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Analysis of the Nutritional Intake of Breastfeeding Mothers in Côte d'Ivoire: Challenges and Perspectives for Maternal and Child Health

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Abstract

A balanced diet during breastfeeding is essential to meet the increased needs of lactating mothers and to ensure high-quality breast milk. However, such a diet is often inadequate and insufficient. This study aims to assess the nutritional intake of breastfeeding women in Côte d'Ivoire and its implications for maternal and child health. A survey was conducted among 300 breastfeeding mothers in health centers located in Abobo, Cocody, Port-Bouët, Dabou, and Bonoua. Nutritional needs were calculated using the Müller equation, and intakes were estimated through biochemical food analysis and the Nutrisurvey 2007 software. Results showed that mothers had an average energy intake of 2157.97 kcal/day, significantly below the estimated requirement of 3629.43 kcal/day. On average, intakes covered 63.27% of lipid needs, 30.81% of protein needs, and 61.35% of carbohydrate needs. Three-quarters of the mothers had insufficient intake of energy and macronutrients. Significant deficits were observed in polyunsaturated fatty acids (9.36 g vs. 17.97 g) and fiber (20.1 g vs. 25 g). Calcium and zinc intakes were inadequate for all mothers. Only 5 to 10% of women aged 16 to 34 met the recommended intakes for potassium and iron. Conversely, phosphorus was consumed in excess by 80% of participants. Deficiencies in vitamins A, B1, B2, B6, B9, C, and E were observed in 75 to 90% of the participants. These results reveal widespread nutritional insufficiency among breastfeeding women in the studied population.

Keywords: Breastfeeding mothers; Nutritional intake; Diet; Maternal and child health; Côte d'Ivoire

1. Introduction

Breastfeeding is the optimal mode of nutrition for infants, providing a complete supply of essential nutrients needed for their growth and development. Breast milk, recognized by the World Health Organization as the gold standard for the first six months of life, not only supports rapid growth but also contributes to the maturation of the immune system due to its richness in biologically active substances [1]. The nutritional quality of breast milk directly depends on the mother's nutritional status, whose needs increase significantly during the breastfeeding period [2]. A varied and balanced diet is therefore essential to safeguard the health of both mother and child [3]. Globally, public health policies promote exclusive breastfeeding while emphasizing the need for appropriate nutritional support for mothers. In Africa, several studies have shown that maternal dietary practices are often inadequate [4], thereby compromising the quality of breast milk and infant health [5].

In Côte d'Ivoire, the nutritional intake of breastfeeding women remains poorly documented. This gap limits the development of targeted recommendations adapted to local realities. Thus, a better understanding of these nutritional

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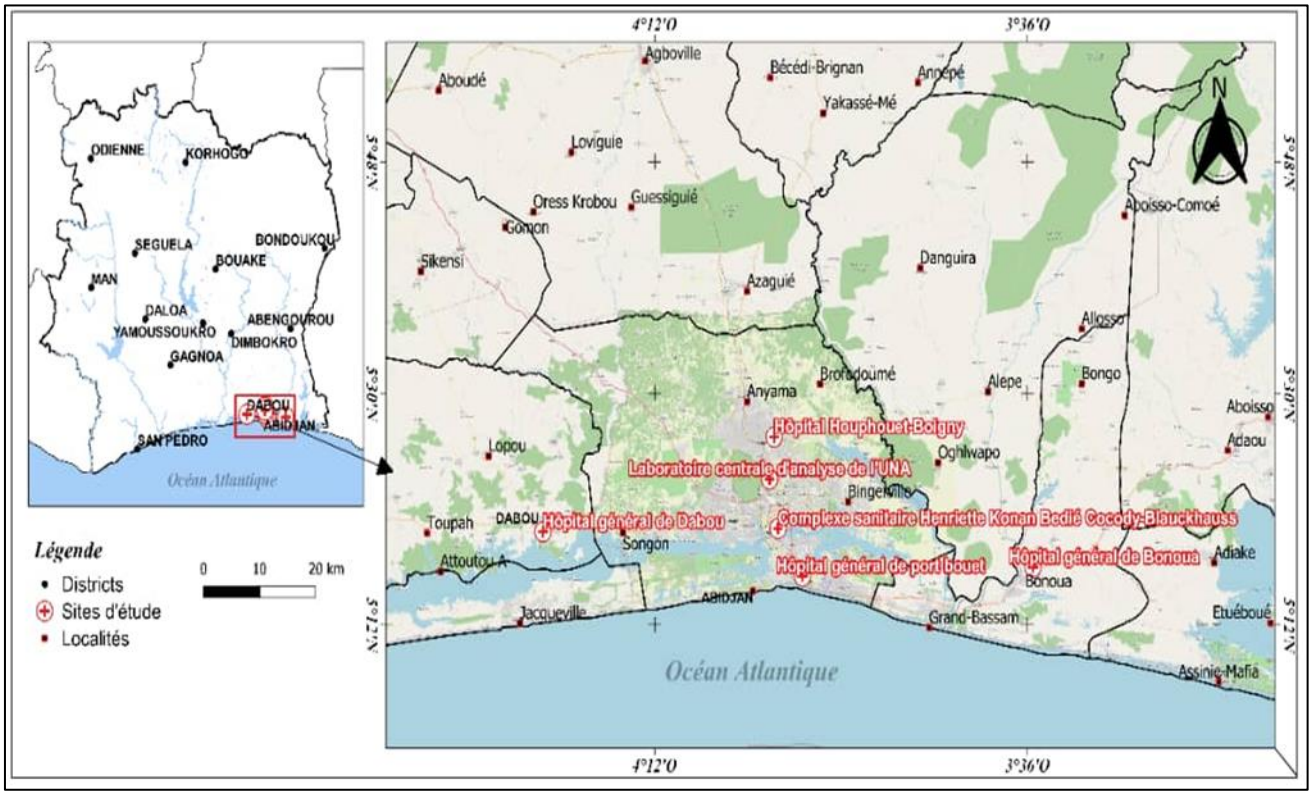
intakes is necessary to guide maternal and child health interventions. This study is based on the hypothesis that the nutritional intake of breastfeeding mothers in Côte d'Ivoire is insufficient and unbalanced in relation to recommended physiological needs. It aims to assess these intakes, compare them to reference nutritional requirements, and identify their implications for maternal and infant health. Specifically, the objectives are: (i) to estimate the nutritional needs of breastfeeding women; (ii) to analyze their actual dietary intake; and (iii) to identify nutritional deficiencies or excesses.

