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Research Protocol

Functional Disorders, Vascular Risks and, Malignant Diseases

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Abbreviations

BG: Blood Glucose, an index of energy availability in blood for the whole body; IH: Initial Hunger consists of gastric pangs or mind or physical weakness: *Inedia* is the Italian word for this weakness. In sedentary adults and in children, IH corresponds to 76.6 ± 3.7 mg/dL BG. In infancy corresponds to demand before sight of food; IHMP: Initial Hunger Meal Pattern: Energy intake is adjusted to three arousals of IH per day; OGTT: Oral Glucose Tolerance Test; AUC: Area Under Curve of GTT; MBG: The mean of 21 BG measurements before the three main daily meals reported by a week diary. MBG measures the compliance with IHMP, MBG shows changes after training and it is negatively correlated to insulin sensitivity. Below 81.8 mg/dL (Low MBG) MBG indicates a healthy meal pattern in sedentary people. Over 81.8 mg/dL, High MBG is associated with fattening/insulin resistance.

In many tissues, there are numerous small neoplastic lesions that rarely become overt cancers. In these small lesions, reproduction and oncogenic mutations have been identified. These lesions include established benign tumors such as melanocytic nevi, and groups of cells that are histologically only marginally abnormal (cancer in situ). Once they have grown to a certain size, such lesions stop growing appreciably and do not become more aggressive over many years or even decades [1]. Endogenous cell metabolism and different chemicals, drugs, ionizing radiation, solar light, cigarette smoking, and air pollution can induce oxidative damage to DNA. Oxidative DNA damage is involved in the development of different diseases, aging, and cancer and in incrementing the neoplastic lesions. In experimental animals, energy intake was (positively) associated with malignancy over being associated with vascular risks [2-11]. Another proof, indirect, comes from those children who had been treated with growth hormone to accelerate growth [12-15]. Cancer prevention has been obtained by a mean 30% decrease in energy intake in animals [2-4]. Repetition of similar experiments in man has been impossible up to now. Indirect proofs have been proposed. An association between tumor prevalence and obesity has been demonstrated [2-15]. Although progress has been made for a number of cancers, there are still enormous unmet needs for cancer treatment. For this reason, new approaches have been welcome [15]. These associations do not coincide with the association with those with low or high energy intake. The role of high energy intake in association with cancer development has been overlooked too early on the reasoning that humans are different from animals. High energy intake means a correspondent 15% increase in RMR and in total energy expenditure, a prevalent condition of insulin resistance and an evolving overall inflammation. The association in animals between energy intake and tumor prevalence reminds to overall Inflammation. This widespread condition provides all chemical factors that promote malignancies and that we have mentioned earlier. Humans show great differences in energy availability and often maintain blood levels that are associated with malignancy development.

Overall Inflammation

This condition follows insulin resistance, increases with age and is reversible, provides oncogenic moments for the association with increase in cell turnover [16-48]. This Overall Inflammation may persist a day or a week but in other subjects may be lifelong. It characterizes the convalescent state of every infectious or not infectious disease. More than half body immune cells are located in the intestinal mucosa. Hundreds of trillions of viable bacteria provide the antigens from intestine. Immune elimination of invading antigens (overall inflammation) and damages to body cells do not locate in intestinal mucosa but they develop in blood circulation and throughout the body. The widespread immune

elimination implies the increase in body cell reproduction everywhere throughout the body. The increased proliferation multiplies moments of DNA alteration. This situation of multiplied cell replication often persists either localized or widespread through many years and decades. This unstable persistence is exposed to environmental factors that increase malignant developments. E.g. the inflammatory state may be intensified and prolonged by conditioned intake. The factor that sustains overall inflammation is high energy availability. Reproduction of energy availability associated with overall inflammation and with its exit has been performed many times. The parameter that measures these changes is Mean Blood Glucose (MBG).

