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Abbreviations: aDQI, Animal-based Diet Quality Index; AHEI, Alternative Healthy Eating Index; ANSES, Agence Nationale de Sécurité Sanitaire de l'Alimentation, de l'Environnement et du Travail; cDQI, Comprehensive Diet Quality Index; CEEI, InfaDiet, Infant diet and the child's health and development; INSERM Ethical Evaluation Committee; CNIL, Comission Nationale de l'Informatique et des Libertés; FFQ, Food Frequency Questionnaire; hPDI, healthy Plant-based Diet Index; INSERM, Institut National

de la Santé et de la Recherche Médicale; IPAQ, International Physical Activity Questionnaires; Org-FFQ, Organic Food Frequency Questionnaire; PANDiet, Diet Quality Index Based on the Probability of Adequate Nutrient Intake; PDI, Plant-based Diet Index; pDQI, Plant-based Diet Quality Index; PNNS, Programme National Nutrition Santé; PNNS-GS2, Programme National Nutrition Santé-Guideline Score 2; uPDI, Unhealthy Plant-based Diet Index.

Abstract

Childbirth is a major life-changing event, this period is an opportunity to improve eating habits. The aim of this longitudinal study was to identify and characterise dietary changes in women according to their parity status.

Dietary intake data from 4,194 women of childbearing age included in the NutriNet-Santé cohort were derived using a food frequency questionnaire, administered in 2014 and 2018, distinguishing between organic and conventional food consumption. Women were classified into four groups: "previous children", "multiparous", "primiparous" and "nulliparous". Multi-adjusted ANCOVA models were used to estimate the changes according to the parity group.

Changes in food consumption towards a more plant-based, healthier and organic diet were observed in all four groups of women, although to various degrees. In multivariable models, "Nulliparous" women showed a greater improvement in terms of "sustainable" food consumption than "previous children" women. "Primiparous" women significantly increased their energy intake (+349 (269-429) kcal/d) and their consumption of dairy products (+30 (3-56) g/d) and they significantly decreased their consumption of alcohol (-23 (-32-15) g/d), coffee and tea (-107 (-155-60) g/d). Regarding organic food, "nulliparous" women increased their consumption more than "previous children" and "primiparous" women were those who were most frequently in the top quintile of organic food increase.

Although there were dietary changes in all groups of women according to their parity, childless women have a shift moving towards a more sustainable diet. Women who had a child during the 4-y study period, particularly those with their first child, reduced their alcohol and caffeine consumption.

Keywords: birth of child, organic food, pregnancy, dietary transition, dietary changes, plant food consumption

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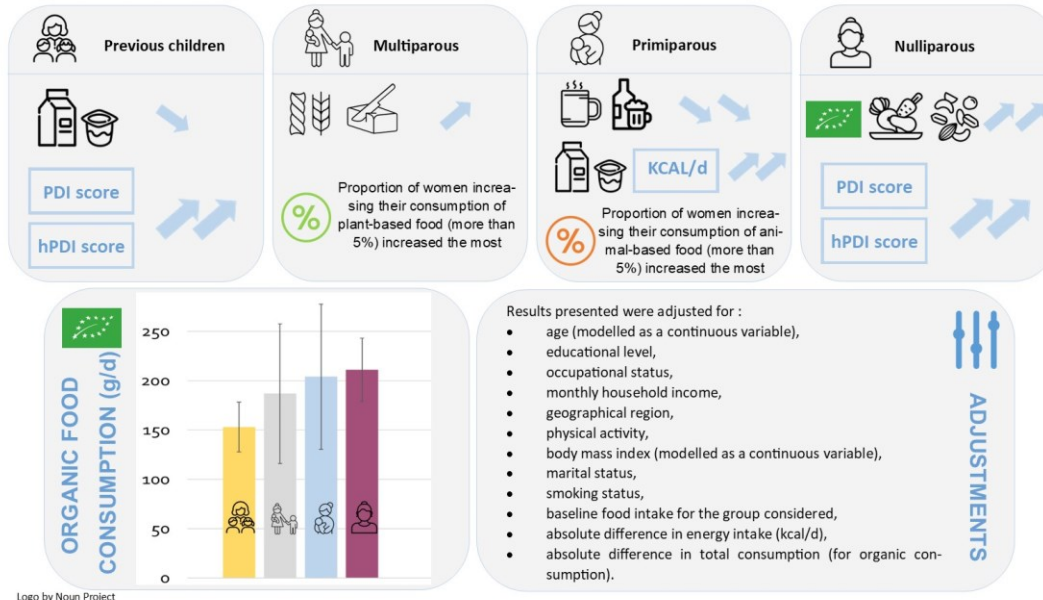
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Highlights

- After many adjustments (socio-demographic, anthropometric and lifestyle), dietary changes during the 2014-2018 period were different depending on women parity status ("previous children", "multiparous", "primiparous", "nulliparous"). In all studied groups, food changes tended to be overall healthier, but with varying degrees.

- The "nulliparous" women had the most sustainable consumption in 2014 (if we consider nutritional aspects, organic consumption and plant-based diet) and they were also the ones who changed the most towards more sustainability between 2014 and 2018 (increase of organic compared to "previous children", PDI and hPDI (Plant-based Dietary Index and healthy Plant-based Dietary Index) compared to "primiparous" women.

- "Primiparous" women significantly increased their energy intake and their consumption of dairy products and they significantly decreased their consumption of alcohol, coffee and tea. While the other women groups of parity status decreased their consumption of dairy products and increased their consumption of alcohol, coffee and tea.

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Introduction

The birth of a child is a radical event in a woman's life and may cause changes in her eating behaviour (1,2). There are various reasons explaining changes in women dietary behaviours with the birth of a child. Due to this emphasis of the link between maternal diet during pregnancy and the health of their child (3), the mother can take advantage of this life event for developing new healthy eating habits during pregnancy (4) and maybe adopt them over the long term. As food can be a factor of social identity (5), motivations may come from the external context, such as social pressure "to be a good mother" and will modify their diet to conform to societal norms (5). During pregnancy and after the child's birth, mothers may adapt or reconsider their own diet because they become responsible for and make decisions of feeding their child (1). More physiological factors may also influence their short-term food choices, such as nausea, cravings, and food aversion (4), even if their long-term effects are understudied. In addition, stress and anxiety may continue or intensify during the postpartum and affect the mother's diet (6). This emotional situation would be strongly related to the women parity (7).

In addition, as in the general population, the PNNS (Programme National Nutrition Santé) recommends increasing the consumption of organic food (8). Some pregnant women will particularly increase their consumption of organic food products (9) due to two main reasons. On the one hand, for health protection as a growing body of studies suggest that eating organic food during pregnancy could be beneficial for the health of pregnant women and their children (9–11). On the other hand, to preserve the environment, having a child can contribute to an awareness of the need to ensure a sustainable environment for future generations. We hypothesize that women having their first child will have healthier diets containing more organic food than other groups of women. Furthermore, it is possible to suggest that they would for the same reasons tend towards more sustainable diets such as diets consisting of more plant foods and less animal foods, more fibre, more legumes and more organic foods (12–15).

As in the general population, sociodemographic factors may also influence mothers' diet. For example, women in vulnerable situation, including unemployed women, would have a less healthy diet during pregnancy than more privileged women (16,17). Parity could play a role during the postpartum period, between primiparous and multiparous women, primiparous women having more feelings of sadness, more problems with breastfeeding, more anxiety, more depressive symptoms (7). This could influence food consumption (16).

To our knowledge, no previous study has examined changes in maternal diet after childbirth over the long term. The main objective of this study was therefore to identify and characterise overall dietary changes over a 4-year period, expressed as overall diet quality and organic food consumption of nulliparous,

60 primiparous, multiparous and women with children before the study period. In addition, another aim was

61 to identify if the level of education is a moderator between the birth of a child and the eating behaviour.

Materials and methods

The NutriNet-Santé cohort

64 The NutriNet-Santé cohort, launched in 2009, is a French study that aims to investigate the relationship

65 between nutrition and health, as well as their determinants. Participants included in the cohort are

66 volunteers and adults (over 18 years old). A specific web-platform is used to collect the data. Participants

67 must complete five questionnaires at inclusion, inquiring diet, health status, anthropometrics,

68 sociodemographics and lifestyles, and then for optimal follow-up they fill in these questionnaires again

69 once or twice a year. Additional questionnaires are regularly proposed to collect data on specific topics

70 such as Organic-Food Frequency Questionnaire (Org-FFQ), psychological features, food purchasing habits,

71 environmental exposure, digestive disorders etc. All questionnaires are self-administered and completed

72 online. Both the National Commission for Information Technology and Freedom (CNIL) and the INSERM

73 Ethical Evaluation Committee (CEEI) have approved this work under the numbers 908450 and 909216 and

74 0000388FWA00005831. The study conforms to the guidelines of the Declaration of Helsinki and is

75 registered with ClinicalTrials.gov (NCT03335644). Detailed data from the NutriNet-Santé cohort have been

76 published elsewhere (18).

Data collection

78 Age (modelled as a continuous variable), educational level (less than high school diploma, undergraduate,

79 postgraduate), and other self-administered individual characteristics including occupational status

80 (unemployed, never employed, self-employed/farmer/employee/manual worker, intermediate

81 professions and managerial staff/intellectual profession) and monthly household income per household

82 unit (less than 1,200€, between 1,200 and 1,800€, between 1,800 and 2,700€, between 1,800 and 2,700€,

83 and more than 2,700€) based on the monthly household income and the household composition were

84 considered in this study.

85 Additional lifestyle variables, such as physical activity (low, moderate, high, missing data) measured by the

86 International Physical Activity Questionnaires (IPAQ) (19) and smoking status (non-smoker, former

87 smoker, smoker), were also assessed. Living area (via postcode) was reported and grouped as: rural, urban

88 <20,000 inhabitants, urban between 20,000 and 200,000 inhabitants and over 200,000 inhabitants. Marital

89 status was considered as: couple (civil union, cohabiting, married) or single (single, divorced or separated,

90 widowed).

91 The socio-demographic, anthropometric and lifestyle variables in the different models were collected at

92 the baseline of this specific study, i.e. data from 2014.