2. Materials and Methods

2.1. Study Type and Setting

This was a cross-sectional study with both descriptive and analytical purposes. It was conducted in three (03) health facilities in Abidjan. The selected facilities included the Houphouët Boigny General Hospital located in the municipality of Abobo, the Henriette Konan Bédié Health Complex in Cocody-Blockhaus (Cocody municipality), and the Port-Bouët General Hospital in the municipality of Port-Bouët. In Bonoua and Dabou, the study was carried out at the General Hospitals of Bonoua and Dabou, respectively (Figure 1).



Source: Personal, QGIS software

Figure 1 Geographic map showing the location of the different sites

2.2. Study Period and Population

The study was conducted from September 2019 to December 2021. It involved 300 breastfeeding mothers.

2.3. Sampling and Participant Selection

The sample size was determined using Daniel Schwarz's formula :

$$n = Z^2 * p*q/i^2$$

n = sample size; Z = 1.96; q = 1 – p; i = 0.05

p = Prevalence of metabolic diseases (0.235)

After calculation, the minimum sample size required for a representative sample was 276.24, meaning 276 individuals to be surveyed. For the purpose of this study, the sample size was adjusted to 300 breastfeeding women, with a distribution of 60 women per health center. Included in the study were all breastfeeding mothers aged between 15 and 45 years, attending the study sites, apparently in good health, and who had given their informed consent.

2.4. Nutritional Survey

This study required a cross-sectional survey. Data collection was carried out through face-to- face interviews using questionnaires. The information collected concerned sociodemographic factors and the dietary intake of breastfeeding women.

2.5. Variable Selection

The sociodemographic variables studied included sex, age, level of education, marital status, and occupation. Dietary intake was assessed using the 24-hour recall method over three non-consecutive days, allowing the determination of the quantity of food consumed per woman and by type of meal. This method is used to evaluate energy and nutrient intake [6]. Daily intakes of macronutrients and micronutrients were estimated using standard food analysis methods, as well as food composition software and food composition tables.

2.6. Estimation of Energy and Nutrient Intakes

In order to limit biases related to regional and seasonal variations as well as nutrient losses during cooking, a biochemical analysis was carried out on certain local dishes commonly consumed by the respondents. These dishes, the most frequently consumed by the target population, included staple foods (rice, foutou banana, attiéké, and Kabato de maïs), sauces (eggplant sauce, peanut sauce, Vegetable sauce, and okra sauce), as well as protein sources (meat and fish) (Figure 2 et Table I). Each dish was sampled in triplicate in the three areas of Abidjan, for a total of 36 dishes. The values obtained from these analyses were entered into the Nutrisurvey software, version 2007. Prior to this, other dishes consumed by the mothers were also entered into the software, based on the quantities consumed. For West African foods not included in the Nutrisurvey database, the West African Food Composition Table was used to better reflect the study context. Thus, the nutritional composition of the identified foods was imported into Nutrisurvey to complement and refine the analysis. Nutrisurvey uses linear programming to automatically calculate the nutrient intake for each food, thereby allowing for an accurate estimation of daily nutritional intakes.

