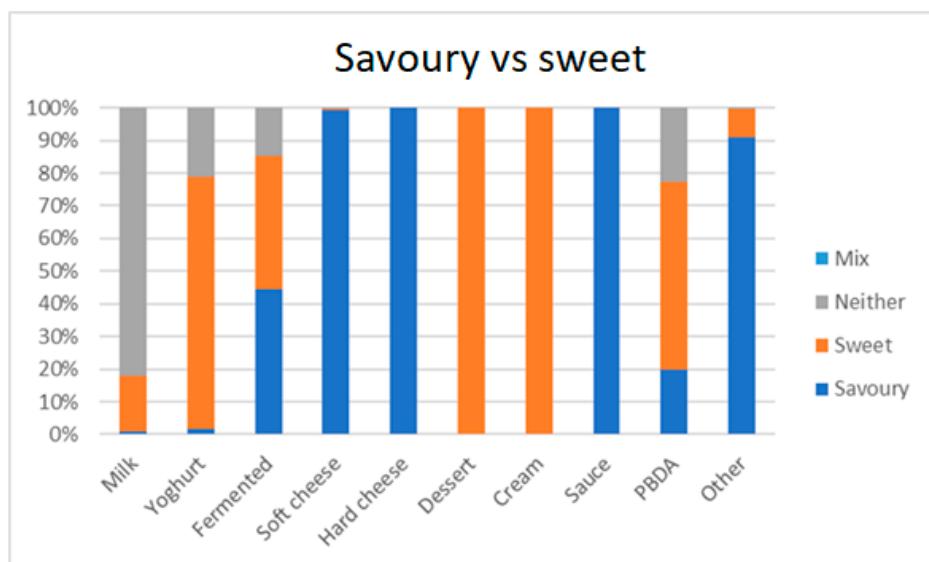


Figure 3. How dairy sub-groups are consumed [%]. Sub-groups can be consumed differently, some of them in both savoury and sweet dishes, or neither way.

3.2.3. Fourth Dimension: “In Combination with Other Foods” vs “By Itself”

Figure 4 shows that dairy products are rarely consumed by themselves, and often in combinations with other foods. The degree of variety in food combinations depends on the dairy type, where food combinations vary according to the sub-group. Some sub-groups were found more suitable for different food combinations, while others, even when consumed in a meal, were more often consumed by themselves.

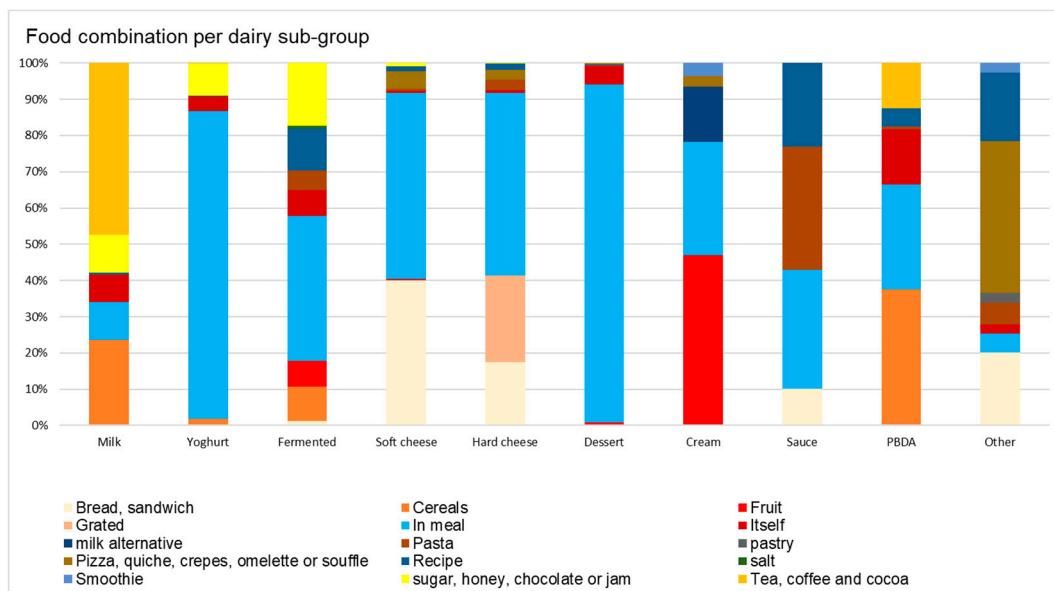


Figure 4. How dairy sub-groups are consumed [%]. *In meal* refers to dairy entries recorded in the same meal with other foods, but without specific details of combination.

