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Food-based Classification of Eating Episodes (FBCE)

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The concept for categorization of eating episodes in dietary surveys was originally developed in studies of shift workers to compare "meal patterns" between night and day work shifts. The concept has been further improved through experience from applications in dietary surveys in other populations. In this paper, results from categorization of eating episodes in shift workers, elderly women and men during life transition periods, elderly female leg ulcer patients and obese men and their lean controls are shown and discussed.

The categorization concept is based on seven food categories with food items of similar nutrient characteristics within each category. Each eating event is categorized as any of four types of "meals" or four types of "snacks" due to its combination of food categories. Thus, categorization is based on visible properties (food types) but at the same time reflecting invisible properties (nutrients). Criteria is also established to sub-categorize the "meal" types as being either "prepared" or "quick-prepared" from a behavioural perspective.

Use of a defined and reliable concept for categorization is necessary to study eating episodes in dietary surveys, their determinants and also consequences on health and performance. Nocturnal eating during the circadian nadir might affect nutritional status. Since increasingly western populations appear to be moving from regular and planned meals to more episodic eating "around the clock", such analyses are of increasing interest in a bio-social perspective.

Introduction

Despite the great number of dietary surveys in different populations, very little is published about human eating periodicity, e.g. the frequency of eating events of various food composition, the temporal distribution of eating events across the 24-h day, the role of eating events ("meals", "snacks") as major contributors of energy and nutrients, the relationship between timing or frequency of eating and nutritional status/health (Drummond *et al.*, 1996; Gatenby, 1997; Halberg, 1989; Lennernäs *et al.*, 1993a; Strubbe, 1997).

One reason for the lack of data may be that scientists themselves have not been interested in circadian variations of food intake and its effect on metabolism (Halberg,

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1989). Another explanation might be the lack of criteria for categorization of eating episodes and the lack of strategies such as data analysis. No one definition that has been universally accepted for categorization of eating events in the scientific lterature (Drummond *et al.*, 1996; Gatenby, 1997; Gibney & Wolever, 1997). Neither is there any consensus of rationale for categorization: should it be based on qualitative (types of food items consumed) or quantitative (estimated content of energy and nutrients) properties, should it reflect time of day ("morning meal") or reflect the "relative importance" of the meal within the daily menu (e.g. reported as "main meal" by subjects themselves)? (Lennernäs *et al.*, 1993a; Lennernäs *et al.*, 1993b).

Since Western populations increasingly appear to be moving away from regular, well-planned meals to more episodic eating of one hand food across the 24-h day, it is indeed time to extend data analysis in dietary surveys from reporting "mean 7-day nutrient intake" and "food frequencies" to also describe the organization of eating events, their determinants and consequences on nutritional status and performance.

From the discipline of chronotherapeutics could be learnt "no drug before its time" due to circadian variations in kinetic and therapeutic effects of drugs (Belanger, 1997; Smolensky & Labrecque, 1997). There are almost no corresponding studies, or recommendations, about irregular and nocturnal eating, nor does any scientifically based dietary guidelines exist for shift workers (Lennernäs *et al.*, 1993a; Lennernäs *et al.*, 1993b).

The lack of interest of, and methodology for, categorization and analysis of human eating episodes in the scientific literature was evident when we started to study the effect of work hours (day work, morning, afternoon, night and 12-h work shifts) on eating habits, nutritional status and well-being (Lennernäs *et al.*, 1993a; Lennernäs *et al.*, 1993b; Lennernäs *et al.*, 1994). In the absence of other alternatives, we developed a concept to categorize all eating events in a diet on the basis of visible properties (type of food item) but at the same time reflecting invisible properties (combination of food categories representing key nutrients). When data on consumed amounts are available, the mean nutrient content or mean nutrient density of each eating type can be calculated as well as the contribution to total intakes of nutrients from each type of "meal" or "snack".

The authors consider the categorization procedure as being "objective" since it is based on well-defined and described criteria which are easy to practise. The opposite, a "subjective" categorization is the case when, for example, eating events are categorized as "main meals", "morning meals", "between meals" etc. without use of criteria to guarantee reliability and also comparisons between studies.