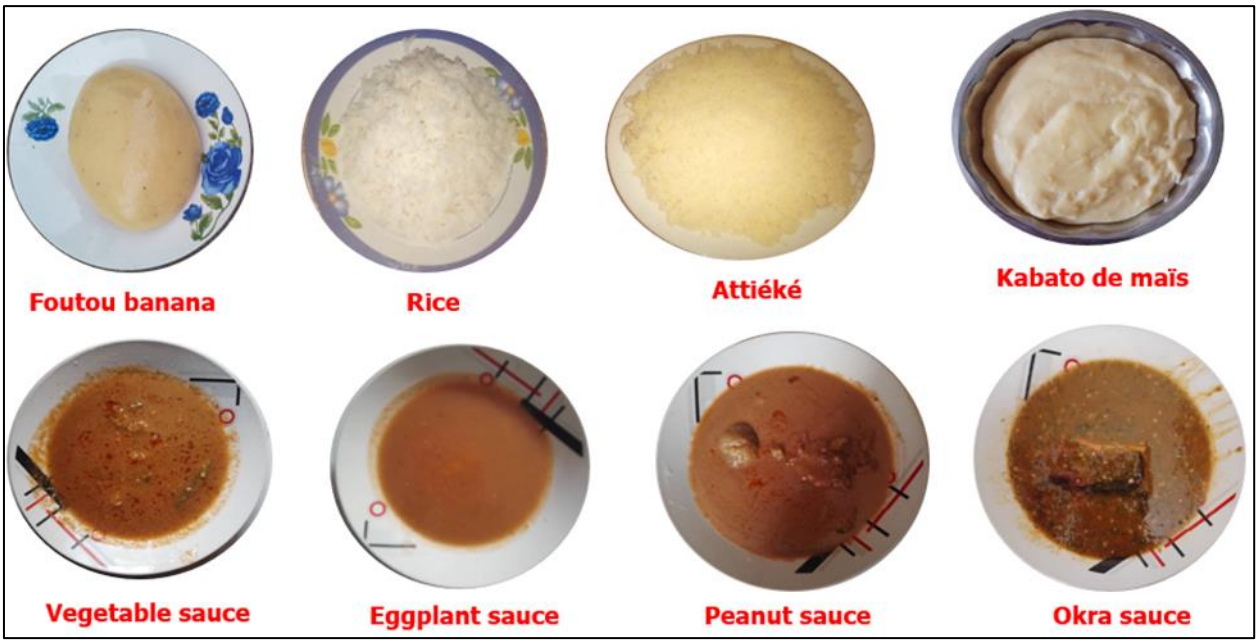


Figure 2 Most Commonly Consumed Local Dishes

Table 1 Most Commonly Consumed Local Dishes and Their Characteristics

Local Dishes	Nutritional Characteristics
Vegetable sauce	Sauce made from tomato, onion, chili pepper, cabbage, zucchini...
okra sauce	Sauce made from fresh or dried okra, ground into powder (Abelmoschus esculentus)
peanut sauces	Sauce made from peanut paste. Arachis hypogaea
Sauce aubergine	Sauce made from Eggplant (Solanum Torvum)
Kabato de maïs	Cornmeal cooked in water (Zea mays)
Attiéké	Steamed cassava semolina (Manihot esculenta)
Foutou banana	Plantain banana (Musa paradisiaca) and cassava (Manihot esculenta) cooked in water and then pounded

2.7. Biochemical Composition of Meals

All analyses were carried out in triplicate. The contents of dry matter, lipids, proteins, ash, and dietary fiber were determined in accordance with the method described by AOAC, 2000 [7]. Carbohydrate content was estimated by differential calculation [8]. The energy value was calculated using the equation defined by the metabolizable energy conversion coefficient, also known as the general Atwater factors [9]. The mineral profile of the samples was determined using a Scanning Electron Microscope (SEM).

2.8. Determination of the Nutritional Requirements of Lactating Mothers

The daily caloric needs of lactating women were calculated using the equation of Müller et al. (2004) [10], with a physical activity level ranging between 1.5 and 2.2 [11]. Macronutrient requirements for lactating mothers were calculated based on their total energy needs. Carbohydrates accounted for 50 to 55% of total energy intake (TEI), proteins for 12 to 15%, and lipids for 30 to 35% of TEI [12]. As for micronutrients, daily micronutrient intakes were compared with the nutritional recommendations of Anses (2019) [12].

2.9. Data Analysis

IBM SPSS Statistics version 20.0 was used to process the survey data, which was based on the calculation of means.

2.10. Ethical Considerations

The protocol for this study was approved by the National Ethics Committee for Life Sciences and Health of Côte d'Ivoire (CNESVS), under reference number N°107-22/MSHPCMU/CNESVS-kp. Informed consent was obtained from all participants prior to their inclusion in the study.

3. Results

3.1. Water Intake

Figures 3 and 4 show the data on water intake. The results reveal that the majority of mothers, regardless of their age group, consumed between 1 and 1.5 liters of water per day: 55.74% among those aged 16–24, 54.48% among those aged 25–34, and 58% among those aged 35–45. On the other hand, a significant proportion of mothers had a water intake of less than one liter: 27.87% for the 16–24 age group, 16.42% for the 25–34 group, and 14% for the 35–45 group. Only 16.39%, 29.1%, and 28% of mothers aged 16–24, 25–34, and 35–45 respectively drank more than 1.5 liters of water per day. Moreover, the average water intake from food was 1309.66 ± 420.21 mL, with respective intakes of 1341.396 mL, 1304.433 mL, and 1258.069 mL for the 16–24, 25–34, and 35–45 age groups.

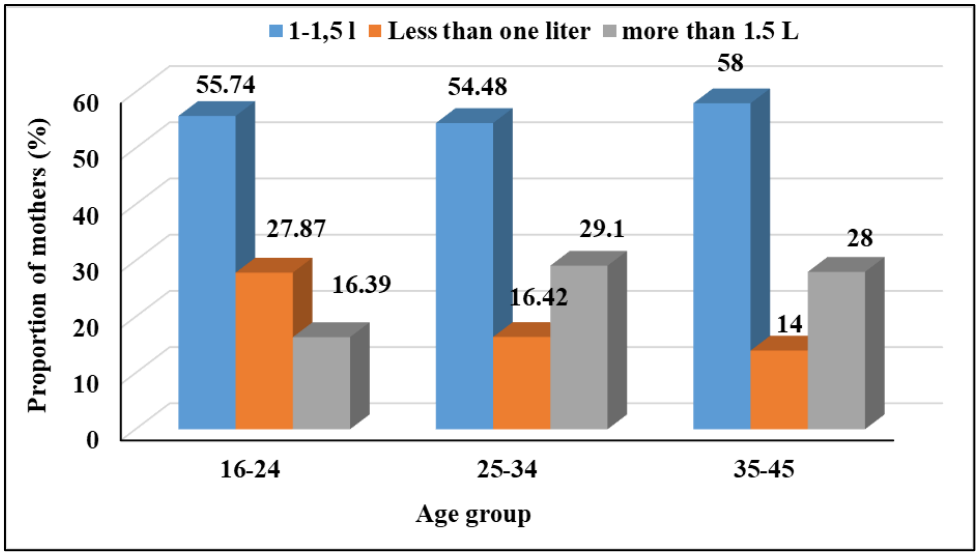


Figure 3 Distribution of mothers according to the amount of water consumed per day

