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PSYCHOLOGICAL ASPECTS OF  
NUTRITION

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**Chairperson**

*J.M. Diehl, Federal Republic of Germany*

**Secretary**

*J.E.R. Frijters, the Netherlands*

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No report received.

CONTRIBUTIONS TO THE WORKSHOP AND RELATED POSTERS

**CEPHALIC INSULIN RESPONSE ASSOCIATED TO FOOD INTAKE IN HUMANS**

F. Bellisle, J. Louis-Sylvestre, F. Demozay, D. Blazy, and J. Le Magneñ.  
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The cephalic insulin response associated with food consumption was measured in 7 normal weight humans. Each subject was tested 6 times so as to study the reproducibility of the response, as well as the behavioural parameters that could possibly be associated with it. The evolution of insulinaemia and glycaemia was examined over an 84-minute observation period starting 2 minutes before the presentation of a standard meal. Blood was drawn in a continuous fashion and collected in 1-minute samples for 30 minutes and then in 3-minute samples. The average glycaemia curve was stable until some 18-20 minutes after meal onset. By contrast, a significant rise in plasma insulin appeared as early as the 4th minute after the beginning of the intake. Three types of pre-absorptive insulin responses were observed: high and/or sustained rise, moderate and/or short increase, moderate decrease in plasma insulin. This is in agreement with other studies on cephalic insulin responses to visual and olfactory presentation of food stimuli to humans. The amplitude of the pre-absorptive insulin response could not be linked to individual response styles or to any behavioural parameter (meal size, meal duration, eating rates). Thus, contrary to what is observed in rats, the cephalic in-

sulin response, is not predictive of actual intake in humans. Furthermore, the surface area of the total cephalic insulin response was not correlated to the surface areas of post-absorptive insulinaemia and glycaemia. The surface area of post-absorptive insulin was correlated to meal size. Thus, the cephalic insulin secretion seems to represent a Pavlovian response of which the biological and behavioural significance remains to be demonstrated.

**AN EMPIRICAL MODEL FOR NUTRITION-BEHAVIOUR SURVEYS**

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The institute of Rural Sociology and the Institute of Human Nutrition developed a hypothetical model which was preliminary testing during 1981/82. The model, called MARS (Multiple Autonomous Regulatory System), is formed of six interrelated feedback loops integrating the physiological (metabolic) mechanisms, attitudes and knowledge, personal attributes, and environmental stimuli with special reference to the household, the natural and the social structure. The model will be presented in visual form.

The first testing phase was mainly devoted to the elaboration of survey instruments and to the assessment of compliance of more than 100 survey panel persons with numerous questions, tests,

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and investigations. Primordially, food intake was measured by means of a 24-hour recall method and a 11-day diary. Anthropometrical measures were taken, a clinical consultation passed, and biochemical parameters could be derived from blood and urine samples.

The data collected were grouped in more than 1,500 variables and stored in a data bank (SIR). Evaluation was done through SPSS, cluster and related analytical routines and was concentrated on the extrapolation of nutrition patterns (Giessen list of all nutrients and dishes), of activity patterns (Giessen evaluation scheme for activity diaries), and of psychological types of eaters.

**STUDY ON THE RELATIONSHIPS BETWEEN PERSONALITY AND FOOD HABITS**

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It is often suggested that personality variables might have an impact on human food behaviour. However, until now this likely relationship has rarely been investigated.

In a nutrition survey (EMSIG), which was carried out in Giessen, in the summer of 1981, a set of data of 80 adults, aged 18-65 years, was collected including the following: ten-day dietary records, a food frequency questionnaire, personality variables (Freiburg personality inventory), questionnaires on food-related attitudes, restrained eating, body image, and health. These data were used to analyse the relationship mentioned above.

First it was analysed univariately, to what degree the single food variables were related to the psychological variables. Then based on the food variables, groups of persons with distinct dietary patterns were cluster analytically formed and compared in the psychological variables.

**THE ROLE OF FOOD RESEARCH IN STUDIES ON NUTRITION BEHAVIOUR**

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A key element in studies on nutrition behaviour is to know the real intake of the individuals. This knowledge should not only cover the intake of nutrients, but also the intake of food items, their preparation, and the situation in which food is consumed.

In a feasibility study (EMSIG) food records of 88 persons were collected, each covering 11 days on average. For each recorded food item the nutrients (12) were compiled with a special Fortran programme, based on a data file of 1,400 single food items grouped in a 4 digit food code and a file of nearly 600 common recipes. All variables were stored in a data bank (SIR).

At different levels (per meal or day) the values for the nutrients and the food items were calculated for each person and stored. These figures can be retrieved any time. A comparison with other studies in the Federal Republic of Germany shows similar results as to the intake of nutrients and food items.

At the level of average intake per person different clusters of food consumption and intake of nutrients were identified and then related to each other. Also other variables, which could determine the observed clusters, were taken into consideration.