Dietary data

94 The Organic-Food Frequency Questionnaire (Org-FFQ) was completed twice, first between June and

95 December 2014 and then in 2018. Each time, the questionnaire estimated the frequency of 264 organic

96 and conventional foods and beverages over the previous year, for more information described elsewhere

97 (20). This questionnaire is based on a previously validated questionnaire that does not distinguish the

98 production origin of foods and beverages (21). Using the published NutriNet-Santé food composition table,

99 individual nutritional consumption was calculated (22). Participants were asked to complete the following

100 options for each item: daily, weekly, monthly, or yearly. Quantities were estimated using different

101 methods, including photos of different portion sizes (seven options were available), use of portion units

102 (one yoghurt, a slice of ham, an egg, etc.) or normalized quantities (a teaspoon, a glass, etc.). In addition,

103 the proportion consumed as organic food was asked for each food or beverage (except those not available

104 as organic such as water) by answering whether it was consumed never, rarely, half the time, often or

105 always. The frequency modalities were then translated into 0, 25, 50, 75 and 100% (20).

106 Recent research suggests that responses to food choice and behaviour questionnaires can be influenced

107 by our desire to look our best (23). Which is why in September 2014, data on social desirability bias was

108 collected using a validated questionnaire that included 36 personality items (subjective well-being, self-

109 esteem, affectivity, and etc) with the objective of quantifying self-dupery and heterodupery (lack of self-

110 knowledge vs. control of self-image). A 7-level scale was defined for each item, ranging from "completely

111 false" to "completely true" (range of 2 to 10) (24). The internal validity of these two components was

112 calculated via Cronbach's alpha, which is 0.8 for heterodupery and 0.85 for self-dupery. A higher score

113 reflects a greater desirability bias.

114 Dietary indexes

115 All 2014 scores were developed using 2014 Org-FFQ consumption and the same for 2018. Two nutritional

116 quality scores were calculated. The first, the "Programme National Nutrition Santé Guidelines Score 2"

117 (PNNS-GS2), is a score that ranges from -∞ to 14.25, and it assesses adherence to French food-based

118 dietary recommendations (Supplemental Material 1). Detailed information about this score are available

119 elsewhere (25,26). The second, the Diet Quality Index based on the Probability of Adequate Nutrient Intake

120 (PANDiet score), measures the individual nutritional adequacy for 28 nutrients compared to the nutritional

121 reference values defined by the Agency for Food, Environmental, and Occupational Health and Safety's

122 nutritional recommendations (ANSES). The PANDiet score, which ranges from 0 to 100, is the average of

123 two sub-scores: moderation and adequacy (Supplemental Material 2). More information can be found

124 elsewhere (27,28).

125 Other existing scores have also been calculated to measure the proportion of plant foods consumed in the

126 diet. The Plant-based Diet Index (PDI) score is composed of plant food groups receiving ascending points

127 (from 1 to 5, with 5 corresponding to the highest plant food consumption). In this score, animal food

128 groups were scoring in reverse order. The points are calculated from the quintile values extracted from

129 the sample completing the Org-FFQ in 2014. Derived from the PDI score are the hPDI (healthy plant-based

130 diet index) and uPDI (unhealthy plant-based diet index) scores, which distinguish between healthy and

131 unhealthy plant-based foods (Supplemental Table 1). These three scores range from 12 to 60. More

132 information can be found elsewhere (29).

133 Finally, a final score, the comprehensive diet quality index (cDQI) was computed, which is the sum of the

134 plant-based diet quality index (pDQI) and the animal-based diet quality index (aDQI), which ranges from 0

135 to 85. Both are calculated using either literature-based thresholds or consumption quintiles values of

136 participants who completed the first Org-FFQ. The purpose of this score is to discriminate between healthy

137 and unhealthy plant and animal foods (**Supplemental Table 2**). More information could be found

138 elsewhere (30).

139 ## Selection of participants

140 After excluding under- and over-reporters (participants who had an energy intake to energy requirement

141 ratio below or above the cut-offs of 0.35 and 1.93 were excluded) (20), people living outside mainland

142 France and missing covariate data, 18,108 participants completed both the Org-FFQ14 and Org-FFQ18

143 questionnaires. Then, women over 50 years of age and men were excluded, resulting in a total sample of

144 4,194 women of childbearing age (**Supplemental Figure 1**).

145 Women were classified into 4 groups (**Supplemental Figure 2**):

146 - **Previous children**: women who already had at least one child before the completion of the Org-

147   FFQ14 or who were pregnant when they completed the Org-FFQ14, with no additional child born

148   between Org-FFQ14 and Org-FFQ18 (N=2269).

149 - **Multiparous:** women who gave birth before (or pregnant during) completing the Org-FFQ14 who

150   had had at least other children between the two questionnaires (N=237).

151 - **Primiparous:** women who had had a first child between the two questionnaires (without being

152   pregnant during the Org-FF18) (N=231).

153 - **Nulliparous:** women without any child before Org-FFQ18 (but could be pregnant during Org-

154   FFQ18) (N=1457). Women without children were kept in the study sample because they allow for

155   comparison with women who have had children.

156 Women who reported a pregnancy but did not report a new child in the following months were not

157 considered as mothers with a new child.

Statistical analysis

Twenty-two food sub-groups were created based on the 264 items: whole-grain products; vegetables; fruit; nuts, seeds, legumes; vegetable oils; coffee, tea; fruit juices; refined grains; potatoes; sugar-sweetened beverages; sweets and desserts; fish, seafood; dairy products; poultry; processed meat; meat; eggs; other fat; other fatty, salty, and sweet products; dairy and meat substitutes; alcoholic beverages and other non-alcoholic beverages. Classification of food groups as healthy and unhealthy animal and plant-based foods for the CDQI score is presented in **Supplemental Table 3**.

ANCOVA models were performed to study the associations between women parity status and daily food group or daily indexes. To better focus on the role of the birth of a child on diet, various models were conducted. Several models with different adjustments were developed. The aim was to reflect as accurately as possible the impact of having a child in a specific period, while minimizing societal effects. Model Uadj was unadjusted. Model Adj was adjusted for baseline (2014) age (modelled as a continuous variable), educational level, occupational status, monthly household income, geographical region, physical activity, body mass index (modelled as a continuous variable), marital status, smoking status, baseline food intake for the group considered and absolute difference in total energy intake (kcal/d). Model Dsb was model Adj with an additional adjustment for social desirability bias. Of note, social desirability bias data were available for 3,980 women (95% of the sample). For the categorical variables, the modalities are presented in the data collection section. In addition, additional sensitivity analyses were performed with the Adj model by removing pregnant women at Org-FFQ14 (N=4,084).

For models related to the evolution of organic food consumption over time, an additional adjustment was performed. To consider the difference in organic consumption, it was important to adjust for the difference in overall consumption (conventional and organic) to be more proximate to the proportion of organic food in the total diet. The models were therefore called Adj bis and Dsb bis respectively.

To consider the adjusted organic consumption quintile differences in the same way as the Adj bis model, we calculated the predicted values. The quintiles allow for a description of the distribution of women according to their parity status in terms of their change in organic consumption.

The predicted values of the main food group intakes in 2014 and 2018 at the two time points adjusted for age, educational level, occupational status, monthly household income, geographical region, physical activity, body mass index, marital status, smoking status, energy intake 2014 or 2018 (kcal/d) were also used to calculate the proportion of women increasing their intake by more than 5%.

Using chi-squared tests, the four groups of women ("Previous children", "Multiparous", "Primiparous", "Nulliparous") were compared in terms of sociodemographic, lifestyle, and anthropometric characteristics. ANOVA or ANCOVA tests with Tukey adjustment for multiple testing were used to examine

191   differences in dietary consumption, nutritional scores, and organic consumption (and consumption in
192   2014) among the 4 groups. The residual method was used to adjust for energy intake for dietary indexes
193   (PDI, hPDI, uPDI, PANDiet, plant to total protein ratio, PNNS-GS2) (31). The quintiles of differences in
194   organic consumption (previously adjusted) according to women's group were compared using a chi-
195   squared test. The proportion of women increasing their adjusted consumption by more than 5% according
196   to main food groups and parity status was also compared using a chi-squared test.

197   In a sensitivity analysis, stratification on educational level was performed and assessed whether there
198   were differences over time in energy intake and PNNS-GS2 score by educational level. These additional
199   analyses were tested by ANCOVA with Tukey adjustment. Similar analysis was conducted to test the
200   difference in organic consumption between women who did or not mention "the birth of a child" as a
201   reason for consuming organic food (exclusively among primiparous and multiparous women).

Results

Baseline characteristics

204   Baseline sociodemographic, anthropometric, and lifestyle data are presented in **Table 1**. "Primiparous"
205   women were the youngest and had the largest proportion of graduated women (together with
206   multiparous women) and with the highest income. The "multiparous" group includes the largest
207   proportion of women with low levels of physical activity and women in couples. "Previous children"
208   women were the oldest and had more frequently "less and high school diploma". The larger proportion of
209   women who had never been employed (with students included in this category), with high physical activity
210   was found in the "nulliparous" group (**Table 1**).

211   Results for 2014 food consumption are available in **Supplemental Table 4** and nutritional and plant-based
212   scores (PDI score, hPDI score, CDQI score, PDQI score, PNNS-GS2 score, PANDiet score and Plant to total
213   protein ratio) in **Supplemental Table 5**.

Change in food consumption

215   Among the 22 food groups considered, women parity status was associated with the 2014-2018 change in
216   consumption of 7 food groups: vegetables, nuts/seeds/legumes, coffee/tea, refined grains, dairy products,
217   other fat and alcoholic beverages (**Table 2**). Considering the model Adj, "Nulliparous" women increased
218   their consumption of vegetables while "primiparous" women decreased it, and increased their
219   consumption of nuts, seeds, and legumes more than "primiparous" and "multiparous" women. They
220   decreased their consumption of refined grains more than "primiparous" and "multiparous" women. With
221   the same model, "Primiparous" women decreased their coffee, tea, and alcohol consumption compared
222   to other women groups who increased their consumption. They increased their dairy product consumption
223   more than "nulliparous" and "previous children" women (**Table 2**). There were no significant differences

in the consumption of whole-grain products, fruit, vegetable oil, fruit juices, potatoes, sugar-sweetened beverages, sweets and desserts, fish, seafood, poultry, processed meat, meat, eggs, other fatty, salty, and sweet products, dairy and meat substitutes, and other non-alcoholic beverages (**Table 2**). Food consumptions were not different after removing from the sample, the women who were pregnant when the Org-FFQ14 was completed (**Supplemental Table 6**).