Right before meals, blood glucose (BG) is an approximate measure of energy availability and of inter-meal balance. Mean BG is the mean of 21 pre-prandial measurements that are reported in a week diary with the name of MBG [31-48]. The metabolic control of this variable is so precise and incessant that MBG concerns not only BG metabolism and diabetes but characterizes all human energy metabolism. We measured preprandial BG to know energy availability at that preprandial moment, when people retain that further energy requires to be added to the body. Thus MBG indicates the personal aim for energy availability.

MBG is much more important as compared to energy intake [36-39]. MBG represents availability to body cells whereas energy intake may remain far from showing availability. During meals, a dose of restriction is somehow unavoidable. We limited intake to let emerge IH after the wished time interval. Experimentally, meals allowing three IH arousals per day are associated with an even energy and body weight balance (Figure 1) [35,49-52]. Hungry subjects in Figure 1 are taken when BG is low. Maintenance of this low BG produces an energy balance that is more constant than conditioned meals. Sometimes two arousals per day are sufficient to indicate effective and not excessive restraining. Children may require four IH arousals. In the old age I made a major meal and 1 or 2 small additional meals. Repeating IH identifications during a day is a guarantee for low BG maintenance. IH is influenced by expenditure. We can adapt intake to expenditure after knowing effects of wind, of low temperature, of heavy manual work and of an overheated ambient on body metabolism and BG.

MBG is correlated to markers of vascular risk in our investigations [35]. Consensus is growing on the idea that abundant energy intake promotes cancer. Energy intake is often confounding, we cannot compare individuals with different energy intake because their energy balance cannot be equal nor we can render equal the balance. Thus we use MBG. We presume that MBG is high at the early diagnosis of malignancy.

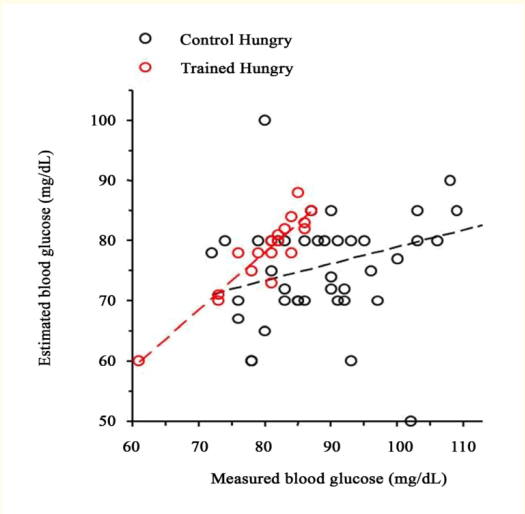

Figure 1

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We present the training protocol to abolish conditioned intake. This abolition is associated with a decrease of energy intake, RMR, Total Daily Expenditure by doubly labelled water, insulin resistance, HbA1c and body weight (Tables 1 and 2).

Training protocol

1. Suspend meals for up to 48 hours
2. Locate physical sensation of hunger
3. Measure blood glucose concentration (BG)
4. Mentally associate the physical sensation with the BG concentration
5. Begin with a meal of about 300 kcal
6. Repeat 1 - 5 increasing the meal size in proportion to the desired interval
7. Repeat the above procedure for two weeks. At each arousal of physical hunger, compare the aroused sensation and the measured BG with the initial ones during intervention.