3.2.4. Fifth Dimension: Time of Day

Figures 5 and 6 show dairy consumption throughout the day. Figure 5 shows the consumption for all dairy sub-groups, including soft dairy, and for the soft dairy sub-group; while Figure 6 focuses on each dairy sub-group by itself, without consideration of the ‘cream’, ‘sauce’, or ‘other’ sub-groups, due to low consumption. Figure 5 highlights that soft dairy covers the majority of dairy consumed,

and both figures show that dairy is more likely to be consumed during traditional mealtimes and is not well distributed across the day.

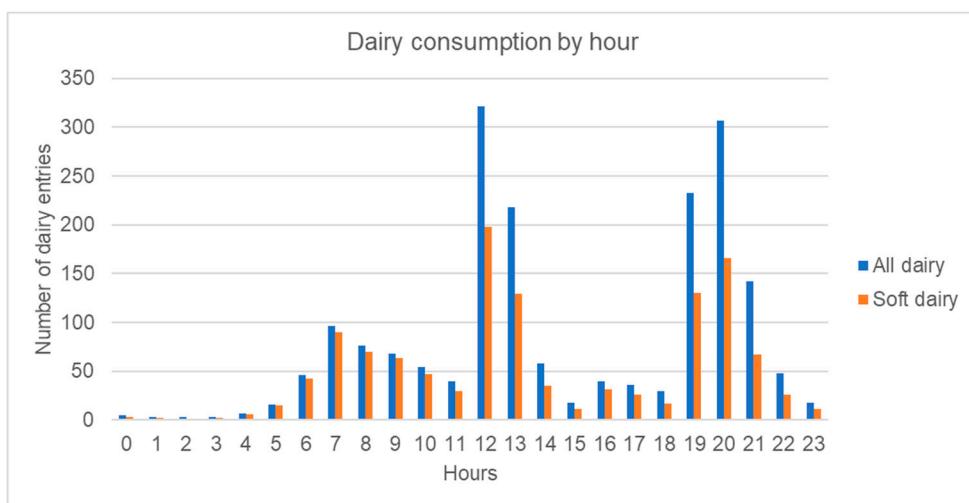


Figure 5. Overall dairy and overall soft dairy consumption by hour. Soft dairy includes milk, yoghurt, fermented dairy, and soft cheese.

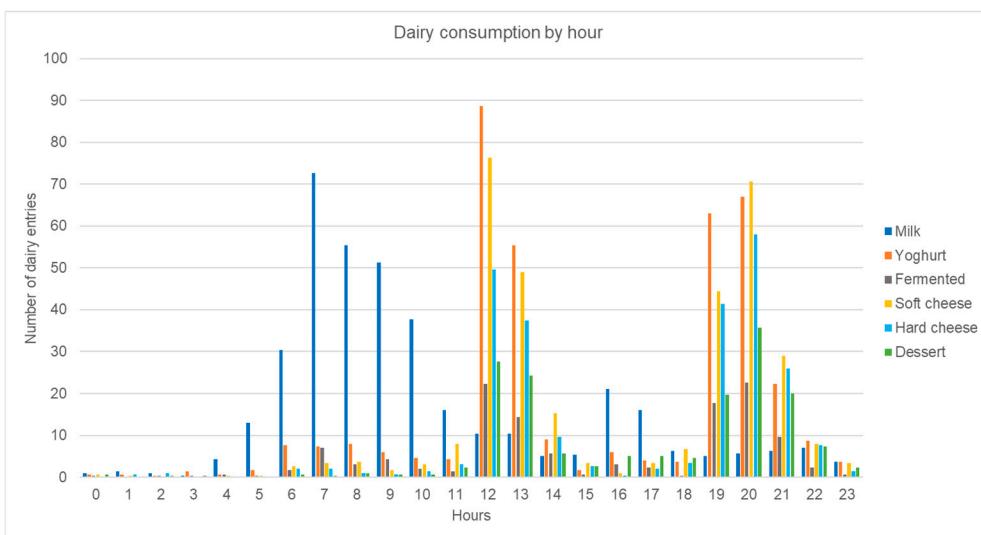


Figure 6. Soft dairy sub-groups, hard cheese, and dessert consumption by hour.

3.2.5. Sixth Dimension: “Meals” vs “Snacks”

A final dimension, derived from dimension 5, *time of day*, shows that dairy consumption tends to happen in meals, in the morning, at lunch time, i.e., 12 am to 1 pm, and at dinner time, i.e., 7-9 pm, even though some intakes are recorded in the afternoon and after dinner too. Higher consumption of milk was recorded in the morning; however, milk entries can be seen all day long, except for at lunch and dinner. Cheeses, yoghurts, and desserts are most likely to be consumed around mealtimes, at lunch or dinner.