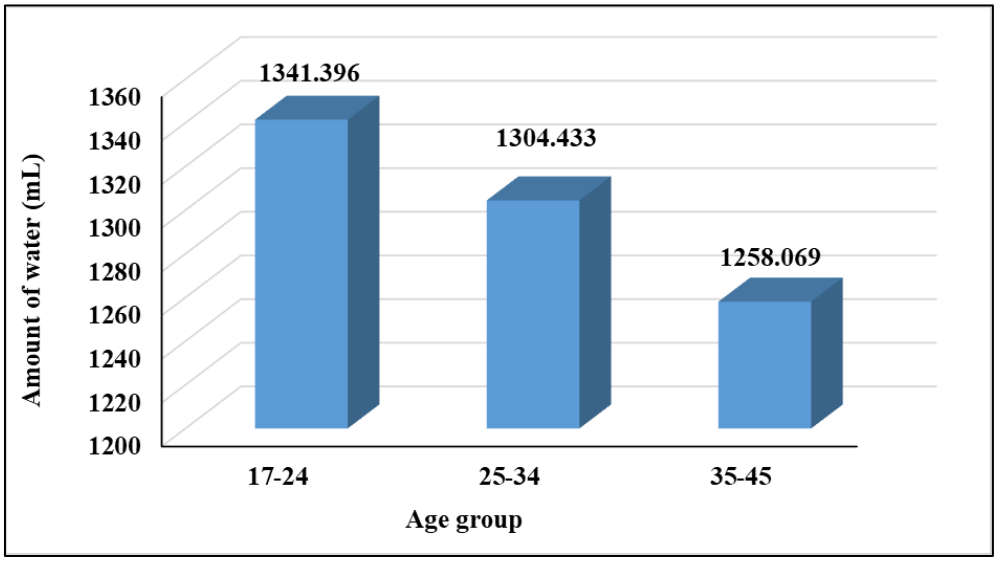


Figure 4 Distribution of mothers according to the amount of water provided by food

3.2. Coverage of Energy and Macronutrient Requirements

Overall, the mothers did not meet their energy requirements, except for 25% of those aged 16–24 and 25–34 who managed to meet half of their needs. As for macronutrients, protein requirements were not met by the mothers, regardless of their age group. However, carbohydrate and lipid requirements were better covered by the younger mothers. In fact, 25% of mothers aged 16–24 and 25–34 met their lipid and carbohydrate requirements, unlike their 35–45-year-old counterparts who met only a portion (half) or none of their respective lipid and carbohydrate needs (Figure 5).

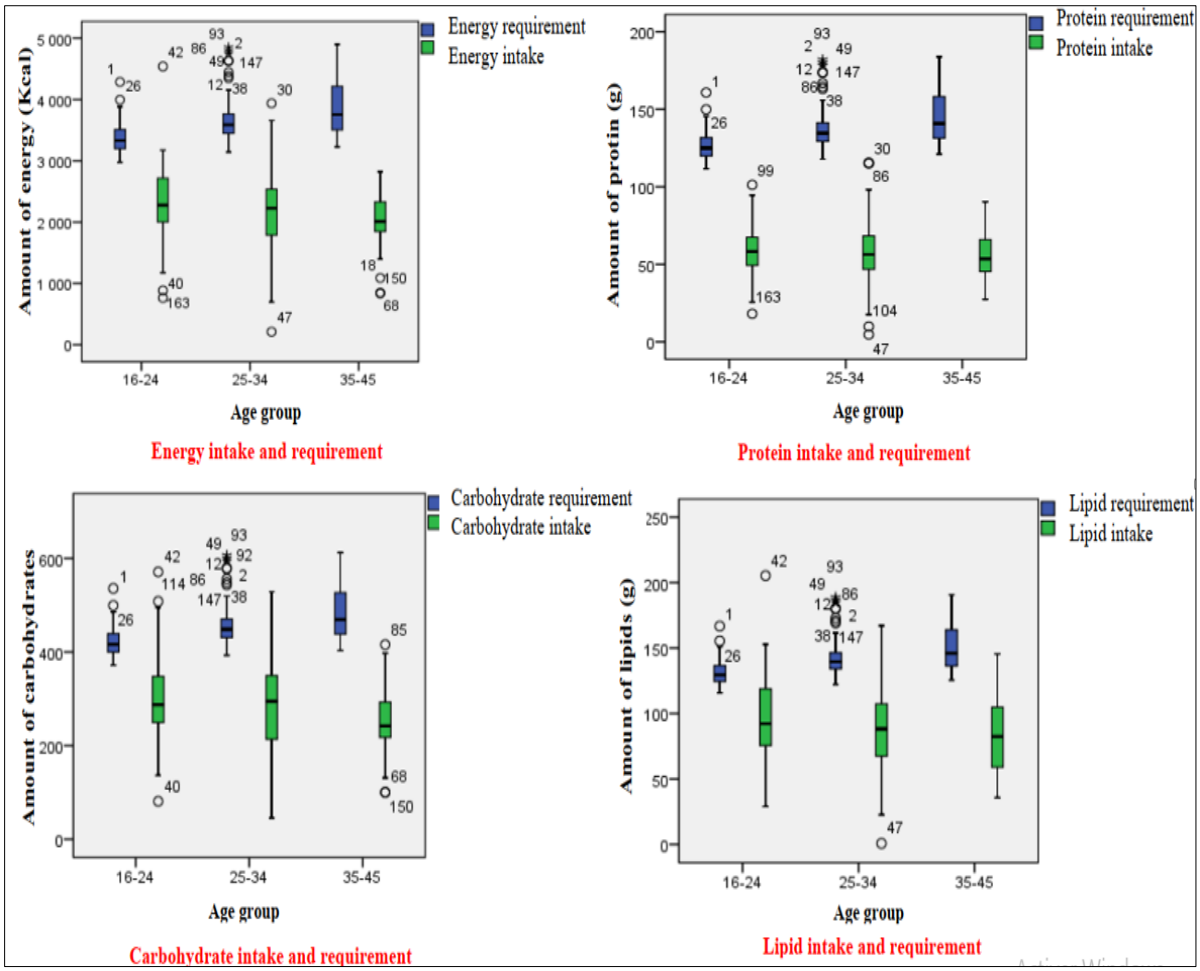


Figure 5 Energy and macronutrient intake and requirements of mothers by age group

3.3. Coverage of PUFA, Cholesterol, and Fiber Requirements

The results show that 75% of the mothers did not meet their fiber requirement (25 g). Moreover, the majority of mothers (80 to 100%) had daily intakes of PUFAs and cholesterol below the respective recommendations of 11.98 to 23.97 g and 300 mg (Figure 6).