Change in dietary quality scores

Over the 2014-2018 period, all women groups had their dietary quality scores increased, as reflected by nutritional and plant-based scores, except for PANDiet and the ratio of plant protein to total protein (**Table 3**). However, limited discrepancies according to the women parity group were observed in these temporal changes. "Primiparous" women increased their energy intake the most compared to other women groups. They also increased their PDI and hPDI scores less than "previous children" and "nulliparous".

The proportions of women who increased their consumption of the plant and animal and healthy and unhealthy food groups by more than 5% according to their parity status are shown in **Supplemental Figure 3**.

Change in organic food consumption

Overall, all the studied groups of women increased their organic food consumption over time, but "Nulliparous" women increased their total organic intake more than "previous children" women (211 g/d vs. 153 g/d) (**Figure 1 and Supplemental Table 7**). The consideration of the desirability bias affected organic consumption for women with children (decreased compared to the model without adjustment for desirability bias) but also for "nulliparous" women but in the other direction (increased compared to the model without adjustment for desirability bias). Nevertheless, the added desirability bias did not change the trends (**Figure 1**). In addition, the mean differences in consumption of "healthy" organic plant-based and animal-based foods were significantly higher for "nulliparous" women compared with "previous children" women, and there was no significant difference for changes in consumption of "unhealthy" organic plant-based and animal-based foods (**Figure 2**). Nevertheless, when considering frequency, the proportion of women in Q5 of organic consumption change (women who increased their organic consumption by more than 360 g/d between 2014 and 2018) was highest among "primiparous" women. The proportion of women in Q1 (women who decreased their organic intake between 2014 and 2018) was the highest among "previous children" (**Supplemental Figure 4**).

Between 2014 and 2018, "primiparous" women significantly increased their consumption of total organic and healthy organic animal-based food, while "multiparous" women did not significantly change their consumption (**Supplementary Figure 5**).

256 Among women giving birth to a child in the period 2014-2018, we examined whether this birth could be
257 considered as a motive to consume organic foods (**Supplemental Figure 6).** Women who mentioned the
258 birth of their child as a motive had a stronger increase in the consumption of organic products and organic
259 plant products than women who did not mentioned the birth of their child as a motive to consume organic
260 foods.

261 Analyses by level of education
262 Findings of sensitivity analyses stratified by educational level are presented in **Figures 3 and 4.** Women
263 with higher level of education (under and postgraduate) who had a child between 2014 and 2018 increased
264 their total energy intake over the studied period while those with a lower level (≤high school diploma) did
265 not change their total energy intake. They also had a lower energy intake at baseline than those who did
266 not have a child between 2014 and 2018. Among women with a lower level of education there was no
267 difference in energy intake between the two time points and between women with and without children
268 between the two time points (**Figure 3**). For both under and postgraduate women, those who did not have
269 a child significantly increased their PNNS-GS2 score between 2014 and 2018 whereas there was no
270 significant difference for women who had a child between 2014 and 2018. Women who were
271 undergraduate and had a child between 2014 and 2018 had a higher PNNS-GS2 score in 2014 than women
272 who had not a child between 2014 and 2018. Among women who had a child between 2014 and 2018,
273 women with a lower level of education had a significantly lower PNNS-GS2 score than other groups of
274 women according to parity status in 2014 whereas in 2018 there was no significant difference (**Figure 4**).

Discussion
276 In the present study, we aimed to compare possible dietary shifts over a 4-year period for different parity
277 women status: women who had children before 2014, women who had a new child between 2014 and
278 2018, first-time mothers between 2014 and 2018 or women without children. This is the first study
279 examining dietary changes over a 4-year period according to women parity status (at baseline and after
280 birth of a child during the follow-up). Overall, all studied women groups have shifted their food
281 consumption towards a healthier and more sustainable diet, but to varying extents. Women "Nulliparous"
282 without any child up to the end of the follow-up had the most sustainable consumption in 2014 and made
283 the most sustainable dietary changes between 2014 and 2018 (most important increase in organic
284 products, vegetables and nuts, seeds, and legumes). Women "Primiparous" giving birth to their first child
285 during the follow-up dramatically changed their consumption of dairy products, alcohol, coffee, and tea,
286 as well as their energy intake. In addition, these women were more likely to increase their consumption
287 of animal products than other women groups.

Given the limited literature on dietary changes related to the birth of a new child, we discuss our findings considering the studies on dietary changes during pregnancy and postpartum in comparison. Many factors may play a role in eating behavioral changes associated with pregnancy and postpartum, including psychological determinants (health awareness, food regulation, anticipation, etc.), situational determinants (effort and practice, time spent), biological determinants (cravings, preferences, taste, fatigue, hunger and satiety, etc.), environmental determinants (availability of food) and social determinants (professional, partner, sensitivity to other opinions, social pressure, influence of the child) (2). To our knowledge, one study examined dietary changes from pregnancy to one year postpartum and did not highlight any difference during this period (except for breastfeeding women) (32). However, they did not consider dietary changes that could occur before or in early pregnancy. A qualitative study showed that the arrival of a child or the presence of a child in the household can lead to healthier choices than before (33). Conversely, another study indicated that the presence of other children in the household could lead to a deterioration in diet during pregnancy (17).

Dietary changes according to parity status

Dietary changes (moderate, adapted, and towards varied and good quality food) during pregnancy are necessary for the proper development of the baby (34,35), so dietary behaviors usually change to follow dietary recommendations, for example: stopping alcoholic beverages, decreasing caffeinated drinks and increasing dairy products (4,36–40). In line with this, in our study, women giving birth to their first child would have kept their pregnancy eating habits as they showed significant changes similar to the literature related to the arrival of a child. With the arrival of a first child in the household, parents and especially mothers can reconsider their own diet (1).

Regarding alcohol consumption, we observed a strong decrease in women giving birth to their first child. These results are consistent with the literature documenting that the proportion of postpartum women consuming alcohol is lower than before pregnancy (but higher than during pregnancy) (41). As regards consumption of tea and coffee, similar results were observed in accordance with previous works (37). However, contrary to our results, one study showed that caffeine consumption decreased during pregnancy and then increased after birth while we observed a decrease during the studied period (41).

Concerning fruit and vegetables, we did not observe an increase in consumption among primiparous women and even an opposite trend was observed. The increase in plant-based food intake by more than 5% was more frequent in the group of primiparous women. However, in line with this work, the number of portions of fruit and vegetables decreased in women from the beginning of pregnancy to the 6th month of the child, another study indicates that women generally decreased their consumption of fruit and vegetables after pregnancy (41,42). In addition, it has been reported that in UK, more than 70% of

postpartum women did not reach the recommended 5 portions of fruit and vegetables a day (43). About the increased consumption of animal products, it was more frequent in the "primiparous" group compared to the other groups in our study. There was also a significant increase in dairy products among primiparous women, in accordance to the literature (41,42). For example, one study showed that the percentage of women consuming dairy products, during post-partum, was higher for fist-time women, then for second-time women, followed by women without children (42).

It is well-documented that mothers dramatically adapt their routine to the demands of the child (1,44). Indeed, a qualitative study showed that a few months after the birth of their child, women experiencing stress around parenting no longer spend time cooking and therefore eat more sweet products and ready-made meals (1). The main quoted reason is lack of sleep (1,44). In France, when children begin to share family meals, the family's eating habits evolve thanks to a greater desire and time to cook and thus towards a diet that is more favorable to health (1). Meanwhile, one of the consequences of this unhealthy diet may be an increase in caloric intake. Indeed, our results indicated a significant increase in energy intake in "primiparous" women and, to a lesser degree, in "multiparous" women. Interestingly, one study reported that women who had a child for the first time increased their energy intake, while the women without children or with a second child decreased their energy intake over time (42). In addition, women's eating behaviors during pregnancy play a role in postpartum weight loss (45).

Regarding overall diet quality or plant-based scores, we did not find any significant differences between "previous children" women group and "primiparous" or "multiparous" women.

The literature on the quality of women's diets in relation to the presence of children is scarce. We found a Australian study in the scientific literature that showed that the dietary reference index (DRI) was higher in postpartum women (0-1 year) than in women who had had children (+1 year)(46). This study is not completely comparable to the present one because we do not specifically consider the postpartum period.

Dietary changes according to education level

In the present study, differences were found according to women's level of education and parity status. Besides, without studies with similar objectives, we compare our results to a period close to ours, i.e. during pregnancy. In that context, three other studies have analyzed the nutritional quality of pregnant women according to socio-demographic data Suárez-Martínez et al. showed significant difference in the Alternative Healthy Eating Index (AHEI-2010) in pregnant women according to their education degree (47). In addition, a Spanish study including pregnant, breastfeeding, and non-breastfeeding and non-pregnant women showed that educational level and income played a role in adherence to the Healthy Food Pyramid (48). Women with higher educational level adhered to healthy diets, and so did those with an income between €1000 and €4000 compared to those with an income of less than €1000 (48). Another study also

354 indicated that pregnant women had better adherence to the Mediterranean diet score and in particular

355 women with a higher socio-economic status (49).

356 One hypothesis that could explain the differences in energy intake among women who had a child between

357 2014 and 2018 according to educational level would be that women with a higher educational level were

358 in dietary restriction in 2014 (due to their considerably lower energy intake) and that at the childbirth, the

359 restriction fades away.

360 Our analyses revealed that there were also differences in the PNNS-GS2 score according to the education

361 and the arrival of a child between 2014 and 2018. This seems somehow in line with the literature, showing

362 that during post-partum women with healthier dietary choices were the most educated women (32,43).

363 Organic consumption

364 To the best of our knowledge, we have not found any literature data comparing organic food consumption

365 of women according parity status. This study with the NutriNet-Santé cohort is therefore pioneering.

