Subject: Design of e-health tools dedicated to the early detection of eating behaviours associated with body weight gain

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Abstract (up to 10 lines):
The aim of the thesis is to design a body weight gain risk index. To build this index, we will use data already acquired via the WellBeNet smartphone application and from food purchase data. WellBeNet collects food choices and estimates energy expenditure. The first research study will consist of evaluating the energy intake of food portions according to energy expenditure. The 2nd study will characterize food choices and meal context as a function of weight status. A 3rd study will establish the link between the food choices filled in the application, purchases and a variation in weight status. Based on all these data, a weight gain risk index will be developed.

Skills:
The candidate must have a background in human nutrition. He/she should have a strong background in statistics and multivariate data analysis. Writing skills in French and English are also essential.

Keywords:
Food behavior and purchase; Food intake and energy expenditure; e-Health; Weight gain; Machine learning; Health; Free living conditions
The health trajectories of individuals depend largely, beyond genetic determinisms, on their lifestyles (Shuval et al., 2015). Food plays a major role in the health status of individuals. An unbalanced diet, mainly rich in ultra processed food products over a long period of time, could induce weight gain and lead to obesity (Fardet, 2018; Fardet et al., 2019). In epidemiological studies, food intake is usually collected through dietary surveys. Many studies have shown that surveys are subject to omissions and estimation biases (Naska et al. 2017). Our hypothesis is that indirect methods for estimating food intake could be developed based on energy expenditure on the one hand and food purchases on the other. Indeed, the maintenance of a stable weight implies that food intakes cover energy requirements, and food consumption is directly related to food purchases. These indirect methods could be used to develop a weight gain risk index.

INRAe has a scientifically validated tool for accurately estimating energy expenditure. This tool consists of the WellBeNet smartphone application and a data processing and storage server. The tool allows the evaluation of activity behaviour (eMouve) and food intake (NutriQuantic). The eMouve tab collects accelerometry data to evaluate the duration of sedentary and physical activity and to deduce the associated energy expenditure. These estimates come from algorithms designed distinctly for normal-weight and overweight adult populations and have been scientifically validated against reference methods (Guidoux et al., 2017; Rousset et al., 2017; Rousset et al., 2018). The NutriQuantic tab allows a quick input of the social context of food intake (date and time, with whom and where), food choices expressed in portions in 12 food categories (fruit, vegetables, alcohol ...).

The objective of the thesis is to design a body weight gain risk index based on behavioral data. To build this index, we will use data already acquired via the WellBeNet smartphone application and from food purchase data. WellBeNet collects food choices and estimates energy expenditure. The first research study will consist of evaluating statistically the mean energy intake of food portions according to energy expenditure (6 months). The 2nd study will characterize food choices and meal context (time, with whom and where) as a function of weight status (6 months). A third study, consisting of 2 surveys 6 months apart, will establish the link between food choices made in the application, purchases and a variation in weight status (12 months). From all these data, a weight gain risk index will be developed (6 months). The last 6 months will be devoted to writing the manuscript and publications.

**References (up to \( \frac{1}{2} \) page):**


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