4. Discussion

This study aimed to explore dairy consumption in a representative dataset of French adults aged between 18 and 44 years old. Dairy consumption was explored in terms of intakes and eating patterns.

Results show that the average total consumption was 246g/d. However, this includes desserts and other products where the advice is to consume these rarely [70]. French dietary guidelines suggest a daily intake of 2 servings of dairy, between 150ml of milk, 125g of yoghurt, or 30g of cheese, or a total of 310ml as milk equivalents [51]. In this sample, soft dairy was also consumed more than other products, and this is promising as French food guidelines suggest consuming milk, yoghurt, and other fermented dairy daily, and other products less frequently [70,71], and soft dairy consumption has environmental benefits when compared with hard cheese consumption [48,49]. Milk was, as expected, found to be the most consumed product in terms of weight, as the most well-known among all dairy foods [24]. Milk is indeed a good source of protein [3], while also being a low-energy-dense product if compared to other foods, including other dairy foods, such as cheeses [72]. Yoghurt was found as the second most consumed product in terms of weight consumed, and this confirms expectations, as these dairy foods are popular in France, due to the wide availability of different types of yoghurt in the French market [51,58,73]. Yoghurt consumption has been associated with several nutritional benefits, e.g., rich in vitamin B6, and health benefits, e.g., for gut health, and its energy content is limited compared with other dairy products [7,8,46,56,74]. Other fermented dairy products were the least consumed among the soft dairy products, by weight, and this may be due to the products included in the sub-group. Products such as *fromage blanc*, *Petit Suisse*, *crème fraîche*, are known in France, but are still less popular than yoghurt [75], while others, such as cultured milks, e.g., *lait ribot*, are still associated with regional traditions [76], thus less common in the French diet [7,76,77]. Moreover, the consumption of these foods can be perceived as “disgusting”, as people associate cultured milks with expired milks, and for this reason, intakes could be affected [29,33]. Although the quantity consumed remains limited, cheeses were found to have the most impact on the diet in terms of energy. These findings demonstrate the energy density of cheeses, particularly hard cheeses, due to the lower water content.

Five dimensions further aimed at identifying eating patterns. First, dairy was more eaten than drunk, except for animal-based and plant-based milks. Even though it can be used in recipes, milk is, in fact, usually considered a beverage [78–81], and it is frequently paired with coffee, cocoa, or tea [79,80]. Other dairy foods were more eaten than drunk, as their sensory characteristics, particularly tribology and texture, make them less suitable to be consumed as beverages [82,83].

Secondly, the majority of dairy products are consumed either in sweet or in savoury dishes, but rarely in both. Only fermented dairy products and PBDA were found to be consumed in both manners. Fermented dairy products appeared as an interesting dairy sub-group, as results suggest that they are suitable for many different recipes, unlike yoghurt, which is produced through a very similar process [21,22]. Compared to yoghurt, fermented dairy products have a less defined role in the meal, and this makes them more versatile, while yoghurt in France is often consumed as a healthy replacement for desserts [29,45].

Thirdly, in the majority of dairy entries, dairy products were consumed with other foods, rather than alone, and the food combinations differed depending on the dairy sub-group. For instance, cheeses were more likely to be consumed with pasta or bread, while milk is often consumed with tea, coffee, or cocoa. Some dairy products, such as yoghurt and desserts, were also consumed in a meal but without direct combination with other foods. Dairy products have all different sensory characteristics that lead to differences in manners of consumption [82–85], thus differences in intakes. In French customs, yoghurt could indeed be consumed at the end of the meal as a dairy-based dessert, either by itself or paired with sugar, honey, or jam [45,78,86]; likewise, cheese, when paired with bread [29].

Finally, in relation to time of day, our results suggest that French adults do not consume dairy foods outside traditional mealtimes. For instance, milk is the most consumed dairy product at breakfast time and throughout the morning, and this is common across different life stages and in many countries around the world [87–92]. By comparison, yoghurt, cheeses, and desserts are more common at lunch or dinner, and this is understandable as differences in sensory characteristics may

not only impact individual preferences but may also make a specific product more or less suitable for some recipes, thus impacting the manner and time of consumption [25,93–96].

These results can indeed aid in the development of strategies to boost the consumption of dairy among the target population. Suggestions to increase consumption could focus on maximizing familiar consumption scenarios, per product type, or taking advantage of existing patterns of low consumption to fill current gaps.