366 Nevertheless, we found a few studies on the consumption of organic food at this period of life (pregnancy

367 and childbirth) but the data remain very sparse. In a study, the authors suggested that the arrival of a child

368 can lead to an increase in organic consumption in the household (33). In our study, we did not observe a

369 significant difference between women who had recently a child and others. However, while women who

370 increased the most their organic consumption were most represented among "primiparous" women. We

371 can hypothesize that women with children do not increase their organic consumption more than women

372 without children for budget reasons. In fact, one of the negative points of consuming healthy food and

373 organic products is that they can be more expensive. Furthermore, the present study shows that the

374 women who were most motivated to increase their consumption of organic products at the birth of their

375 child did actually increase their consumption. The change would occur but only in a part of the population.

376 This question needs to be studied in depth in a new study.

377 As it is also the case in the general population (26,50), pregnant women who consume the most organic

378 food are those who make the best food choices (9,51). In addition to having less impact on the

379 environment (15), eating organic food during pregnancy may reduce the risk of illnesses during pregnancy

380 (e.g. pre-esclampsia) (52) or for the child (11). Indeed, one study reported that pregnant women

381 consuming organic food had significantly lower levels of pyrethroids in their urine than women consuming

382 conventional food (53). In addition, exposure to pesticides (organophosphates) during the first months of

383 life could lead to dysfunction at term (54). However, health data (both for the child and the mother) are

384 sparse, and studies are needed to better identify the role of dietary change on health.

Public policies implications

Dietary guidelines for pregnant women seem to be more and more widely adopted and communicated by medical staff. During this period, eating habits change and energy intakes are higher during pregnancy and even breastfeeding. Returning to or starting a healthy diet seems complicated during this period (lack of time, lack of desire). In fact, the mother's diet is a subject that is rarely discussed when following up the newborn. It would be interesting to take the opportunity of all post-natal consultations (gynecologist, midwife, pediatrician, etc.) to encourage the mother's awareness of her own diet, which does not seem to be the most appropriate according to our results. Baby-feeding awareness is currently being promoted, but it would be important at the same time to inform the mother, and even the accompanying partner, and give them the keys to a healthy, sustainable diet (discussion, brochure, recipes, etc.). Moreover, this period seems to be particularly propitious for raising awareness, as it is a medically supervised time, but also a time of changing habits, which could lead to changes in eating habits too.

Strengths and limitations

Some limitations should be acknowledged. In the NutriNet-Santé cohort, the population is not representative of the French population because the study is based on volunteers, so it includes more educated, older people with better health choices (55) but the relatively large sample allows to have an access to a wide diversity of behaviors and to conduct adjusted and stratified analyses. Thanks to the completion of validated and repeated questionnaires, we were able to collect data on dietary intakes of women during the period preceding and following the birth of a child. In addition, the food frequency questionnaire was self-administered and therefore consumption may be overestimated (56), but as we were studying individual differences in consumption with the same questionnaire and all women were concerned, this point may not be major. Furthermore, the use of an additional adjustment: desirability bias (using a validated questionnaire) did not indicate a substantial change in the results. As this questionnaire was for the previous year, a memory bias may have occurred and misestimation of consumption is possible. However, the validation of this questionnaire allows to answer the limited mentioned below (21). Moreover, the Org-FFQ was completed on the previous year's consumption, which could lead women who had a child in 2017 to complete their food consumption during pregnancy. However, additional analyses, excluding women with children born one year before the completion of the Org-FFQ18 (N=3,964), were carried out and did not substantially affect the results (data not shown). As this study is a sub-study of the NutriNet-Santé cohort, specific questions and questionnaires were not specifically designed. In addition, data concerning the mother's gestational conditions (diabetes, hypertension etc.) were not collected and may interfere with dietary changes as the nutritional recommendations are specific to them.

418 Nevertheless, classification errors may had occurred despite all our efforts of data management because

419 when classifying women into the 4 groups, some women who declared a pregnancy and did not confirm

420 subsequently the arrival of a child were not considered as women who had a child between the two

421 questionnaires and were interpreted as miscarriage or stillbirth. The larger number of questionnaires

422 available in NutriNet-Santé allows us to be as precise as possible. Given that NutriNet-Santé is a general

423 population cohort and that the average age of the cohort is relatively high (55), our sample of study was

424 reduced as well as the number of women who had a child in the period, which may have reduced the

425 power of our statistical tests and led to non-significant results. Similarly, for women with "less and high

426 school diploma" who were less well represented.

427 This study is the first to compare changes in women's dietary behavior according to birth of child and to

428 consider two food production methods (organic and conventional). It includes a detailed analysis of diet,

429 in food groups, overall profiles and innovative aspects such as organic. It uses validated scores such as the

430 PANDiet. It considers important confounding factors including social desirability bias. Moreover, this study

431 used an innovative approach to make possible to further promote prevention during this key period. Of

432 note, numerous factors could influence the healthiness of women's diets during pregnancy or after the

433 birth of the child, such as physical activity, income (57), smoking status and high age at childbirth (46,57).

434 All these factors, which are not exclusive to these specific women, but are well-documented in the general

435 population (58,59) have been accounted for in the present analysis.

436 It would be interesting to follow up these women according to their parity status in the future to explore

437 if these changes in eating behaviors were persistent.

Conclusion

439 During the study, it was observed that women's diets changed depending on whether they had children.

440 Childless women tended to adopt a more sustainable diet, while women who gave birth during the study

441 period increased their energy intake and consumption of dairy products but decreased their consumption

442 of alcohol and caffeine. These changes were also influenced by the women's social status. Although these

443 changes may have long-term effects on the individual and household level, it is important to take

444 advantage of this opportunity to help women achieve sustainable diets for themselves and future

445 generations. Health professionals can improve the mother's nutritional knowledge regarding dietary

446 changes and promote healthy plant-based foods during pregnancy to ensure healthy eating habits for the

447 mother and child.

Ethics approval and consent to participate

449 The NutriNet-Santé study is conducted according to the Declaration of Helsinki guidelines and was

450 approved by the Institutional Review Board of the French Institute for Health and Medical Research (IRB

451 Inserm n°0000388FWA00005831) and the "Commission Nationale de l'Informatique et des Libertés" (CNIL
452 n°908450/n°909216). The study protocol is recorded at Clinicaltrials.gov under the number: NCT03335644.
453 All subjects provided informed consent.

454 Consent for publication
455 Not applicable.

456 Availability of data and material
457 Researchers at public institutions can submit a project collaboration request that includes information
458 about their institution and a brief description of the project to: collaboration@etude-nutrinet-sante.fr. All
459 requests are reviewed by the steering committee of the NutriNet-Santé study. In case of approval, a signed
460 data access agreement will be requested and additional authorizations from the competent administrative
461 authorities may be needed regarding human subjects' data protection. In accordance with existing
462 regulations, no personally-identifiable data will be made available.

463 Competing interests
464 The authors declare that they have no competing interests.

468 Authors' contributions
469 The authors contributed as explained in the section: JBr performed the statistical analysis and drafted the
470 manuscript. BLG, JBa, EKG and JBr contributed and validated the design and protocol of this study. EKG
471 supervised the research project and contributed to the drafting of the manuscript. JBa, BA, MG, MT, SH,
472 DL, BLG, EKG contributed to the interpretation of the data and reviewed each version of the manuscript
473 for important intellectual content. MT and SH were implicated in the design and protocol of the NutriNet-
474 Santé cohort. All authors read and approved the final manuscript. JBr had full access to all study data, JBr
475 assumes responsibility for the integrity of the data and the exactitude of the data analysis.

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Table 1: Baseline sociodemographic, lifestyle and anthropometric characteristics by women parity group (NutriNet-Santé study, n=4,194, 2014)

	Total	Previous children	Multiparous	Primiparous	Nulliparous	P
N	4194	2269	237	231	1457	
Age [1]	38.241 (7.421)	41.6 (41.3-41.9)	32.8 (32.0-33.6)	30.2 (29.4-31.0)	35.2 (34.8-35.5)	<0.0001
Occupational status, (%)[2]						<0.0001
Unemployed	230 (5.48)	92 (4.0)	16 (6.7)	14 (6.1)	108 (7.4)	
Never employed	394 (9.39)	176 (7.8)	10 (4.2)	13 (5.6)	195 (13.4)	
Self-employed, farmer, employee, manual worker	1077 (25.68)	614 (27.1)	48 (20.2)	51 (22.1)	364 (25.0)	
Intermediate professions	1047 (24.96)	613 (27.0)	53 (22.4)	66 (28.6)	315 (21.6)	
Managerial staff, intellectual profession	1446 (34.48)	774 (34.1)	110 (46.4)	87 (37.7)	475 (32.6)	
Educational level, (%)[2]						<0.0001
Less and high school diploma	701 (16.71)	432 (19.0)	26 (11.0)	17 (7.4)	226 (15.5)	
Undergraduate	1433 (34.17)	834 (36.8)	62 (26.2)	68 (29.4)	469 (32.2)	
Postgraduate	2060 (49.12)	1003 (44.2)	149 (62.9)	146 (63.2)	762 (52.3)	
Monthly income per household unit in euros, (%)[2]						<0.0001
< 1200	719 (17.14)	430 (18.9)	30 (12.7)	15 (6.5)	244 (16.7)	
1200-1800	1125 (26.82)	684 (30.1)	54 (22.8)	47 (20.3)	340 (23.3)	
1800-2700	1122 (26.75)	495 (21.8)	87 (36.7)	86 (37.2)	454 (31.2)	
> 2700	990 (23.61)	531 (23.4)	61 (25.7)	72 (31.2)	326 (22.4)	
Unwilling to answer	238 (5.67)	129 (5.7)	5 (2.1)	11 (4.8)	93 (6.4)	
Body Mass Index (kg/m²)[1]	23.045 (4.689)	23.2 (23.0 -23.3)	22.6 (22.0-23.2)	22.5 (21.9-23.1)	23.0 (22.8-23.3)	0.07
Physical activity, (%)[2]						0.0004
Low	1035 (24.68)	604 (26.6)	69 (29.1)	53 (22.9)	309 (21.2)	
Moderate	1753 (41.80)	934 (41.2)	97 (40.9)	100 (43.3)	622 (42.7)	
High	910 (21.70)	450 (19.8)	41 (17.3)	50 (21.6)	369 (25.3)	
Missing data	496 (11.83)	281 (12.4)	30 (12.7)	28 (12.1)	157 (10.8)	
Smoking habits, (%)[2]						<0.0001
Never smoker	2443 (58.25)	1235 (50.6)	144 (55.3)	145 (58.4)	919 (59.2)	
Former smoker	1143 (27.25)	740 (37.9)	55 (32.5)	50 (30.7)	298 (26.0)	
Current smoker	608 (14.50)	294 (11.5)	38 (12.2)	36 (10.8)	240 (14.8)	
Living area, (%)[2]						<0.0001
Rural	882 (21.03)	589 (26.0)	47 (19.8)	38 (16.4)	208 (14.3)	
Urban <20,000 inhabitants	575 (13.71)	380 (16.7)	22 (9.3)	23 (10.0)	150 (10.3)	
Urban between 20,000 to 200,000 inhabitants	717 (17.10)	358 (15.8)	43 (18.1)	46 (19.9)	270 (18.5)	
Urban >200,000 inhabitants	2020 (48.16)	942 (41.5)	125 (52.7)	124 (53.7)	829 (56.9)	
Marital status, (%)[2]						<0.0001
In couple	3048 (72.68)	2004 (88.8)	230 (97.0)	199 (86.1)	615 (42.3)	
Single	1146 (27.32)	265 (11.2)	7 (2.9)	32 (13.8)	842 (57.7)	
Social-desirability score (2 to 10)[1]*	6.91 (1.32)	7.05 (6.99-7.11)	6.99 (6.81-7.16)	6.64 (6.46-6.81)	6.71 (6.63-6.78)	<0.0001