Qualitative Categorization before Quantitative Calculations

As mentioned above, food-based classification of eating episodes (FBCE) is developed as a tool to categorize eating events also when data on consumed amounts are not necessary or even possible to collect. Use of the FBCE concept provides data on the frequency and temporal distribution of eating events representing different combinations of food categories, each of them representing key nutrients. Those who want to categorize eating events due to their "absolute" content of food items (e.g. grams of bread or tomatoes), nutrients (e.g. mg ascorbic acid) or energy has to do this as a statistical procedure by setting intervals, or cut-off values, to assign eating types after nutrient calculations. In our concept, we go the other way around: the mean content of energy and nutrients in the eating types are calculated after categorization.

Dietary Guidelines

Meals

The name of each type of "meal" type is chosen to reflect food composition relative to the "complete meal" which corresponds to dietary guidelines for not being vegetarians. Thus, each other "meal type" lacks a particular source of key nutrients when compared to the "complete meal".

Snacks

The name of each type of snack reflects high nutrient density foods or high energy density (meaning low nutrient density) foods or foods containing no energy (Tables 1–3).

In this short report, the principles of the FBCE concept are described together with results from applications in dietary surveys in 16 shift-workers (Lennernäs *et al.*, 1993a; Lennernäs *et al.*, 1993b), nine female leg ulcer patients (Wissing *et al.*, 1998), 20 elderly men and 25 women in a retrospective study (Sidenvall *et al.*, 1996), and finally in 23 obese men and their 33 lean controls (Andersson 1997).

Method

The FBCE is designed to be applied to dietary data (food items and time of day for consumption) collected by 24-h Recall, Food Diary or Dietary History methods (Gibson, 1990). The concept consists of two elements:

(1) Seven food categories (a–g) that differ from each other with respect to nutritional composition or "profile", see Table 1.
(2) Criteria for the categorization of eating episodes due to combinations of food categories, see Table 2.

Table 3 shows examples of food composition within the "nick-named" types of meals and snacks.

As seen in Table 1, the seven food categories include the universe of food items within a Western diet. Most of the food items within each food category have a certain combination of key nutrients in common. Still, exceptions from this similarity has to be tolerated, e.g. raw liver in food category a contain (a lot of) ascorbic acid in contrast to most other foods of animal origin. Furthermore, the content of ascorbic acid and beta carotenoids varies a lot between vegetables, fruits, berries and roots (food category c). Such variations are tolerated within, and between, food categories since it would be difficult to handle a concept for categorization of eating events based on criteria for amounts of certain nutrients per serving size or 100 gram food. Those who want to categorize eating events due to their "absolute" content of energy or nutrients have to do this as a statistical procedure after calculation of intakes. Still, the FBCE concept is qualitative and designed to reflect food purchase/combinations without considering amounts.

As seen in Table 2, the categorization is primarily food based (visible properties) reflecting food purchase behaviour: food items/beverages/ingredients consumed. Note: salt, pepper, herbs or spices do not affect classification.

TABLE 1
Food categories and their nutrient properties as the base for categorization of eating events

Category a	Animal origin	Meat and meat products, fish and shellfish, poultry, egg, milk and cheese	*High nutrient density*	Animal protein and fat, iron, zinc, calcium
Category b	Plant origin	Rice, pasta, bread, dried legumes, seeds, potatoes	*High nutrient density*	Starch, plant protein, dietary fibre
Category c	Plant origin	Green vegetables, fruit, berries, roots	*High nutrient density, low energy density*	Starch, carontenoids, ascorbic acid
Category d	Plant origin	Nuts, olives, avocado	*High fat density*	Plant fat, plant protein
Category e	Animal and plant origin	Cooking fat, spreads, cream, fatty sauces	*High fat density*	Fat
Category f	Plant origin	Products in which white sugar often is added, beverages containing alcohol, ice cream, sweets, chocolate, biscuits, sweet desserts	*Low nutrient density*	Sugar, fat, alcohol
Category g		Water, coffee, tea, unsweetened light beverages	*No energy*	No nutrients

TABLE 2
Criteria for the categorization of eating episodes due to the combination of food categories

	Meals	
a+b+c	CM	Complete meal
a+b	IM	Incomplete meal
a+c	LM	Less-balanced meal
b+c	VM	Vegetarian meal
	Snacks	
a or b or c	HS	High-quality snack
any of a or b or c and/or d and/or e and/or f	MS	Mixed-quality snack
e and/or f	LS	No quality snack
g	NS	No energy snack