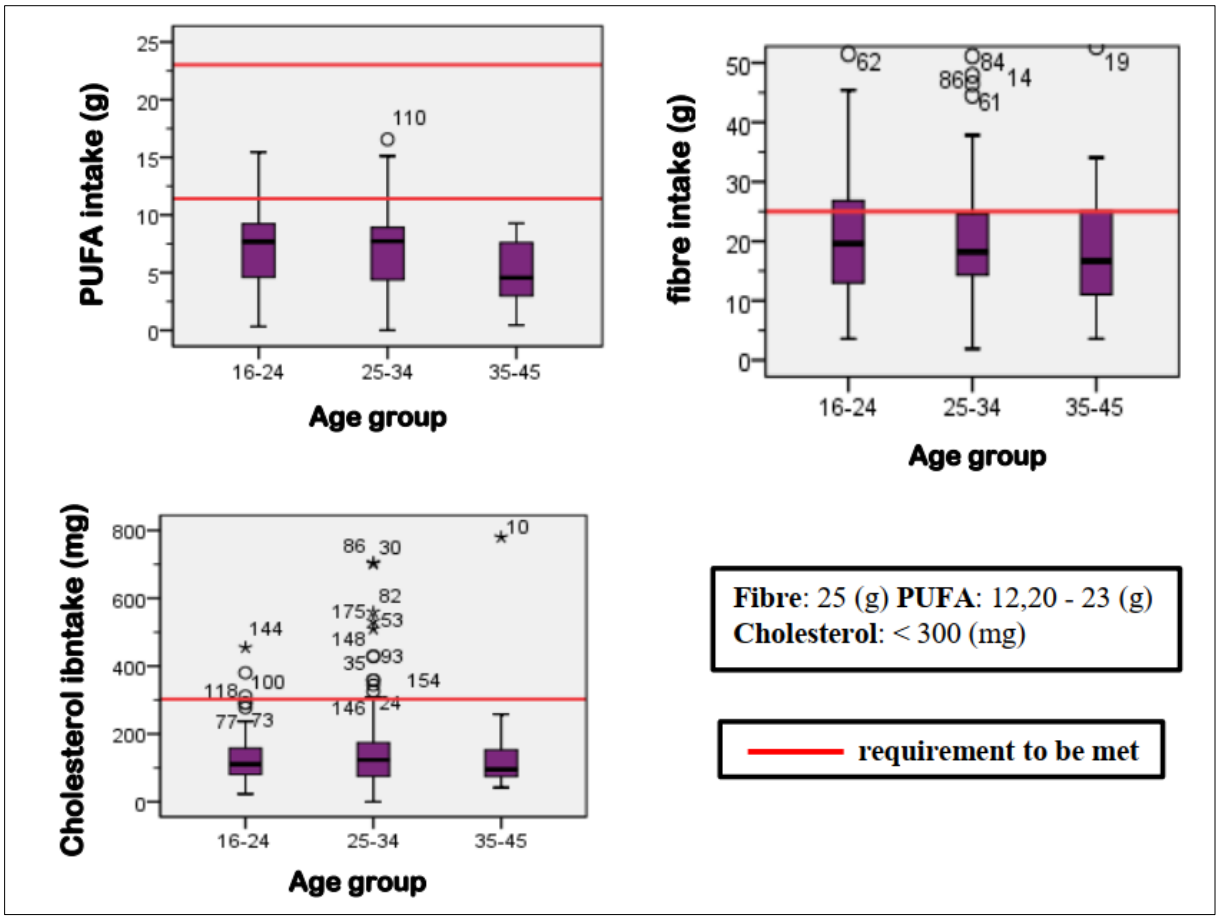


Figure 6 Fiber, PUFA, and cholesterol intake according to mothers' age

3.4. Micronutrient Requirement Coverage

The results on mineral requirement coverage showed that calcium and zinc needs were not met by the mothers, regardless of age group. As for potassium and iron, only 5 to 10% of mothers aged 16–24 and 25–34 met their needs, unlike mothers aged 35–45. Magnesium requirements, however, were met by about 50% of the mothers across all age groups. Furthermore, phosphorus intake in the majority of mothers (80%) was significantly higher than the requirements across all age groups (Figure 7).

Regarding vitamin A, B2, and B9 requirements, they were not met by the mothers in any age group. On the other hand, only 10 to 25% of mothers aged 16–24 and 25–34 met their requirements for vitamins B1, B6, C, and E, while their 35–45-year-old counterparts met little (5 to 10%) or none of their respective needs for vitamins B6, C, B1, and E (Figure 8).