651 [1] Values are means (SD or 95% CI). P-values were based on ANOVA test with Turkey adjustment for multiple testing
652 [2] Values presented are frequency (percentages). P-values were based on chi-squared test
653 *N= 3980 (respectively N=2161; N=219; N=224; N=1376). The higher the score, the greater the desirability bias

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Table 2: Absolute differences over time (2018 vs 2014) in daily food group consumption by women parity group
(NutriNet-Santé study, n=4,194)[1]

g/d	Previous children 2269	Multiparous 237	Primiparous 231	Nulliparous 1457
Whole-grain products				
Model Uadj	7.03 (4.23-9.83)[a]	8.01 (-0.64-16.67)[a,b]	22.17 (13.40-30.94)[b]	5.01 (1.52-8.50)[a]
Model Adj	5.81 (3.09-8.52)[a]	8.04 (0.40-15.67)[a]	12.82 (4.92-20.73)[a]	8.39 (4.93-11.85)[a]
Model Dsb*	5.66 (2.90-8.41)[a]	7.64 (-0.18-15.47)[a]	13.36 (5.28-21.44)[a]	8.69 (5.15-12.22)[a]
Vegetables				
Model Uadj	20.95 (10.37-31.52)[a]	21.20 (-11.53-53.93)[a,b]	18.22 (-14.94-51.37)[a,b]	48.44 (35.24-61.64)[b]
Model Adj	26.54 (15.09-37.98)[a,b]	14.32 (-17.90-46.53)[a,b]	-13.17 (-46.54-20.20)[a]	45.83 (31.23-60.42)[b]
Model Dsb*	27.58 (15.81-39.34)[a,b]	14.29 (-19.11-47.69)[a,b]	-18.19 (-52.67-16.29)[a]	44.65 (29.58-59.72)[b]
Fruit				
Model Uadj	36.20 (27.67-44.73)[a]	38.48 (12.10-64.86)[a]	41.56 (14.84-68.28)[a]	30.99 (20.35-41.63)[a]
Model Adj	30.15 (21.84-38.46)[a]	41.17 (17.79-64.55)[a]	19.85 (-4.38-44.07)[a]	43.42 (32.82-54.01)[a]
Model Dsb*	30.61 (22.13-39.09)[a]	46.57 (22.50-70.65)[a]	19.86 (-5.00-44.72)[a]	43.90 (33.03-54.77)[a]
Nuts, seeds, legumes				
Model Uadj	10.50 (8.98-12.01)[a]	9.18 (4.48-13.88)[a]	11.12 (6.35-15.88)[a]	11.91 (10.01-13.80)[a]
Model Adj	10.23 (8.64-11.81)[a,b]	6.06 (1.60-10.52)[a]	4.87 (0.25-9.49)[a]	13.82 (11.80-15.85)[b]
Model Dsb*	10.24 (8.64-11.84)[a,b]	5.95 (1.40-10.50)[a]	4.33 (-0.37-9.03)[a]	13.40 (11.34-15.46)[b]
Vegetable oil				
Model Uadj	2.64 (1.99-3.28)[a]	3.80 (1.80-5.79)[a,b]	5.40 (3.38-7.42)[b]	2.52 (1.71-3.32)[a]
Model Adj	2.94 (2.31-3.56)[a]	3.45 (1.70-5.21)[a]	2.94 (1.13-4.76)[a]	2.50 (1.71-3.30)[a]
Model Dsb*	2.94 (2.30-3.57)[a]	2.99 (1.18-4.80)[a]	2.84 (0.98-4.71)[a]	2.37 (1.55-3.19)[a]
Coffee, tea				
Model Uadj	30.61 (14.91-46.31)[a]	71.93 (23.35-120.50)[a]	-64.76 (-113.96--15.56)[b]	18.43 (-1.16-38.02)[a]
Model Adj	43.32 (26.99-59.65)[a]	18.53 (-27.50-64.56)[a]	-107.35 (-154.98--59.71)[b]	14.07 (-6.75-34.90)[a]
Model Dsb*	46.12 (29.35-62.88)[a]	20.63 (-27.04-68.30)[a]	-110.49 (-159.64--61.34)[b]	12.43 (-9.05-33.90)[a]
Fruit juices				
Model Uadj	-16.24 (-20.84--11.64)[a]	-32.06 (-46.29--17.82)[a]	-24.07 (-38.49--9.66)[a]	-26.48 (-32.22--20.73)[a]
Model Adj	-18.34 (-22.49--14.19)[a]	-31.14 (-42.82--19.46)[a]	-20.33 (-32.43--8.23)[a]	-23.94 (-29.23--18.65)[a]
Model Dsb*	-18.38 (-22.62--14.14)[a]	-32.43 (-44.48--20.38)[a]	-21.24 (-33.67--8.80)[a]	-23.37 (-28.81--17.94)[a]
Refined grains				
Model Uadj	-13.87 (-17.88--9.86)[a]	9.86 (-2.54-22.27)[b,c]	13.42 (0.86-25.99)[b]	-6.89 (-11.89--1.89)[a,c]
Model Adj	-5.53 (-9.30--1.77)[a]	6.78 (-3.79-17.35)[a]	-11.61 (-22.57--0.65)[a,b]	-15.40 (-20.20--10.60)[b]
Model Dsb*	-6.02 (-9.85--2.18)[a]	7.10 (-3.77-17.98)[a]	-11.37 (-22.61--0.13)[a,b]	-15.14 (-20.05--10.22)[b]
Potatoes				
Model Uadj	-0.63 (-1.39-0.14)[a]	1.61 (-0.76-3.97)[a]	0.93 (-1.47-3.33)[a]	-0.43 (-1.39-0.52)[a]
Model Adj	-0.13 (-0.81-0.54)[a]	1.53 (-0.38-3.43)[a]	-1.26 (-3.23-0.71)[a]	-0.85 (-1.71-0.02)[a]
Model Dsb*	-0.12 (-0.80-0.57)[a]	1.67 (-0.27-3.61)[a]	-1.55 (-3.56-0.45)[a]	-0.92 (-1.80-(-0.04))[a]
Sugar-sweetened beverages				
Model Uadj	-9.93 (-14.25--5.62)[a]	-4.32 (-17.67-9.03)[a]	-6.14 (-19.66-7.38)[a]	-17.56 (-22.94--12.17)[a]
Model Adj	-12.92 (-16.96--8.88)[a]	-9.97 (-21.34-1.41)[a]	-3.91 (-15.69-7.87)[a]	-12.34 (-17.49--7.19)[a]
Model Dsb*	-12.25 (-16.29--8.21)[a]	-7.67 (-19.15-3.81)[a]	-8.39 (-20.24-3.45)[a]	-12.49 (-17.67--7.31)[a]
Sweets and desserts				
Model Uadj	0.99 (-0.90-2.87)[a]	6.32 (0.49-12.14)[a,b]	14.32 (8.43-20.22)[b]	1.38 (-0.97-3.73)[a]
Model Adj	3.01 (1.24-4.77)[a]	3.46 (-1.51-8.43)[a]	3.66 (-1.49-8.81)[a]	0.38 (-1.87-2.64)[a]
Model Dsb*	3.30 (1.52-5.07)[a]	4.19 (-0.86-9.23)[a]	2.67 (-2.54-7.88)[a]	-0.29 (-2.57-1.99)[a]
Fish, seafood				
Model Uadj	2.07 (0.40-3.75)[a]	-3.11 (-8.29-2.08)[a]	3.11 (-2.14-8.36)[a]	-0.64 (-2.73-1.45)[a]
Model Adj	2.23 (0.72-3.74)[a]	-2.70 (-6.95-1.55)[a]	-2.79 (-7.19-1.61)[a]	-0.02 (-1.94-1.91)[a]
Model Dsb*	2.33 (0.77-3.88)[a]	-2.94 (-7.36-1.48)[a]	-2.89 (-7.45-1.67)[a]	0.25 (-1.75-2.24)[a]
Dairy products				
Model Uadj	-22.88 (-32.19--13.58)[a]	-15.48 (-44.27-13.31)[a]	63.58 (34.42-92.75)[b]	-24.25 (-35.86--12.63)[a]
Model Adj	-24.02 (-33.13--14.91)[a]	-16.92 (-42.55-8.70)[a,b]	29.82 (3.25-56.39)[b]	-16.89 (-28.49--5.28)[a]
Model Dsb*	-22.16 (-31.47--12.86)[a]	-15.75 (-42.18-10.67)[a,b]	20.01 (-7.30-47.33)[b]	-17.60 (-29.53--5.68)[a,b]
Poultry				
Model Uadj	-1.17 (-4.34-2.01)[a]	-1.32 (-11.16-8.51)[a]	1.78 (-8.18-11.74)[a]	1.64 (-2.33-5.61)[a]
Model Adj	2.45 (-1.02-5.91)[a]	-3.85 (-13.60-5.90)[a]	-10.00 (-20.11-0.10)[a]	-1.70 (-6.12-2.71)[a]
Model Dsb*	0.33 (-0.82-1.48)[a]	-1.72 (-4.98-1.55)[a,b]	-3.49 (-6.87--0.12)[a,b]	-2.77 (-4.25--1.30)[b]
Processed meat				
Model Uadj	-3.93 (-4.95--2.91)[a]	-1.39 (-4.54-1.75)[a]	-3.00 (-6.19-0.18)[a]	-2.30 (-3.57--1.03)[a]
Model Adj	-2.32 (-3.24--1.40)[a]	-2.35 (-4.95-0.25)[a]	-5.29 (-7.98--2.60)[a]	-4.29 (-5.47--3.11)[a]
Model Dsb*	-2.32 (-3.27--1.37)[a]	-2.43 (-5.13-0.27)[a]	-5.01 (-7.80--2.23)[a]	-4.03 (-5.26--2.81)[a]
Meat				
Model Uadj	-9.30 (-11.48--7.12)[a]	-6.49 (-13.23-0.24)[a,b]	1.31 (-5.51-8.13)[b]	-3.76 (-6.48--1.05)[b]
Model Adj	-6.16 (-8.13--4.19)[a]	-7.82 (-13.36--2.29)[a]	-8.87 (-14.61--3.14)[a]	-6.83 (-9.34--4.32)[a]
Model Dsb*	-6.09 (-8.03--4.14)[a]	-8.55 (-14.07--3.03)[a]	-9.08 (-14.78--3.38)[a]	-7.32 (-9.81--4.82)[a]
Eggs				
Model Uadj	2.54 (1.81-3.27)[a]	2.41 (0.15-4.67)[a]	1.94 (-0.35-4.23)[a]	3.51 (2.59-4.42)[a]

