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ORIGINAL ARTICLE

Familial aggregation and maximal heritability of exercise participation: A cross-sectional study in schoolchildren and their nuclear families

Groupes familiaux et héritabilité maximale à la participation à l'exercice : une enquête transversale sur des élèves et leurs familles nucléaires

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KEYWORDS
Motor activity;
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Summary
Objectives. — The exploration of variability in exercise behaviour is crucial in childhood and adolescence, as a tracking of this behaviour from that chronological period to adulthood, has been annotated. Therefore, aim of this research was to investigate the familial genetic and environmental determinants of individual differences with respect to exercise participation.
Equipment and methods. — Six hundred and ten members (156 mothers, 140 fathers, 156 daughters and 158 sons) of 175 nuclear families completed a 16-item questionnaire of physical activity. Their trait under examination, calculated as minutes of exercise per week, was adjusted for the effect of age (age, age 2, age 3) for each gender subcategories (mothers-daughters, fathers-sons).
Results. — The ANOVA results ($F[174,433] = 2.36$, $P < 0.05$) indicated that there was 2.36 times more variance between than within families in exercise participation, suggesting that this trait aggregated in families. Maximal heritability was estimated 0.60, that was genetic factors and shared familial environment explained the 60% of the variance in exercise levels of the participants.
Conclusion. — The lower correlation between spouses ($r = 0.21$, $P < 0.05$), with respect to other intrafamilial correlations ($r = 0.30$, $P < 0.05$ between parent and offspring and $r = 0.36$, $P < 0.05$ in siblings), highlighted the genetic factor in exercise participation. Also, the significant influence (40%) of the non-shared environment was confirmed.

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MOTS CLÉS
Activité motrice ;
Enquêtes ;
Variation génétique ;
Environnement social

Résumé
Objectif. — L'exploration de la variabilité de l'exercice physique exercé pendant l'enfance et l'adolescence est d'autant plus cruciale qu'elle se répercute sur le comportement de l'adulte, comme il a été observé. Par conséquent, le but de cette recherche était d'enquêter sur le rôle de la génétique familiale et des facteurs environnementaux dans les différences individuelles concernant l'exercice physique.
Méthodes. — Six cent dix participants (156 mères, 140 pères, 156 filles et 158 garçons) de 175 familles nucléaires ont complété un questionnaire comportant 16 questions sur l'activité physique. Le paramètre examiné, calculé en nombre de minutes d'exercice effectué par semaine, prend en compte l'effet de l'âge (âge, âge 2, âge 3) et le genre (mères-filles, pères-fils).
Résultats. — Les résultats d'analyse de variance ont indiqué qu'il y avait 2,36 fois plus de variance entre les familles qu'à l'intérieur des familles, suggérant ainsi l'existence d'un effet familial sur l'exercice physique. L'héritabilité maximale était estimée à 0,60, c'est-à-dire que les facteurs génétiques et l'environnement familial expliquent 60 % de la variance du niveau d'exercice physique des participants.
Conclusion. — La corrélation plus faible entre les époux, par rapport aux autres corrélations intrafamiliales souligne le facteur génétique dans l'exercice physique. L'influence significative (40 %) de l'environnement non familial a été, par ailleurs, confirmée.

1. Introduction

It was well stated that human species was designed for movement [1]. Actually, until the industrialization of western societies, that took place in the 19th century, humans lived as gatherers, scavengers, toolmakers, hunters, farmers and artisans. Thus, it was concluded that for most of human history, physical activity (PA), especially with the form of occupational PA, i.e. demand of work, had a dominant place in the daily life. After the industrialization, and under the additive effect of urbanization, all the forms of PA gradually decreased. In the case of the so called white-collar workers, occupational PA tent to be annihilated, while leisure-time PA was diminished for most age and gender subcategories. This reality resulted in a significant energy misbalance or decrease of the level of balance, associated with chronic diseases.

The discrepancy between the benefits from physical activity (PA) and its recommendations, and the current trends, highlighted the need to explore the factors that influenced PA-related behaviours. The main research in this area centered on the identification of the role of social agents, like family, school, peers, physical environment, time constraint, equipment and facilities, education level, neighbourhood and economical status. Less attention was given to biological determinants of PA. Current models that did not incorporate biological influences accounted for only a moderate fraction of the variance in PA levels and did not discriminate fully between sedentary and physically active people [2]. Thereafter, a proper model of a PA-related trait's determinants should consider both genetic and environmental factors.

Exercise participation was regarded in the integrated context of energy expenditure. The components of total energy expenditure were the basal metabolic rate, thermic effect of food and physical activity (PA). The largest component was resting metabolic rate, which was the energy expended to maintain the basic physiological function of the body (e.g., heartbeat, muscle function, respiration) [3]. PA was the most variable and easily altered component of total energy expenditure, was considered as the energy used above that which was needed for basal metabolic rate and thermic effect of food and was usually measured as volitional exercise (i.e., conscious sports, fitness-related activities and active lifestyle) [4]. In turn, PA included a variety of subdivisions, like leisure-time and occupational PA, which contributed different amounts of energy expenditure and had miscellaneous implications in human organism (Fig. 1).

It would be unwise to view these environmental factors in isolation from the biological factors that normally control body metabolism and the compelling evidence that inter-individual differences in physical activity had genetic determinants. Among other agents, familial factors, distinguished in genetic and shared-environmental, also contributed in physical activity levels and families were important influences on the development of health habits [5]. Although both environmental and social factors had

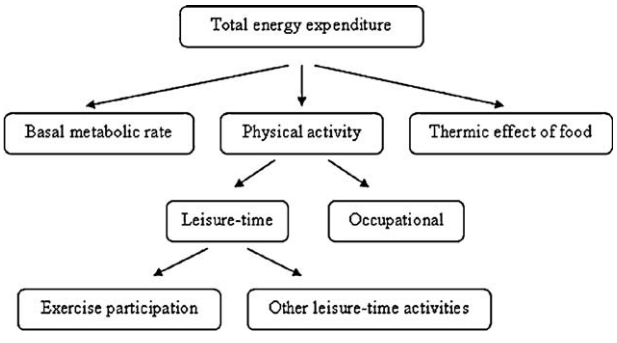

Figure 1 Exercise participation in the context of total energy expenditure.