Part of population does not require to learn this fine intervention on intake. About 30% of investigated adults or toddlers maintained after training the energy intake, blood glucose (BG), resting metabolic rate (RMR) and insulin resistance that they had already low at recruitment. This means that they easily renounced by free choice to the complete energy intake during post-absorptive period. A consistent minority of population adopts and maintains this meal pattern by free choice. We trained IH recognition by an initial suspension of intake. Objectively, the adoption of IHMP creates a different life. Table 1 reports effects on energy metabolism, table 2 reports effects on insulin sensitivity and Body Mass Index (BMI). At recruitment, the investigated population presents individuals that have mixed levels of energy availability. We assess this energy availability by blood glucose (BG) that is correlated to other macronutrients and is burnt out before other nutrients. Omega three fatty acids circulate in blood after 24 hours from intake and BG for only two or three hours. Thus BG is a useful index of energy availability in blood. The individual meal pattern in a time period, during a week e.g. can be assessed by mean blood preprandial glucose (MBG) that is measured 21 times, i.e. before three main meals in a week. We found that each recruited toddler and recruited adult had his own individual MBG and maintained the individual MBG with poor variability. The confidence interval within a week was 3.8 mg/dL around each subject [35,49-52]. The MBG informed on the habitual metabolic condition (energy availability and balance) in different times, with different diets and in different individuals. In case of divergence between estimation and portable measurement, mothers followed estimation. Thus, the subject's meal pattern is guided by his aim for a definite level of energy availability. Subjects or parents measured capillary blood by glucometer (a portable potentiometer for whole blood glucose measurement: Glucocard Memory; Menarini Diagnostics; Florence, Italy) in the quarter-of-an-hour before they intended to take a meal. We identified a subject's error as the mean absolute difference between the portable device and autoanalyzer in the measurement of the same blood sample. The mean error was 5.7 mg/dL in a week and 6.0 mg/dL in 5 months [51,52]. The error by portable is modest and negligible. The BG assessment by portable is useful to signal the BG and energy availability correspondent to the arousal start of contrary, depressive reflexes (Figures 1 and 2). Inflammation and damages to body cells are mainly due to antigen/antibody and killing monocytes encounters. There is an important biological observation: More than half body immune cells are located in the intestinal mucosa. Hundreds of trillions of viable bacteria provide the antigens from intestine. Inflammation and damages to body cells do not locate in intestinal mucosa but they develop in blood circulation and throughout the body. This widespread pathogenic mechanism implies the increase in cell reproduction. This mechanism is well known and increases moments of DNA alteration. Malignant developments arise through many years and decades of maintenance of a situation of multiplied cell replication often localized.

Training	Before	After	Before	After
	Energy intake		**M B G**	
38 OW adults	1756 ± 585	1069 ± 487	86.8 ± 8.7	78.8 ± 6.8
40 NW adults	1852 ± 697	1270 ± 457	91.4 ± 7.7	80.1 ± 6.6
70 Toddlers	946 ± 230	749 ± 187	86.9 ± 9.4	76.4 ± 6.7
	R M R			
14 Toddlers	58.6 ± 7.8	49.0 ± 9.1		

Table 1: Initial Hunger Meal Pattern, Effects on energy metabolism.

Note: Assessments before and after 5 months training. All differences are significant.

	26 trained OW		**13 control OW**	
Either before or after 5 months	Before	After	Before	After
OW adults with High MBG BMI	29.0 ± 4.1	26.5 ± 4.0	29.2 ± 3.9	27.8 ± 4.2
	40 NW		15 control NW	
NW adults with High MBG BMI	21.8 ± 2.4	20.7 ± 1.9	20.2 ± 2.3	21.4 ± 2.1
(High MBG)	55 High MBG		19 High MBG control	
Insulin area under curve at GTT	244 ± 138	164± 92	222 ± 81	214 ± 98
(Low MBG)	34 trained		12 control	
Insulin area under curve at GTT	180 ± 98	183 ± 83	192 ± 106	243 ± 133

Table 2: Initial Hunger Meal Pattern and effects on insulin curve and BMI.

Note: Assessments before and 5 months after training. * Significant difference. IHMP and MBG were the most significant predictors of BMI in multivariate analysis of variance. High MBG OW subjects are here reported.