Model Adj	2.52 (1.75-3.29)[a]	2.06 (-0.10-4.23)[a]	0.91 (-1.34-3.15)[a]	3.76 (2.78-4.74)[a]
Model Dsb*	2.48 (1.69-3.27)[a]	1.99 (-0.27-4.24)[a]	0.72 (-1.61-3.05)[a]	3.62 (2.60-4.64)[a]
Other fat[2]				
Model Uadj	-0.35 (-0.70-0.01)[a]	1.08 (-0.01-2.18)[a,b]	2.00 (0.89-3.11)[b]	-0.03 (-0.47-0.41)[a]
Model Adj	0.22 (-0.11-0.56)[a]	1.05 (0.10-2.00)[a]	0.45 (-0.54-1.43)[a,b]	-0.67 (-1.10--0.24)[b]
Model Dsb*	0.24 (-0.10-0.59)[a]	1.10 (0.13-2.08)[a]	0.48 (-0.53-1.48)[a,b]	-0.78 (-1.22--0.34)[b]
Other fatty, salty, and sweet products[3]				
Model Uadj	3.48 (1.51-5.46)[a]	9.00 (2.88-15.11)[a,b]	16.91 (10.72-23.11)[b]	4.48 (2.01-6.95)[a]
Model Adj	5.75 (3.95-7.54)[a]	7.29 (2.24-12.33)[a]	7.13 (1.90-12.36)[a]	2.78 (0.49-5.07)[a]
Model Dsb*	5.40 (3.57-7.23)[a]	7.96 (2.76-13.15)[a]	7.28 (1.92-12.65)[a]	2.74 (0.39-5.09)[a]
Dairy and meat substitutes[4]				
Model Uadj	17.23 (12.84-21.62)[a]	9.52 (-4.06-23.10)[a]	1.63 (-12.12-15.39)[a]	11.94 (6.46-17.41)[a]
Model Adj	15.14 (10.50-19.78)[a]	5.79 (-7.25-18.82)[a]	-0.29 (-13.79-13.20)[a]	16.10 (10.18-22.02)[a]
Model Dsb*	13.59 (8.96-18.22)[a]	5.18 (-7.94-18.30)[a]	-0.30 (-13.85-13.24)[a]	16.30 (10.37-22.24)[a]
Alcoholic beverages				
Model Uadj	6.88 (4.17-9.59)[a]	8.18 (-0.21-16.56)[a]	-18.67 (-27.16--10.18)[b]	2.87 (-0.51-6.25)[a]
Model Adj	7.31 (4.46-10.17)[a]	2.54 (-5.49-10.58)[a]	-23.52 (-31.84--15.19)[b]	3.88 (0.24-7.51)[a]
Model Dsb*	7.34 (4.44-10.25)[a]	-0.49 (-8.74-7.76)[a]	-24.45 (-32.98--15.93)[b]	3.64 (-0.08-7.37)[a]
Other non-alcoholic beverages[5]				
Model Uadj	43.67 (29.83-57.51)[a]	5.92 (-36.90-48.74)[a]	78.52 (35.15-121.89)[a]	36.58 (19.31-53.85)[a]
Model Adj	42.18 (27.77-56.58)[a]	17.56 (-23.04-58.15)[a]	56.22 (14.21-98.23)[a]	40.55 (22.18-58.91)[a]
Model Dsb*	39.87 (25.04-54.70)[a]	14.61 (-27.56-56.77)[a]	56.27 (12.79-99.74)[a]	40.88 (21.88-59.88)[a]

658 [1] Values are means (95% CI)
659 [2] Butter, mayonnaise and cream
660 [3] Snacks, chips, salted biscuits, dried fruits, dressing, sauces, milky-desserts and mixed dishes
661 [4] Soy, soy milk plant-based cream
662 [5] Chocolate or chicory with milk, chicory, water, infusion, kombucha, non-alcoholic beer
663 Means annotated with a different letter are significantly different means
664 ANOVA (model Uadj) and ANCOVA (model Adj and Dsb) with Tukey's post-hoc tests were used for testing differences between groups
665 Model Uadj was unadjusted
666 Model Adj was adjusted for age (modelled as a continuous variable), educational level, occupational status, monthly household income, geographical region, physical
667 activity, body mass index (modelled as a continuous variable), marital status, smoking status, baseline food intake for the group considered and absolute difference in
668 energy intake (kcal/d)
669 Model Dsb was model Adj further adjusted for social-desirability bias
670 *N= 3980 (respectively N=2161; N=219; N=224; N=1376)

671

Table 3: Absolute differences over time (2018 vs 2014) in daily indexes by women parity group (NutriNet-Santé study, n=4,194)[1]

	Previous children	Multiparous	Primiparous	Nulliparous
	2269	237	231	1457
Total energy intake (kcal/d)				
Model Uadj	59.67 (35.61-83.73)[a]	147.80 (73.39-222.27)[a]	330.00 (254.62-405.43)[b]	87.86 (57.84-117.88)[a]
Model Adj	54.59 (27.16-82.01)[a]	160.23 (83.00-237.46)[b]	349.18 (269.53-428.83)[c]	90.73 (55.74-125.71)[a,b]
Model Dsb*	69.89 (44.11-95.68)[a]	169.07 (95.89-242.24)[b,c]	268.09 (192.65-343.52)[b]	65.09 (32.05-98.13)[a,c]
PDI score (12 to 60)[2]				
Model Uadj	2.24 (1.99-2.49)[a]	1.57 (0.81-2.32)[a,b]	0.95 (0.18-1.72)[b]	1.70 (1.40-2.01)[a,b]
Model Adj	2.10 (1.85-2.34)[a]	1.34 (0.64-2.04)[a,b]	0.90 (0.18-1.62)[b]	1.97 (1.65-2.29)[a]
Model Dsb*	2.11 (1.86-2.36)[a]	1.38 (0.66-2.10)[a,b]	0.85 (0.11-1.60)[b]	1.95 (1.63-2.28)[a]
HPDI score (12 to 60)[2]				
Model Uadj	2.25 (1.99-2.51)[a]	1.82 (1.02-2.62)[a]	1.22 (0.41-2.03)[a]	2.21 (1.89-2.53)[a]
Model Adj	2.14 (1.86-2.41)[a]	1.22 (0.45-1.99)[a,b]	0.69 (-0.11-1.49)[b]	2.56 (2.21-2.92)[a]
Model Dsb*	2.08 (1.80-2.36)[a]	1.25 (0.45-2.04)[a,b]	0.55 (-0.27-1.37)[b]	2.54 (2.18-2.90)[a]
UPDI score (12 to 60)[2]				
Model Uadj	-2.60 (-2.85--2.36)[a]	-2.61 (-3.36--1.85)[a]	-2.44 (-3.21--1.68)[a]	-2.58 (-2.88--2.27)[a]
Model Adj	-2.55 (-2.80--2.30)[a]	-2.29 (-2.99--1.60)[a]	-2.07 (-2.79--1.34)[a]	-2.77 (-3.08--2.45)[a]
Model Dsb*	-2.53 (-2.78--2.28)[a]	-2.20 (-2.92--1.48)[a]	-1.94 (-2.68--1.20)[a]	-2.78 (-3.10--2.45)[a]
CDQI score (0 to 85)				
Model Uadj	3.18 (2.87-3.49)[a]	2.15 (1.20-3.10)[a]	3.04 (2.08-4.01)[a]	2.85 (2.47-3.23)[a]
Model Adj	3.01 (2.70-3.33)[a]	1.93 (1.05-2.82)[a]	2.66 (1.74-3.58)[a]	3.21 (2.81-3.61)[a]
Model Dsb*	3.02 (2.70-3.34)[a]	1.85 (0.94-2.76)[a]	2.55 (1.62-3.49)[a]	3.17 (2.75-3.58)[a]
PNNS_GS2 score (-∞ to 14.25)[2]				
Model Uadj	0.63 (0.51-0.75)[a]	0.14 (-0.24-0.51)[b]	0.20 (-0.18-0.58)[a,b]	0.48 (0.33-0.63)[a,b]
Model Adj	0.46 (0.35-0.57)[a]	0.28 (-0.03-0.59)[a]	0.76 (0.44-1.08)[a]	0.64 (0.50-0.77)[a]
Model Dsb*	0.45 (0.34-0.56)[a]	0.31 (-0.01-0.63)[a]	0.81 (0.48-1.14)[a]	0.66 (0.51-0.80)[a]
PANDiet score (0 to 100)[2]				
Model Uadj	-0.34 (-0.63-0.05)[a]	-1.14 (-2.03--0.24)[a]	-0.35 (-1.26-0.56)[a]	-0.89 (-1.25--0.53)[a]
Model Adj	-0.57 (-0.85--0.28)[a]	-1.28 (-2.08--0.48)[a]	-1.04 (-1.87--0.21)[a]	-0.41 (-0.77--0.04)[a]
Model Dsb*	-0.56 (-0.85--0.27)[a]	-1.33 (-2.15--0.51)[a]	-0.96 (-1.81--0.11)[a]	-0.35 (-0.72-0.02)[a]
Plant to total protein ratio (%)[2]				
Model Uadj	2.84 (1.90-3.78)[a]	5.05 (2.15-7.95)[a]	2.20 (-0.74-5.14)[a]	2.73 (1.56-3.90)[a]
Model Adj	-0.57 (-0.85--0.28)[a]	-1.28 (-2.08--0.48)[a]	-1.04 (-1.87--0.21)[a]	-0.41 (-0.77--0.04)[a]
Model Dsb*	-0.56 (-0.85--0.27)[a]	-1.33 (-2.15--0.51)[a]	-0.96 (-1.81--0.11)[a]	-0.35 (-0.72-0.02)[a]