TABLE 3
Examples of food composition in types of meals and snacks

CM	"Complete meals"	e.g. meat, potatoes or bread, carrots
IM	"Incomplete meals"	e.g. meat, potatoes or bread
LB	"Less balanced meals"	e.g. meat, carrots
VM	"Vegetarian meals"	e.g. potatoes or bread, carrots
HS	"High-quality snacks"	e.g. an apple
MS	"Mixed-quality snacks"	e.g. an apple and some chocolate
LS	"Low-quality snacks"	e.g. some chocolate
NE	"No energy snacks"	e.g. coca cola light

Classification Hierarchy

The "nutrient profile" is used, i.e. which and how many food categories that are represented/combined as parameters when we say that a "meal" has a higher level than a "snack". Thus, by definition a "meal" consists of more food categories of "high nutrient density" (food categories a–c, Table 1) than a snack. Consequently, if an eating event does not qualify as a "meal", it must correspond to any of the types of "snack" (Table 2).

A Meal With or Without a Dessert

The consumption of low nutrient density foods, e.g. a sweet dessert or alcohol consumption, does not affect categorization if the eating event once has qualified as any type of "meal". It is, of course, possible to "sub-categorize" eating events from this perspective. A "complete meal" including foods from the food categories "e" or "f" could be named CM/LQS or CM/ef or whatever the researcher prefers. However, it is not recommended that too many variables (eating types) are established since the statistical analysis might be less powerful due to a low frequency of certain eating types for many of the subjects.

"Nick-naming" the "Meals" and "Snacks"

The names selected for the "meals" and "snacks" in our concept are "nick-names" that we think reflect the nutrient profiles of eating types when compared to nutrient recommendations, and with the "complete meal" as the reference (Table 2 and Table 3). Consequently, "incomplete meals" are considered "incomplete" since they lack fruits, berries, roots and vegetables (potential sources for ascorbic acid and carotenoids) except for potatoes. Furthermore, "less balanced meals" lack starch (being the recommended source of energy). A "low-quality snack" reflects solely consumption of products containing white sugar and/or alcohol, sometimes in addition to a high-fat content (fat intake and intake of alcohol and sucrose should be restricted), see Tables 1–3.

Instead of using "nick-names", neutral names as "eating event type 1" etc. could have been used. The authors think, however, that use of the latter terminology would make it more difficult to interpret tables and results because it is difficult to remember and recognize the "nutrient profiles" of eating events when their name does not give you any clue.

Quick-prepared and Prepared Meals

To identify other behavioural aspects of an eating event than food purchase, a criteria has been suggested for sub-categorization of meals with respect to "level of preparation". Thus, a meal is considered as "quick-prepared" when the starch component (food category **b**) consists of breakfast cereals and bread. Meals including rice, potatoes, pasta, pizza-buttom or pie-shells are considered as "prepared", most of them require a knife and fork to eat. When sub-categorization is the case, a prepared meal is given the prefix "**p**" and quick-prepared "**q**". Snacks will never be sub-classified with respect to level of preparation.

The amount of preparation or the duration of cooking is not expected to have any effect on nutrient density or fat content. The sub-classification is just meant to distinguish between "sandwiches" and hot dogs with bread and "cooked" dishes.

Improvements of the Concept

Note that the classification system as described in this paper has been slightly modified since its first version.

Potatoes are a staple food in Sweden. Originally, potatoes had their own food category and the consumption of food from food category a + potatoes qualified to a "complete meal" (Lennernäs *et al.*, 1993a,b). This was criticized by The National Food Administration and other dietary investigators and has now been changed (Table 1, Table 2). Coffee/tea (without sugar, milk), water and light beverages are now classified as "no energy snack". Earlier, these beverages (except for water) belonged to the food category with products with sugar/alcohol added and were consequently considered as "low-quality snacks". The first version of the FBCE concept was applied to the studies by Lennernäs *et al.* (1993a,b) and Sidenvall *et al.* (1996). The modified version was applied to the studies of Wissing *et al.* (1997, 1998) and Andersson (1997). The modification affects primarily the content of ascorbic acid in "incomplete meals" that now may contain ascorbic acid (from potatoes). Furthermore, low-quality snacks probably have a higher mean content of energy in

the modified version of FBCE since intakes with no energy will no longer belong to this type of snack.

Results with Comments

Results from application of the FBCE in different studies and populations are shown in Tables 4 and 5.

Frequency of Eating Events, Types of Meals and Snacks

General aspects

As seen, the mean frequency of eating events per day varied between 3·6 (retired subjects) and 6·5 (shift workers), see Table 4. According to our concept for classification, "meals" were more frequently eaten than "snacks".