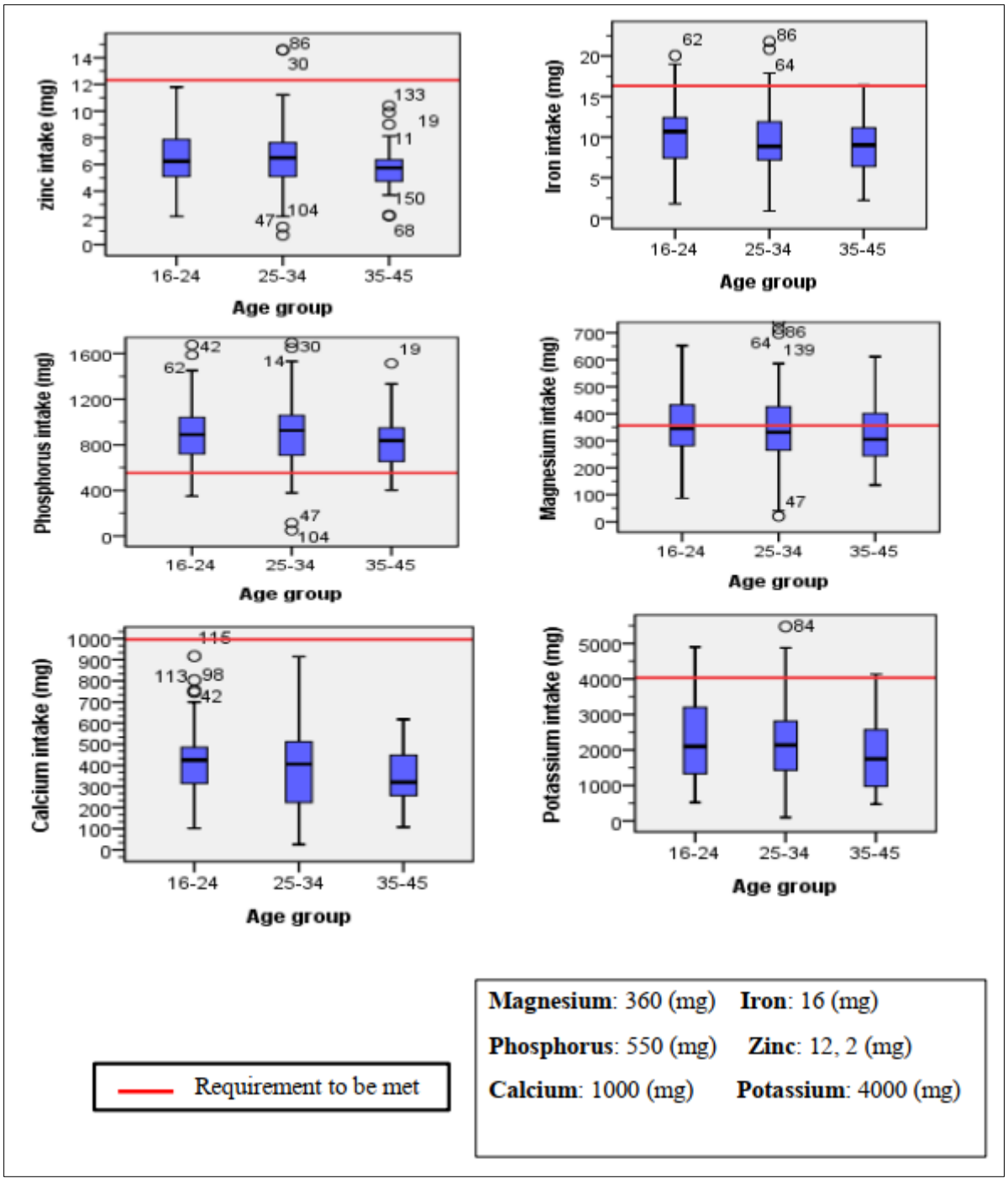


Figure 7 Mineral intake according to mothers' age

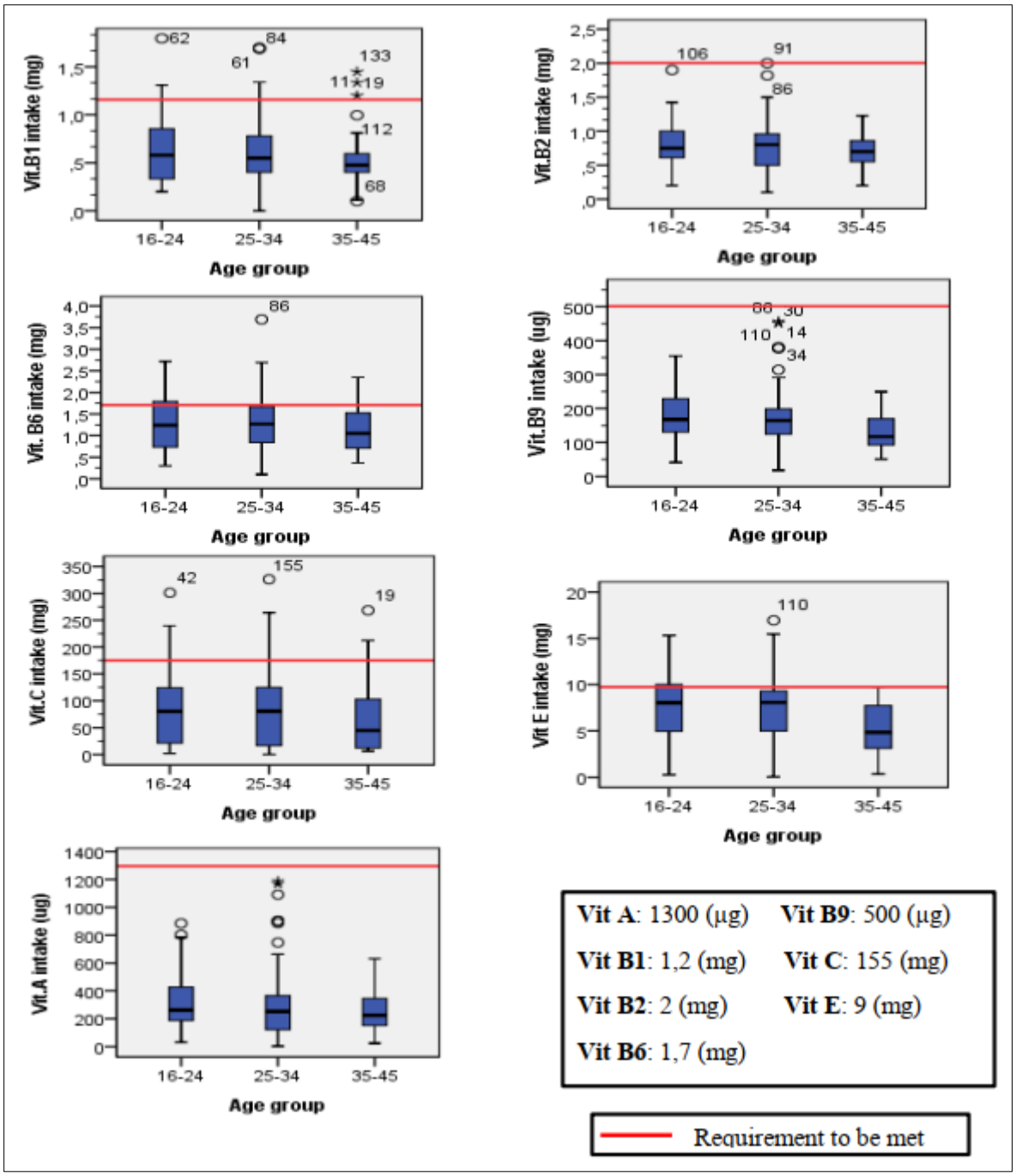


Figure 8 Vitamin intake according to mothers' age

4. Discussion

This study aimed to assess the nutritional intake of breastfeeding women in Côte d'Ivoire and its implications for maternal and child health. The results reveal several concerning deficiencies, both in terms of hydration and nutrition. Regarding hydration, 71.67% of the mothers consumed between 1 and 1.5 liters of water per day, which falls below international recommendations. Indeed, the Institute of Medicine recommends a total water intake of 3.3 L/day for lactating women [13]. In China, this value is set at 3.8 L/day [14, 15], while the European Food Safety Authority recommends a total intake of 2.7 L/day, including about 1.7 L from beverages and 1 L from food sources [16]. In our sample, the average water intake from food was 1309.66 ± 420.21 mL, thus exceeding the EFSA's food-based intake recommendation. Although beverage intake was lower than recommended, overall hydration could be considered acceptable. However, due to variability in the guidelines, drawing definitive conclusions remains uncertain. Further studies tailored to the context of Côte d'Ivoire are necessary to establish appropriate local standards.

In terms of energy intake, the mothers did not fully meet their energy and macronutrient requirements. This deficiency may result from unbalanced dietary practices, a lack of awareness about the increased needs during breastfeeding, and a limited number of daily meals—typically 2 or 3 instead of the recommended 4 to 5 meals [17, 18]. Previous studies have shown that preexisting eating habits can influence dietary behavior during breastfeeding. Mothers who had unbalanced diets before pregnancy tend to maintain similar habits during lactation [19, 20]. However, breastfeeding increases energy needs by approximately 500 kcal per day. These findings are consistent with those of Hébel et al. (2018) [3] and Demmouche et al. (2014) [21], who also observed energy and nutritional deficits among breastfeeding mothers. Young mothers, on the other hand, were better able to meet their needs, likely due to a higher metabolism that stimulates greater energy consumption [22, 23, 24].

Regarding polyunsaturated fatty acids (PUFAs) and fiber, intake levels were below the recommendations for all age groups. PUFAs, particularly omega-3 and omega-6, are essential for cardiovascular health, neurological development, and immune function. Fiber plays a fundamental role in digestion and the prevention of chronic diseases, especially cardiovascular diseases and diabetes [25, 26]. On the other hand, cholesterol intake was generally below the thresholds, which is beneficial for cardiovascular health.

Regarding micronutrients, no age group fully met its requirements. Calcium and potassium intakes were insufficient among all mothers. Calcium, vital for bone health, blood clotting, and neuromuscular activity, must be closely monitored, as a deficiency can lead to bone demineralization in the mother and harm the infant [27, 28]. Potassium, essential for fluid balance and muscle function, was also deficient, posing risks of hypertension and adverse effects on the child [29, 30]. Phosphorus, although essential for bone health and acid-base balance, was present in excess, which can lead to electrolyte imbalances. Magnesium intake was adequately met in about half of the women. This mineral plays a major role in neuromuscular and cardiac function.