[1] Values are means (95% CI)

[2] Values are adjusted with the residual method for energy intake

Means annotated with a different letter are significantly different means

ANOVA (model Uadj) and ANCOVA (model Adj and Dsb) with Tukey's post-hoc tests were used for testing differences between groups

Model Uadj was unadjusted

Model Adj was adjusted for age (modelled as a continuous variable), educational level, occupational status, monthly household income, geographical region, physical activity, body mass index (modelled as a continuous variable), marital status, smoking status, baseline food intake for the group considered and absolute difference in energy intake (kcal/d)

Model Adj bis was adjusted for age (modelled as a continuous variable), educational level, occupational status, monthly household income, geographical region, physical activity, body mass index (modelled as a continuous variable), marital status, smoking status, baseline food intake for the group considered, absolute difference in energy intake (kcal/d) and absolute difference in total consumption (conventional + organic)

Model Dsb was model Adj further adjusted for social-desirability bias

Model Dsb bis was model Adj bis further adjusted for social-desirability bias

Abbreviations: cDQI: Comprehensive Diet Quality Index; hPDI: Healthy Plant-based Diet Index; PANDiet: Diet Quality Index Based on the Probability of Adequate Nutrient Intake; PDI: Plant-based Diet Index; PNNS-GS2: Programme National Nutrition Santé-Guideline Score 2; uPDI: Unhealthy Plant-based Diet Index

*N= 3980 (respectively N=2161; N=219; N=224; N=1376)

691 **Figure 1:** Difference in organic consumption over time (2018 vs 2014) by women parity group (NutriNet-Santé study,
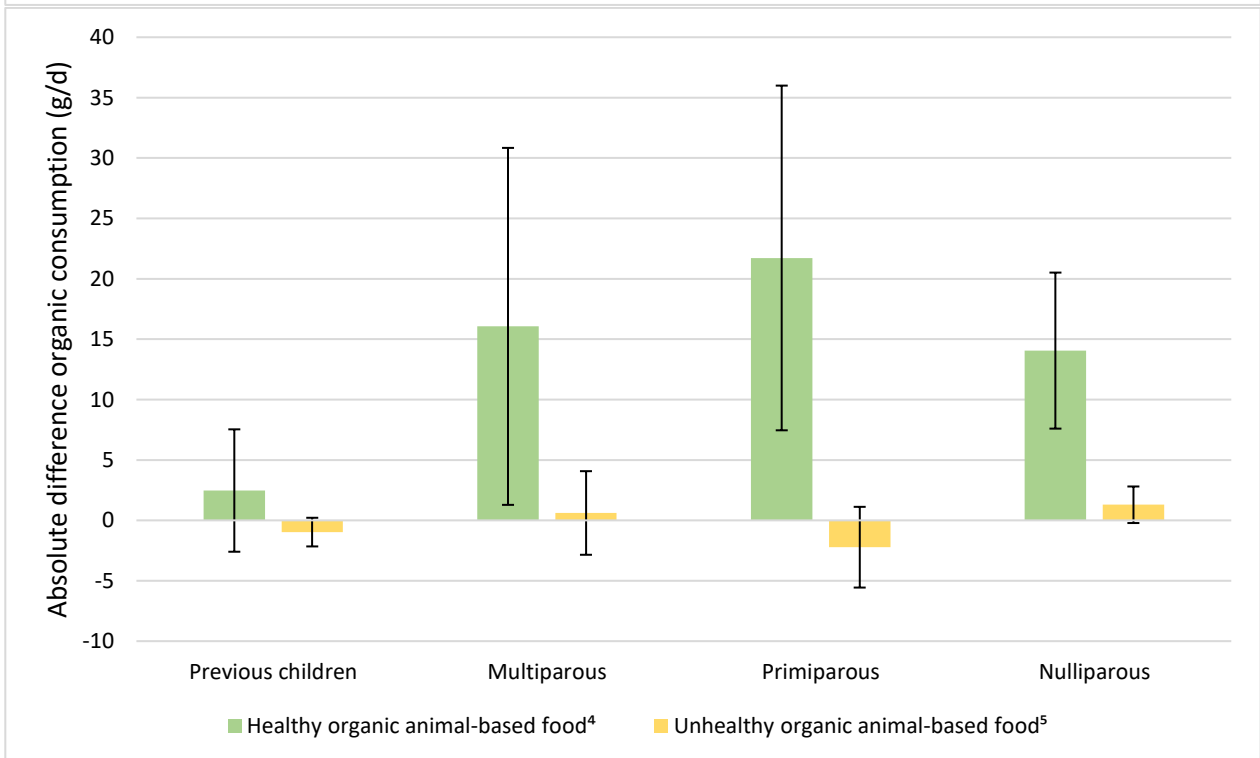692 n=4,194)[1]
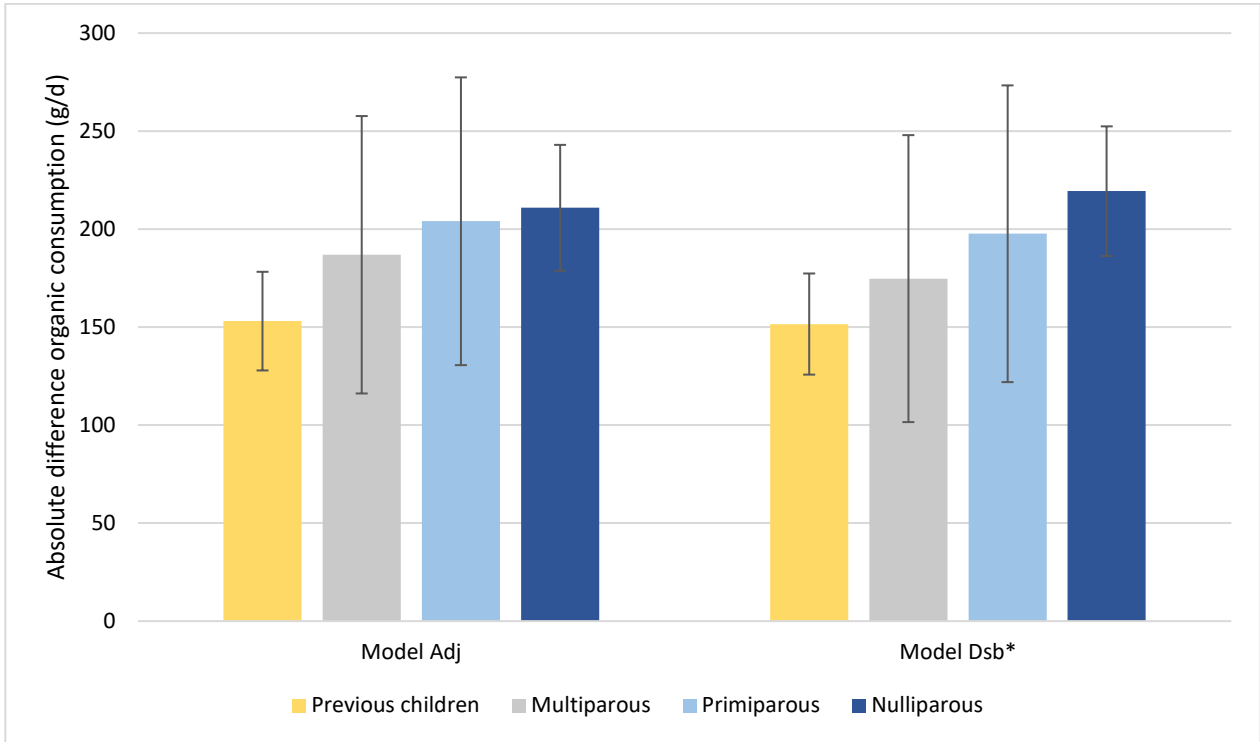
693

694 [1]Values are means (95%CI)
695 ANCOVA with Tukey's post-hoc test was used for testing differences between groups
696 Model Adj was adjusted for age (modelled as a continuous variable), educational level, occupational status, monthly household income, geographical region, physical
697 activity, body mass index (modelled as a continuous variable), marital status, smoking status, baseline organic food intake, absolute difference in energy intake (kcal/d)
698 and absolute difference in total consumption (conventional + organic)
699 Model Dsb was model Adj + social-desirability bias
700 *N= 3980 (respectively N=2161; N=219; N=224; N=1376)