As to the types of meals, "less balanced meals" (lacking starch component) and "vegetarian meals" (lacking an animal component) were rarely consumed within these populations. Perhaps these meal types occur more frequently in young female subjects trying to control weight and, of course, in vegetarians.

Shift workers

The shift workers seemed to eat more "incomplete meals" than "complete meals" which means that they ate fewer meals *without* than with vegetables, fruits, berries and roots (Table 4). Data from sub-classification of the shift worker data (not shown here, Lennernäs *et al.*, 1993b) showed that a majority of the "complete meals" were "prepared" which means that potatoes, roots, pasta, rice, pie-shell or pizza-buttom was included. In contrast, the "incomplete meals" consisted of "sandwich meals" or yoghurt and breakfast cereals. As to the quantitative data, Table 5 shows that most energy was provided by the "complete meals". This means that the portion sizes of the more frequent "incomplete meals" was smaller.

Despite their low frequency, "high-quality snacks" contributed 20% of ascorbic acid which indicates that fruits often were purchased. As seen, "complete meals" contributed 71% of ascorbic acid and "incomplete meals" 1%. The lack of ascorbic acid in "incomplete meals" was of course expected since fruits, berries, roots and also potatoes were lacking (see Method section, "Improvements of the concept"). Another observation (not shown here) is that "low-quality snacks" contributed 39 ± 4% of total sucrose intake in shift workers. "Low-quality snacks" contributed 10% of total energy. Obviously, the shift workers should be recommended to make the "incomplete meals" "complete" by adding a carrot, fruit, fruit-juice or vegetables. They should also be recommended to eat fewer low-quality snacks and more high-quality snacks.

It was concluded that the "complete meal" and the "high-quality snack", respectively, was a good indicator of consumption of ascorbic acid, and that the "low-quality snack" was a good indicator of sucrose consumption in the shift worker study (Lennernäs *et al.*, 1993a). Such observations were seen for other nutrients, e.g. the "meals" contained and contributed more energy and essential nutrients than the "snacks" did, the "low-quality snack" had a higher energy content and a lower nutrient density than the "high-quality snack". Thus, the qualitative food based

TABLE 4

Results from application of food-based classification of eating events (FBCE)

Eating type	Lennernäs, 1993a,b 16 male shiftworkers	Sidenvall, 1996 25 female; 29 male elderly. $N=45$			Wissing, 1997 Nine female leg ulcer patients	Andersson, 1997	
		"Working" f/m	"Retirement" f/m	"Hospital" f/m		23 obese	33 lean
Complete meal	27	59; 33	48; 29	95; 51	26	29	27
Incomplete meal	31	56; 31	52; 32	26; 14	33	28	28
Vegetarian meal	0	0; 0	0; 0	0; 0	0	1	1
Less-balanced meal	0·002	0; 0	0; 0	0; 0	0·005	1	1
High-quality snack	9	6; 3	12; 7	19; 10	7	7	4
Mixed-quality snack	5	13; 7	14; 9	14; 7	14	9	9
Low-quality snack	27	46; 26	38; 23	33; 18	22	25	30
Mean eating events	6·5	4·0	3·6	5·2	4·8	5·7	6·0
Dietary assessment method, days per individual	5×24 h recall	"Qualitative" dietary history—not consumed amounts			7-day estimated food record	7×24 h recall	

Frequency of eating types as percentage of total eating events. Mean daily frequency of eating events. Dietary assessment method and number of observed days

TABLE 5

Results from food-based classification of eating events (FBCE) in dietary surveys. Contribution of energy and ascorbic acid from different eating types to total intakes

Eating type	Lennernäs, 1993 16 male shiftworkers	Wissing, 1998 Nine female leg ulcer patients	Andersson, 1997 56 males	
			23 obese	33 lean
Energy				
Complete meal	48	37	43	46
Incomplete meal	36	42	35	31
Vegetarian meal	0	0·2	1	1
Less-balanced meal	0	2	2	2
High-quality snack	2	1	2	1
Mixed-quality snack	4	6	7	7
Low-quality snack	10	11	10	12
Ascorbic acid				
Complete meal	71	71	Data lacking	
Incomplete meal	1	8		
Vegetarian meal	0	0		
Less-balanced meal	0	5		
High-quality meal	20	9		
Mixed-quality snack	3	6		
Low-quality snack	5	0·7		

classification reflected behaviour (food purchase) as well as the nutritional profiles of the eating events in this study.