Intakes of trace elements such as iron and zinc were also insufficient. Iron deficiency can lead to fatigue, cognitive disorders, and reduced maternal performance, affecting both the mother and the child. Zinc, necessary for growth, immunity, and antioxidant protection, was also lacking [31].

Finally, overall vitamin intake was inadequate. Intakes of vitamins A, C, and B group were insufficient in the majority of mothers, while vitamin E exceeded recommendations in 25% of them. Vitamin C supports immunity and iron absorption. Vitamin A is essential for vision, growth, and immune defenses. B vitamins support energy metabolism, the nervous system, and red blood cell production [31].

5. Conclusion

In conclusion, this study shows that breastfeeding mothers do not fully meet their nutritional needs, particularly in essential macronutrients and micronutrients such as calcium, iron, zinc, potassium, and vitamins. This insufficiency may compromise the quality of breast milk and, consequently, reduce its effectiveness in meeting the infant's nutritional requirements, potentially harming both maternal and child health. It is therefore essential to improve maternal nutrition education and promote more balanced dietary practices to ensure better nutritional quality of breast milk and support the health of both mother and baby.

Compliance with ethical standards

Acknowledgments

We express our sincere gratitude to the directors of Houphouët-Boigny General Hospital, the Henriette Konan Bédié Health Complex in Cocody-Blockhaus, and the Port-Bouët General Hospital for authorizing the conduct of this survey within their respective institutions. We also sincerely thank all the mothers who kindly agreed to participate in this study.

Disclosure of conflict of interest

The authors declare no conflict of interest.

Statement of ethical approval

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Statement of informed consent

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References

[1] WHO. (2017). 10 facts on breastfeeding. [Online]. https://www.who.int/features/factfiles/breastfeeding/en/ (accessed 17/01/2019)

[2] Castel, B., & Billeaud, C. (2017). Nutrition of breastfeeding mothers. Cahiers de Nutrition et de Diététique, 52(2), 9–93. https://doi.org/10.1016/j.cnd.2016.12.003

[3] Hébel, P., Francou, A., Egroo, L. D. V., Rougé, C., & Mares, P. (2018). Food consumption and nutritional intakes among breastfeeding women in France. OCL. https://doi.org/10.1051/ocl/2018014

[4] Coulibaly, G. A., Yépié, A. H., Koné, N. T., Anin-Atchibri, A. L., Adjehi, D. (2024). Evaluation of the Dietary Practices of Breastfeeding Mothers: Case of General Hospitals in Bonoua and Dabou. Journal of Food and Nutrition Sciences, 12(1), 55-60. https://doi.org/10.11648/jfns.20241201.15

[5] Kellenberger, S., & Laurent, M. (2020). Does the nutritional status of the breastfeeding mother influence galactogenesis and/or the composition of breast milk? Bachelor's thesis, Geneva School of Health, 70 p.

[6] Lawn, J., & Harvey, D. (2003). Nutrition and food security in Kugaaruk, Nunavut (145 p.).

[7] AOAC. (2000). Official Methods of Analysis of the Association of Official Analytical Chemists (17th ed.). Gaithersburg, Maryland, USA.