The damage might be produced by either a high mean or a high SD of energy administration. In animal experiments and in infants, we varied the energy availability by changes in environmental temperature and maintaining constant energy intake. Low temperature decreased energy availability by higher metabolic rate. High environmental temperature instead increased availability and the high level provoked reflexes that decreased absorption [53-57]. At that time, xylose was commonly used to estimate absorption rate. Experiments in animals and in adults confirmed the hypotheses (Figures 2 and 3). Prolonging a slow absorption state produced damage by bacteria proliferation during increased energy availability. In animal experiments, an increase of thousand times has been seen in duodenal bacteria number. We had to administer a little less food than the maximal amount that the infant was capable of absorption. Only after exhaustion of the previous meal from small intestine, we allowed the caregiver to administer a new meal. We hypothesized that demand by the infant, crying often, signaled this emptiness of the small intestine after (two) – three hours without food. We named this way of eating as initial hunger meal pattern (IHMP). Infants adopted this pattern, lost diarrhea relapses and grew normally like controls. This normal growth was a great achievement [35,49-52]. The infants recruited for these experiments differed from the normal anthropometric reference (USA, NIH). Recruited infants had a thin arm skinfold up to the seventh year of age and did not increase the skinfold thickness by increased energy intake [52]. The increase in energy administration increased BG, insulin resistance, overall inflammation and Resting Metabolic Rate but not weight or skinfold thickness in children with relapsing diarrhea. The children were examined at the age of 6 - 7 years, when they were well [35,49-52]. Differences in body weight and in height growth in dependence of high energy intake, emerged after the seventh year of life [67].

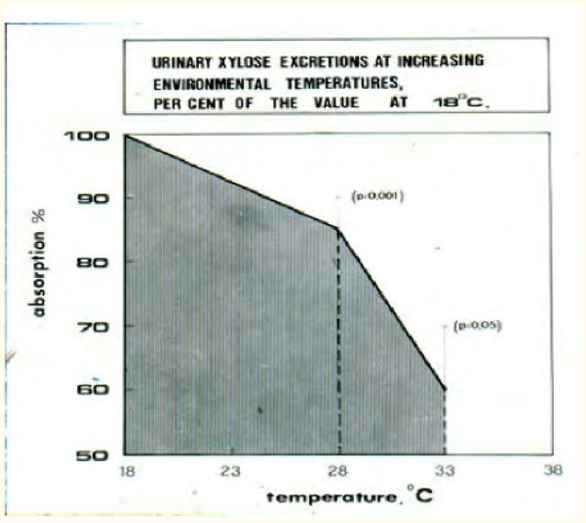

Figure 2

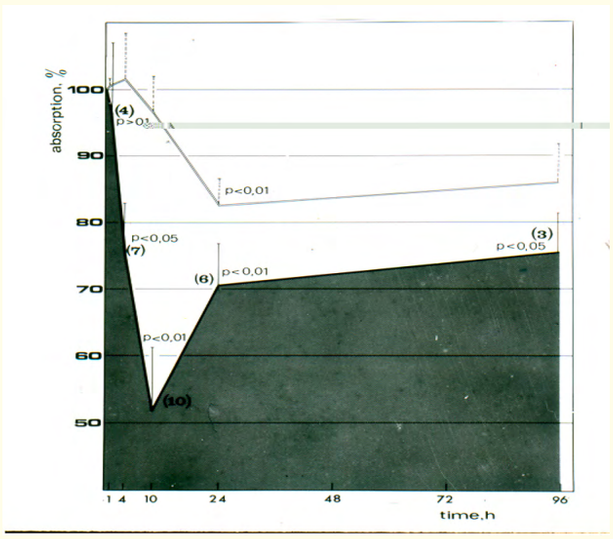

Figure 3: Xylose absorption in rats kept at 30°C in percent of absorption at 4 °C environmental temperature.

We obtained meal-by-meal fasting nutrient levels (low BG) prior to the next meal and suppressed fattening/insulin resistance. This pattern has been termed the Initial Hunger Meal Pattern (IHMP). Ignoring Initial Hunger contributes to increase obesity and diabetes in adults and in children. In the last half century, not only obesity and diabetes have increased in children but also asthma, autism, birth defects, dyslexia, attention deficit-hyperactivity disorder, schizophrenia. IHMP and minimal bacteria growth in the alimentary canal might become a strategy for health, to reduce these increases, as well as reversible, functional disorders, vascular and malignant diseases.

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Conflict of Interests

No conflicts of interest.

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