Elderly men and women

Data on consumed amounts was not reported in eating episodes in elderly men and women during transition periods (Sidenvall *et al.*, 1996). This study was performed by nurses who had noticed that elderly in general had a poor nutritional status when they came to hospital. They wanted to study whether subjects' eating behaviour changed after retirement in terms of daily frequency of eating events and their "nutritional profile".

As seen in Table 4, the mean frequency of total eating events, "complete meals" and "low-quality snacks", respectively, decreased during retirement according to the subjects' self-report data in this retrospective study. At the same time, the frequency of "high-quality snacks" increased. According to shift worker data, and the results about energy content in types of "meals" and "snacks", this should indicate a decrease in energy intake after retirement. Still we do not know the energy content in the eating events since data on consumed amounts were not possible to collect by the nurses.

As expected, the frequency of mean total events increased during hospital stay, the "complete meals" becoming much more frequent than the "incomplete meals" when compared to home conditions during retirement. The frequency of "high-quality snacks" increased and the frequency of "low-quality snacks" decreased.

If FBCE concept has the capacity to detect dietary quality and the relative energy content in eating categories, these results indicate a change to a more nutritious diet and also more frequent eating episodes during a hospital stay than during retirement at home. Still, no data on consumed amounts were collected in this study.

TABLE 6
A comparison between tailored and food-based categorization of eating events

The tailored system	Food based classification of eating events
"Cooked meals"	Prepared complete meal, prepared incomplete meal, prepared less-balanced meal, prepared vegetarian meal
"Sandwich meals"	Quick-prepared complete meal, quick-prepared incomplete meal, quick-prepared vegetarian meal
"Snacks"	Mixed-quality snack, low-quality snack
"Breakfast-like meals"	Quick-prepared complete meal, quick-prepared incomplete meal, less-balanced meal, quick-prepared vegetarian meal
"Cocktail meals"	Mixed-quality snack, less-balanced meal, quick-prepared complete meal, quick-prepared incomplete meal, quick-prepared less-balanced meal, quick-prepared vegetarian meal
"Beverages"	Less-balanced meal, high-quality snack, mixed-quality snack, low-quality snack, no energy snack
"Fruits"	High-quality snack
"Extreme meals"	All types in food-based classification of eating events
Other intakes	All types in food-based classification of eating events

Data from Andersson, 1997

Female leg ulcer patients

For female leg ulcer patients, data was available on consumed amounts (Wissing *et al.*, 1997, 1998). The pattern of frequency of eating events and their contribution to total intake of energy and ascorbic acid is very similar to the shift worker data; the "incomplete meals" being more frequent than the "complete meals" and the "low-quality snacks" being more frequent than the "high-quality snacks" (Table 4). However, in this group the "incomplete meals" contributed more energy than the "complete meals". Perhaps those elderly women eat smaller portion sizes of "prepared meals" than shift workers do. Similar to the shift workers, "low-quality snacks" contributed 11% of total energy intake while 71% of ascorbic acid came from the "complete meals" (Table 5). The content of ascorbic acid in "incomplete meals" was higher than in shift workers (1 and 8%, respectively) probably due to potatoes that were not "permitted" in this meal type in the shift worker study (see Method section).

Obese men and their lean controls (Andersson, 1997)

Table 4 shows that the lean men reported a slightly higher mean frequency of eating events than the obese did, the frequency of "complete" and "incomplete" meals were about the same within, and between, groups, "low-quality snacks" were much more frequent than "high-quality snacks" in both groups. The "complete meals" contributed most energy in both groups as in the shift workers (Table 5). Furthermore, the contribution of energy from "low-quality snacks" was about the same as in shift workers and female leg ulcer patients.

Tailored or Food-based Classification

Finally, we want to illustrate that researchers' own terminology like "cooked meals", "sandwich meals", "snacks" etc. corresponds to eating types of various food combinations and probably "nutrient profiles". Table 6 shows the correspondence

between a tailored system for classification of eating events and the FBCE concept. At the Obesity unit of Karolinska Institute, Sweden, hundreds of patients have been monitored over a decade. It has been concluded that a combination of "perceptual" and "objective" methods are needed to achieve information about the eating events of obese subjects. The objective (FBCE) system is needed to get information about the food combinations (nutritional quality) while the tailored system seems closer an adaptation to the obese clienteles eating behaviour and thereby is of valuable interest. This is especially the case when dietary assessment is implemented in intervention projects like weight reduction programmes. Table 6 has been developed from a study of obese men and their lean controls (Andersson, 1997).