[8] FAO/INFOODS. (2015a). Guidelines for Conversion of Units, Denominators and Expressions (Version 1.0). FAO, Rome.

[9] FAO/INFOODS. (2015b). Guidelines for Checking Food Composition Data Prior to the Publication of a User Table/Database (Version 1.0). FAO, Rome.

[10] Müller, M. J., Bosy-Westphal, A., Klaus, S., Kreymann, G., Luhrmann, P. M., Neuhauser-Berthold, M., Noack, R., Pirke, K. M., Platte, P., Selberg, O., & Steiniger, J. (2004). WHO equations have shortcomings for predicting resting energy expenditure in modern populations: A new standard. American Journal of Clinical Nutrition, 80(5), 1379–1390. https://doi.org/10.1093/ajcn/80.5.1379

[11] Vermorel, M., et al. (2001). Energy. In A. Martin (Ed.), Recommended Nutritional Intakes for the French Population. Paris: Tec & Doc.

[12] Anses. (2019). Opinion of the French Agency for Food, Environmental and Occupational Health & Safety on updating dietary guidelines for pregnant or breastfeeding women (53 p.). www.anses.fr

[13] IOM (Institute of Medicine). (2004). Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate. Nutrition, 30(6), 73–185.

[14] Zhang, N., Morin, C., Guelinckx, I., Moreno, L. A., Kavouras, S. A., Gandy, J., Martinez, H., Salas-Salvadó, J., & Ma, G. (2018). Fluid intake in urban China: Results of the 2016 Liq.In7 national cross-sectional surveys. European Journal of Nutrition, 57(Suppl 3), 77–88.

[15] Zhu, L., Luo, F., Hu, W., Han, Y., Wang, Y., Zheng, H., Guo, X., & Qin, J. (2018). Bacterial communities in the womb during healthy pregnancy. Frontiers in Microbiology, 9, 2163. https://doi.org/10.3389/fmicb.2018.02163

[16] EFSA. (2010). Scientific opinion on dietary reference values for water. EFSA Journal, 8(3), n/a–n/a.

[17] EFSA .2017. "Dietary Reference Values for nutrients. Summary report." EFSA Supporting Publications 14 (12):92 p. doi: 10.2903/sp.efsa.2017.e15121

[18] PNN. (2017). The Picture Box: Essential Nutrition Actions and Practices (ENA/EPN). 62 p. file:///C:/Users/HP/Desktop/Discussion%201/Cote-dIvoire-Boite-Image-Flipchart-Jun2017-FRENCH.pdf (accessed 20/09/

[19] Fowles, E. R., & Walker, L. O. (2006). Correlates of dietary quality and weight retention in postpartum women. Applied Nursing Research, 19(4), 197–204.

[20] Kerver, J. M., Yang, E. J., Obayashi, S., Bianchi, L., & Song, W. O. (2006). Meal and snack patterns are associated with dietary intake of energy and nutrients in US adults. Journal of the American Dietetic Association, 106(1), 46–53.

[21] Demmouche, A., Beddek, F., Chalal, N. E. H., Mai, A. H., & Ghani, A. E. (2014). Nutritional status of breastfeeding women in the city of Sidi Bel Abbes (western Algeria). Antropo, 31, 51–59. www.didac.ehu.es/antropo

[22] Wang, Z., Ying, Z., Bosy-Westphal, A., Zhang, J., Heller, M., Later, W., Heymsfield, S. B., & Müller, M. J. (2011). Evaluation of specific metabolic rates of major organs and tissues: Comparison between men and women. American Journal of Human Biology, 23(3), 333–338. https://doi.org/10.1002/ajhb.21137

[23] Müller, M. J., Wang, Z., Heymsfield, S. B., Schautz, B., & Bosy-Westphal, A. (2013). Advances in the understanding of specific metabolic rates of major organs and tissues in humans. Current Opinion in Clinical Nutrition and Metabolic Care, 16(5), 501–508.

[24] Caron, N. (2017). Estimation of energy expenditure in individuals with type 2 diabetes using “smart” sensors (Doctoral dissertation, University of La Réunion).

[25] Abdelhamid, A. S., Martin, N., Bridges, C., Brainard, J. S., Wang, X., Brown, T. J., Hanson, S., Jimoh, O. F., Ajabnoor, S. M., Deane, K. H. O., Song, F., & Hooper, L. (2018). Polyunsaturated fatty acids for the primary and secondary prevention of cardiovascular disease. Cochrane Database of Systematic Reviews, Issue 7. https://doi.org/10.1002/14651858.CD012345.pub2

[26] Anjarkouchian, A. (2023). What are the effects of fiber on digestive health? [Online]. https://cdhf.ca/fr/quels-sont-les-effets-des-fibres-sur-la-sante-digestive/ (accessed 10/10/2021)

[27] Olausson, H., Goldberg, G. R., Laskey, M. A., Schoenmakers, I., Jarjou, L. M., & Prentice, A. (2012). Calcium economy during human pregnancy and lactation. Nutrition Research Reviews, 25, 40–67.

[28] Superior Health Council. (2016). Nutritional recommendations for Belgium – 2016 (Opinion No. 9285). Brussels: SHC. Retrieved from https://www.health.belgium.be/sites/default/files/uploads/fields/fpshealth_theme_file/css_9285_avis_rec_nutr.pdf

[29] Aburto, N. J., Hanson, S., Gutierrez, H., et al. (2013). Effect of increased potassium intake on cardiovascular risk factors and disease: Systematic review and meta-analyses. BMJ, 346, f1378. https://doi.org/10.1136/bmj.f1378

[30] Zisimopoulou, S., Pechère-Bertschi, A., & Burnier, M. (2016). Potassium and blood pressure: An old story revisited. Revue Médicale Suisse, 12, 1502–1506.

[31] Ares, S. S., Arena, A. J., & Díaz, M. G. N. (2016). The importance of maternal nutrition during breastfeeding: Do breastfeeding mothers need nutritional supplements? Anales de Pediatría, 84, 347.