**SENSORY DISCRIMINATION, INTENSITY PERCEPTION, AND AFFECTIVE JUDGEMENT OF SUCROSE SWEETNESS IN THE OVERWEIGHT**

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Differential sensitivity, intensity perception, and the pleasantness of sucrose sweetness was determined with 2 groups of women (13 overweight and 12 normal weight). Discriminability, psycho-physical, psycho-hedonic, and the preference functions were determined for both groups. In addition, maximally preferred

sweetness intensities and the corresponding maximally preferred sucrose concentrations were calculated. The data showed that the two groups did not differ with respect to any of these functions or measures. Individual variability in affective response behaviour was larger within the overweight than within the group of normal weight. Thus, it seems that there is no empirical basis for the popular belief that overweight people have a 'sweet tooth'.

**DIURNAL PATTERNS OF FEEDING IN BREAST- AND BOTTLE-FED INFANTS**

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Mothers of both breast- and bottle-fed infants were recruited at birth and kept a detailed diary of the feeding and sleeping patterns of their infants over three-day periods. Time of start, end, and quantity of milk taken was recorded. This occurred in the first week of life and thereafter at one month intervals until aged six months.

Breast-fed infants, in contrast to bottle-fed infants, showed changes in the diurnal pattern of feeding, with a progression from large meals early in the morning to large meals at the end of the day. This pattern is the means by which the infants come to anticipate a period of night fasting. Detailed continuous feeding records of infants from birth on show a move from predominantly preprandial correlations between meal size and intervals between meals, to postprandial correlations as the infants become older. These studies indicate the impact of feeding technique in learning about hunger and satiety. They have implications for the development of rapid weight gain and obesity in adults.

**THE IMMEDIATE IMPACT OF TELEVISION NUTRITION ADS ON ADOLESCENTS**

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In a sample of 300 male and 350 female students, aged 12-30 years, the short-term effects of four television spots (advertising a pizza-dish, a cream dessert, a cream cheese, and a bar of chocolate) were studied. Six impact measures were analysed: attractiveness of each film by means of an adjective scale (1-4), total impact of the ads by means of a Likert scale (5), change of hunger feeling during the presentation of the film (6).

For each film and for their total impact as well, it is shown to what degree the presented nutrition ads have a different impact on males and females, and how much the effects of these ads change with increasing age.

**THE RELATIONSHIP BETWEEN EXTERNALITY AND RESTRAINED EATING**

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In one of his experiments Nisbett concluded that it appears that responsiveness to taste cues is indeed a positive function of weight. This study appeared to support the externality theory, originally formulated by Schachter.

In the same experiment, however, Nisbett observed also a very remarkable phenomenon, which could not well be explained by the externality hypothesis; obese subjects appeared to eat either a very large or only a very small amount of food, as if some sort of 'eating switch' was controlling their behaviour.

This same 'eating switch', though, could also be provoked in people of normal weight, who scored high on what Herman and Mack have called the 'restrained eating questionnaire'. Apparently, the phenomenon of the 'eating switch' could be predicted by the variable 'restrained eating', as well as by the variable body weight.

The question which now arises reads: is this 'eating switch' caused by the degree to which people respond to external cues, like taste of salience of food cues. Or does a high degree of restrained eating result in externality.

*Methods estimating energy expenditure and body composition*

women as compared to men both in the dry and the rainy season. Generally the work level of the women is found to be high, while that of the men is extremely low (dry season) to normal (rainy season). These results are not fully in accordance with those of other surveys, in which different techniques were used (recall methods, time-motion studies). Although the heart rate registration technique has its disadvantages, its value is highly estimated because of its objectivity.

**DAILY PHYSICAL ACTIVITIES IN RELATION TO THE NUTRITIONAL ENERGY REQUIREMENT OF THE INDIVIDUAL**

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The human body weight depends directly on the energy balance. Commonly, in nutrition surveys much emphasis is placed on the determination of the food intake, whereas the energy requirement, which is hard to measure during field surveys, is cared for rather superficially. One of the aims of this feasibility study (EMSIG) was to put equal emphasis on both sides of the energy balance. The participants recorded (besides a food record and other investigation) for 3 days in each of the two study phases (June/July, Sept/Oct 1981) their daily activities in a notebook. These data of 75 adults, together with their anthropometric measurements, were used for the calculation of their individual energy requirement. The values were computed with a specially developed programme (GAST), which calculated basal metabolic rate (BENEDICT-HARRIS formula), specific dynamic action and the energy value of the activity (11 categories with a specific value multiplied by time and body weight). The energy requirements of the study population were distributed normally. Men have higher values compared to women, but there is no difference as to the percentage due to physical activity, which on the average is only about 38%.