Taken together, the results from the reported studies indicate similarities in eating behaviour between groups with respect to the frequency of different "meals" and "snacks", and their contribution to total intake of energy and ascorbic acid. Still, the mean intakes of energy per subject varied between the studies; the shift workers reporting the highest and the leg ulcer patients reporting the lowest intakes.

The Swedish Nutrient Recommendations from the National Food Administration 1997 recommends two to three "main meals" and one to two "between meals" of good nutritional quality evenly distributed throughout the day. In this perspective, the prevalence of "low-quality snacks" (21–30% of eating events) seem to be too high and the prevalence of "high-quality snacks" too low (2–9%) in the reported studies. Furthermore, 13–33% of the eating events were "incomplete meals" lacking green vegetables/fruit/berries/roots which seems to be less optimal from a nutritional point of view.

Discussion

Until now we have developed, tested and improved the FBCE concept. As to the technical aspects, the categorization procedure is integrated in computer software and can be done as an application within a nutrient calculation system (Nordin, 1997) based on the Swedish Nutrient Database.

It is hoped that future dietary surveys will provide us with baseline data from different populations on the frequency and temporal position of the different types of "meals" and "snacks", their mean nutrient content, their mean nutrient density, the proportions between macro nutrients (E%) and also their relative contribution to total intakes. Such data should be used to validate the FBCE concept; i.e. to test if there are any relationships between these variables and the overall dietary quality. If this is the case, and if it is found that the eating categories differ from each other in the same way between studies with respect to energy size and nutrient quality, the FBCE can be used to predict the dietary quality in studies where data on consumed amounts are not collected. It would also be interesting to create contingency table analysis where a "tailored" or "subjective" categorization of eating events is compared with categorization in accordance with the FBCE concept (Table 6). Such analysis would reflect food and nutrient composition of what people themselves call "breakfast", "lunch", "snack", etc.

The authors believe that the categorization of eating events has a high reliability between studies when the categorization procedure is done manually also, since the instructions are easy to understand. However, this needs to be validated by letting

different researchers categorize the eating events within the same study and by comparing the results.

Even before validation studies as suggested above, the authors think that the FBCE concept is a good and useful tool when evaluating eating episodes in dietary surveys to get more data on how often and when we eat "prepared meals" and "quick-prepared meals" as well as the frequency and temporal position of eating categories that seems to be more or less healthy from a nutritional perspective. Today, the FBCE concept is developed to fit Swedish, and probably also Nordic, eating behaviour. Yet, it is not known if the food categories and criteria for eating categories suit eating manners, e.g. in Southern Europe. Ideas of improvement to the FBCE are welcomed and the authors invite other researchers to evaluate the FBCE concept.

It is of course of great interest to use the FBCE concept to study relationships between eating periodicity and nutritional status parameters. We think that more attention should be paid to chronometric (time of day, periodicity) aspects of eating in surveys, epidemiological and also experimental studies since life-style in the "24-h society" affects human circadian rhythms of food intake, sleep and metabolism (Halberg, 1989; Strubbe, 1994) which might lead to negative consequences on nutritional status and health.

Self-perceived effects of work hours on eating conditions is supported by data from a pan-European survey of Consumer Attitudes to Food, Nutrition and Health (Gibney *et al*., 1997). Interestingly, an average 24% of the EU population (range 12–41%) reported "irregular work hours" to be the major perceived barrier to healthy eating. (One-third of the working populations in western Europe have displaced work hours, about 10% of them having night work.)

The effects of work hours on diet and health are poorly investigated. Biological and social consequences of nocturnal and irregular eating are expected since human beings are diurnal (day active), and displaced work hours might undermine their (chrono-) biology (Lennernäs *et al.*, 1994). Such hypotheses are supported from the science of chronopharmacology; during the last 20 years, numerous studies have shown that the pharmacokinetic properties, therapeutic effects and toxicity of many drugs depend on the hour of the day they are administered in both animals and humans. Temporal variations in hepatic drug metabolism, gastric emptying, organ blood flow rate etc. may explain some of these variations (Bélanger, 1997; Smolensky & Labrecque, 1997). There is evidence to believe that such endogenous metabolic rhythm factors also affect the uptake and metabolism of nutrients. More work is needed on *when we eat* and *when to* eat.

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