For instance, while the majority of dairy products are eaten and not drunk, some products, such as yoghurt-to-drink and some fresh fermented dairy products, have a texture that makes them suitable for drinking and drinkable recipes. A recent study suggests that a valuable strategy to boost fluid milk intake among adults is by adding it to smoothies, an already popular drink [104]. More liquid fermented dairy products could also be incorporated similarly.

Food combinations revealed that dairy products are already consumed in a wide range of different dishes, recipes, and direct combinations with other foods. However, the savoury vs sweet dimension suggests that the majority of sub-groups tend to be consumed in savoury or sweet dishes, and not both. New recipes or new versions of traditional recipes may be provided and/or taught to adults to boost their consumption of dairy. Yoghurt can be used to prepare a refreshing side sauce for spicy recipes [97], replacing crème fraîche, which is notably higher in fat content [98,99], or may be used in sweet dishes, in non-traditional food combinations [98], e.g., yoghurt with fruit, nuts, and chocolate or caramel for a lower-fat dessert. Soft cheese, similarly, while usually consumed in savoury dishes, can be paired with fruit, nuts, and sweet biscuits for a sweet dish.

France has a strong food culture, including a long-lasting dairy tradition [38,100,101], with dairy foods from different production processes and with different sensory characteristics [23,25,93,94]. This may indeed have an impact on food combinations and dietary choices, in creating individual and cultural unspoken rules. Apps and digital tools may be developed or implemented to enable personalised recipe substitution, permitting consumers to swap between products with similar sensory characteristics or taking into account personal preferences or needs [103].

In the late 1990s - early 2000s, a change in the structure of the meals was recorded in France, following a change in social structure, especially related to work-life balance [67]. Although the French now have more opportunities to eat outside their main meals [67], the results of the present study suggest that French adults do not consume dairy foods outside traditional mealtimes. However, the French dietary guidelines already suggest consuming dairy, specifically soft dairy products, as mid-afternoon snacks [70], in combination with fruits and bread [70]. Strategies increasing the accessibility and availability of healthy foods in different out-of-home locations, such as canteens, restaurants, and food trucks, have already been tested to promote healthier food choices, including dairy consumption, with promising results [105–107]. Higher availability of these products in vending machines could also boost their consumption, assuming safety concerns are addressed, if these products are coupled with good product positioning, readable labelling, and accessible prices [108–113]. Other strategies could be helpful, such as implementing menus, considering rewards, incentives [107], or better promotion of these products, through an infographic with key messages, e.g., recommended frequency of consumption, via different communication channels [114,115]. Developing tailored strategies promoting consumption of dairy at unusual times or out of home may indeed boost consumption of these products while also increasing the chances of adhering to food guidelines.

5. Conclusions

Results showed that in France, among adults aged 18–44 years, an average of 246g and 1126kJ of dairy is consumed per day, from a variety of dairy sub-groups. Focusing on dietary patterns, dairy was more eaten than drunk, in sweet and savoury dishes depending on the type of product, in proper meals in combination with other foods, rarely by itself, and is mostly consumed at traditional mealtimes and rarely as a mid-day snack. Suggestions to increase consumption could focus on

maximizing these familiar consumption scenarios, per product type, or taking advantage of current patterns of low consumption to fill current gaps.

Author Contributions: Conceptualization, K.M.A. and C.F.; methodology, K.M.A, C.F.; investigation, C.F.; analysis, C.F.; writing—original draft preparation, C.F.; writing—review and editing, K.M.A., A.D., J.M., C.F.; supervision, K.M.A., A.D., J.M.; funding acquisition, K.M.A., A.D, J.M. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: This study was approved by the Research Ethics Committee of Bournemouth University, UK (ID: 45760). The INCA3 database is public, already anonymised, and has obtained appropriate ethics approval before its data collection.

Data Availability Statement: For this study, data were download from the INCA3 database. The INCA3 is entirely available online on the French website for data collected by public agencies. All data can be downloaded for free at <https://www.data.gouv.fr/fr/datasets/donnees-de-consommations-et-habitudes-alimentaires-de-letude-inca-3/#/resources>.

Conflicts of Interest: This work was part funded by Danone S.A. – a company with a product portfolio that includes dairy products. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Abbreviations

The following abbreviations are used in this manuscript:

BMI	Body Mass Index
INCA	French Individual and National Survey Consumption (études Individuelles Nationales des Consommations Alimentaires)
Kcal	Kilocalories
kJ	Kilojoules, 1Kcal = 4.186 kJ.
PBDA	Plant-Based Dairy Alternatives
PNNS	French National Nutrition and Health Program (Programme National Nutrition Santé)
UK	United Kingdom

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