Since in field studies absolute accu-

racy in the measurement of the energy requirements and food intake values is not achievable the individual energy balance is computed in terms of relative values. For this the individual positions within the distribution of the group (z-value) for the energy intake and energy requirement were compared. These 'balance-values' (NEBIG) indicate quite well the problems of overweight people and restrained eaters with regard to the energy balance.

**SEASONAL VARIATION OF ENERGY EXPENDITURE AMONG MALE AND FEMALE FARMERS IN UPPERVOLTA**

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In order to contribute to the definition of energy requirement standards for tropical regions, both field and laboratory measurements have been conducted. Field work consisted in the recording of activities of a large sample of subjects over a period of one year, and the measurement of oxygen uptake, corresponding to the most frequent activities. The total time-motion study for all age-groups includes 28,160 days of recording, of which 21,388 days concerning 657 women and men, aged 15-59 years, have been processed.

On small groups of subjects, short measurements of the energy cost of activities have been made using Kofranyi-Michaelis respirometers and Servomex oxygen analysers.

Wide seasonal variations and significant differences in energy expenditure were observed for men and women.

The validity of this method of indirect calorimetry has been questioned. Laboratory work, using a water cooled garment from Webb Associates, has been initiated to compare the extrapolation of short measurements of oxygen uptake to a continuous recording of heat loss. The discrepancies between the two sets of results and the large margin of error involved in extrapolating short periods of measurements by indirect calorimetry are presented. New methods are explored on the basis of laboratory results.

*Methods estimating energy expenditure and body composition*

- \* Anthropometric measurements.
- \* Body density, by underwater weighing. Body weight was recorded weekly.

After the baby is born, all of the above measurements are being continued every 4 weeks. The development of the baby is monitored and the production of breast milk is measured by test-weighing during 48 hours.

Details of the methodology and some preliminary results will be discussed. This study was supported by a Grant from The Nestlé Foundation.

**MEASUREMENT OF 24-HOUR ENERGY EXPENDITURE IN HUMANS USING DOUBLE LABELLED WATER**

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In the research on adaptations and responses of man to the environment, data on energy expenditure have to be extrapolated from the laboratory. Energy expenditure is usually studied while subjects breathe directly in a respirometer or are confined in a respiration chamber. Using double labelled water allows observations of energy expenditure to be made while daily routines are maintained without interference.

The oxygen of expired CO<sub>2</sub> is in isotopic equilibrium with the oxygen of body water. When a subject is loaded with <sup>2</sup>H<sup>18</sup>O (by oral administration), the decrease in <sup>18</sup>O in the body water (determined in blood or urine) is a measure for H<sub>2</sub>O plus CO<sub>2</sub> outputs and the decrease in <sup>2</sup>H is a measure for H<sub>2</sub>O output alone. Hence the CO<sub>2</sub> output can be obtained by the difference. This method, as used in small animals, has been validated with respirometry giving errors <10%, usually <5%.

The applicability of this method in humans has been limited for a long time by the cost to enrich the body water with the stable isotopes, especially with <sup>18</sup>O (as <sup>2</sup>H is not expensive). Now, with high resolution mass-spectrometers, we can afford these experiments by working with very low concentrations. Using this

method, energy expenditure in man has been measured over two-week intervals and differed from dietary intake plus change in body composition by an average of 2% (Schoeller, D.A. and E. van Santen, J., *Appl. Physiol.* 53 (1982) 955-959), compared to the method with direct measurements of CO<sub>2</sub> production over 24-hour intervals.

The CO<sub>2</sub> production in two subjects was measured simultaneously with double labelled water and respirometry in the respiration chambers of the Department of Animal Physiology in Wageningen. Both subjects were observed over 3 consecutive days including one or two days on a high activity level (19 MJ/day) and the remaining day(s) on a low activity level (11 MJ/day).

**ESTIMATING ENERGY EXPENDITURE: EXPERIENCES WITH THE ELBOS HEART RATE REGISTRATION SYSTEMS ON A RURAL POPULATION IN WEST-AFRICA**

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A pilot study has been carried out to evaluate the value of measuring heart frequency with the aim to estimate energy expenditure and to test the social acceptability and technical reliability of the ELBOS heart rate registration apparatuses (Heart rate integrator and Heart rate memory). About 130 24-hour registrations could be obtained (38 males and 25 females co-operated).

For analysis of the results a separate regression equation was used for each individual based on a work-test on the double-Master-step-test (females) or the LODE bicycle-ergometer (males). The following questions were dealt with:

- \* Social acceptability: the willingness to co-operate was high, many volunteered a second day.
- \* Electrode attachment: ten different electrodes were tested, the CONMED-adult electrodes proved to function satisfactorily. Only in about 10% electrodes were disconnected (most cases: women carrying children).
- \* Accuracy: both registration systems functioned almost perfectly even under the hard climatic conditions.

The data indicate a higher work level for