701

702 **Figure 2:** Absolute differences over time (2018 vs 2014) daily organic plant-based and animal-based food group
703 consumption by women parity group (NutriNet-Santé study, n=4,194)[1]
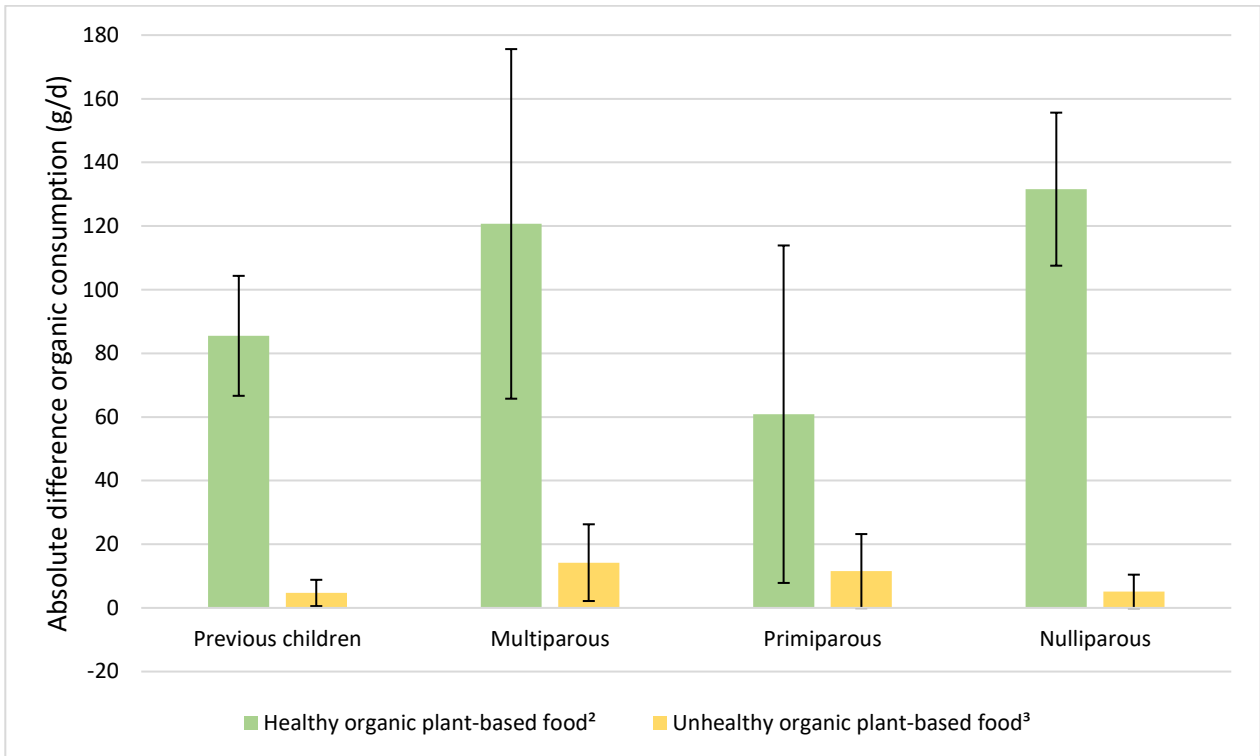
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705

706 [1] Values are means (95%CI)
707 ANCOVA with Tukey's post-hoc test was used for testing differences between groups
708 Difference in organic consumption was adjusted for age (modelled as a continuous variable), educational level, occupational status, monthly household income,
709 geographical region, physical activity, body mass index (modelled as a continuous variable), marital status, smoking status, absolute difference in energy intake (kcal/d),
710 baseline food intake for the group considered and absolute difference in total consumption for the group considered (conventional + organic)
711 [2] Wholegrain products, vegetables, fruit, nuts, legumes, vegetable oils, coffee, tea
712 [3] Fruit juices, refined grains, potatoes, sugar-sweetened beverages, sweets and desserts
713 [4] Fish, seafood, dairy, poultry
714 [5] Processed meats, red meats, egg

715 **Figure 3:** Mean (2014 and 2018) in total energy intake (Kcal/d) stratified by educational level by women parity group

716 (NutriNet-Santé study, n=4,194)[1]
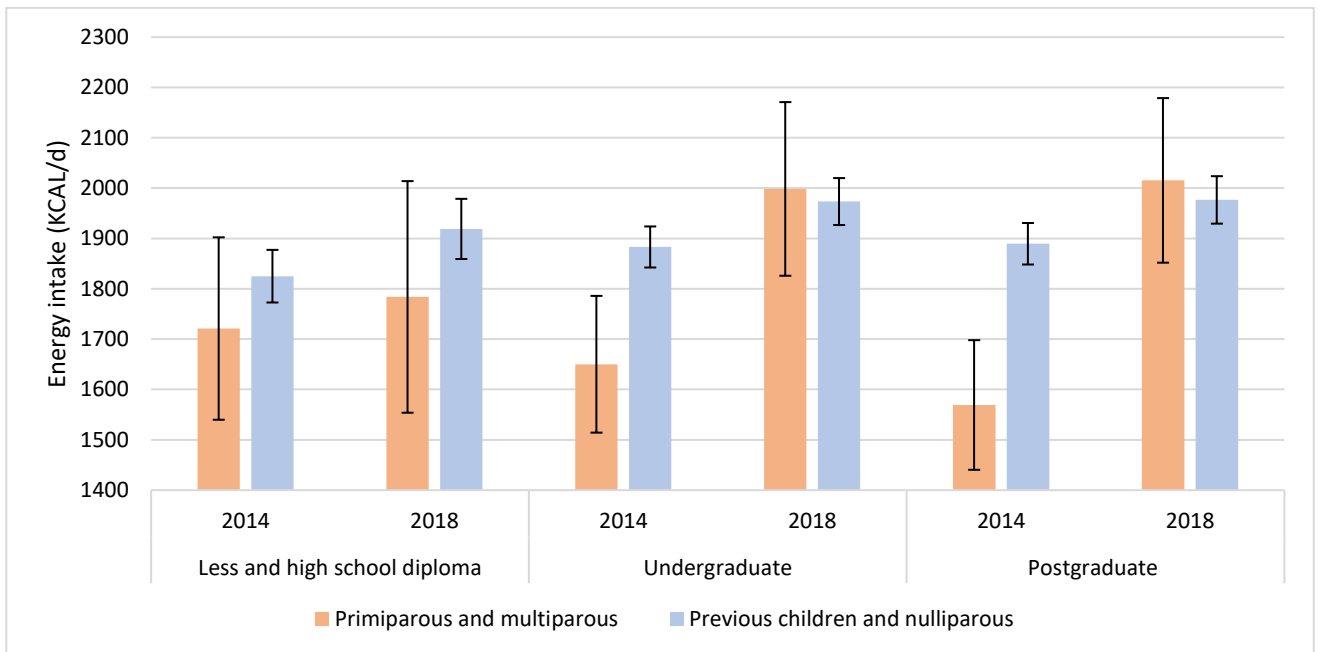
717

718 [1]Values are means (95% CI)

719 ANCOVA with Tukey's post-hoc test was used for testing differences between educational level

720 Difference in total energy intake was adjusted for age (modelled as a continuous variable), occupational status, monthly household income, geographical region,

721 physical activity, body mass index (modelled as a continuous variable), marital status, smoking status

722 **Figure 4:** PNNS-GS2 score at baseline (2014) and at follow-up (2018) stratified by educational level by women
723 parity group (NutriNet-Santé study, n=4,194)[1]
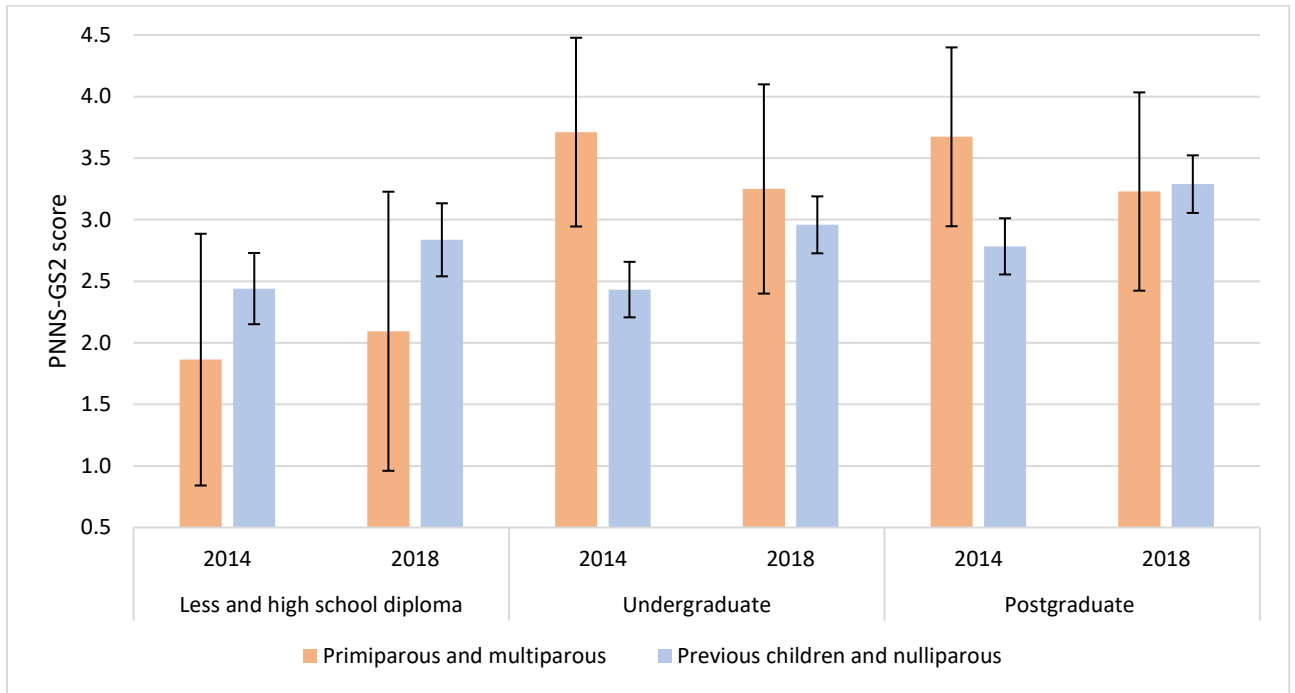
724

725 [1]Values are means (95% CI)
726 ANCOVA with Tukey's post-hoc test was used for testing differences between groups at the same point
727 PNNS-GS2 score was adjusted for age (modelled as a continuous variable), occupational status, monthly household income, geographical region, physical activity,
728 body mass index (modelled as a continuous variable), marital status, smoking status
729 Abbreviation: PNNS-GS2: Programme National Nutrition Santé-Guideline Score 2 (-∞ to 14.25)

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