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FOOD INTAKE IN UNIVERSITY STUDENTS AND ITS IMPACT ON NUTRITIONAL STATUS.

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ABSTRACT

The present study has assessed the composition of the food distributed by a University canteen (CORIS, Modena, Italy) analyzing the principal nutrients of both winter and summer menus for a period of one week. The analysis of the principal nutrients (carbohydrates,lipids and proteins) contained in the food was carried out by laboratory methods and by using a computerized data bank of food composition tables. The computerized data were compared with the laboratory data and both with LARN (italian RDA, recommended daily allowance) for a male (M) and female (F) student aged 18-29 years. In winter the energy intake exceeded LARN of a value comprised between 481 and 981 Kcal/day for M and between 981 to 1481 Kcal/day for F; in summer energy intake in M exceeded RDA of a value ranging from 387 to 887 Kcal/day, in F from 887 to 1387 Kcal/day. Proteins exceeded LARN of 25-40% in M and 40-50% in F in both periods. The lipid intake was unbalanced in both sexes being 10-20% in excess for M and 30-40% in excess for F in both periods. The daily complex carbohydrate intake was deficient for M (-25% of LARN), especially in summer, less deficient for F (-5% of LARN), these consuming also too much simple carbohydrates (+32% of LARN). The results of the computerized survey were fairly close to the laboratory data and proved that this form of control is sufficiently reliable.

Key Words: Food Intake, Nutritional Status

INTRODUCTION

In the course of this century industrial civilization, the civilization of steel, chemicals, nuclear energy and informatics processing, has not only profoundly changed the economic, social and cultural conditions of the countries in which it has been established, but has also delineated within the social context a new age of eating, so that we may justifiably speak of this age as "the era of community catering". In fact, not only we have the quality and quantity of

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the food we eat changed, but also the way in which we eat it. It is becoming increasingly necessary to eat outside the home, in one of the common forms of community catering, such as the canteen or cafeteria, frequented more particularly by the younger age groups (1). Our study has therefore been conducted at the Modena University canteen, analyzing the principal nutrients of the daily food intake (midday and evening) of the student sampled from the summer and winter menus for a week (2,3). Our experimental study had the following aims: to identify any deficiencies or excesses of nutrients in the student's daily food intake (DFI), to assess the compliance of the food supplied by a community catering service with correct dietary principles, to define how much the season (winter and summer) affects the quality and content of the principal nutrients in the dishes considered and to check the reliability of the data recorded in a computerized food history by comparing them with the laboratory analysis.

MATERIAL AND METHODS

The catering firm that handles the cafeteria service (CORIS-MO) provided us with a list of the dishes most frequently chosen by the students during a representative week, which did not differ from others in the quality, quantity or variety of the food served during the periods considered: winter and summer (Tables 1 and 2).

The firm also supplied the weights in grams of the individual constituents of every dish on the menu, which enabled us to identify and reconstruct the potential daily food intake (DFI) and to do an analysis both on a personal computer (PC) and in the laboratory. For the PC analysis of the principal nutrients in the DFI we used the Dietosystem (Milano, Italy) "Food Investigation" program, capable of furnishing 62 constituents. This program not only qualifies the potential energy value of the food considered, but permits an assessment of what for investigation was of special interest, namely, the animal and vegetable proteins, the saturated, monounsaturated and polyunsaturated fats, simple and complex carbohydrates.

For the laboratory analysis the various dishes (midday and evening meals) were sampled at the University cafeteria when the meals were served. The samples were placed in weighed glass containers (calibrated) to arrive at the gross weight of the sample on a balance (Sartorius model) accurate to the nearest gram. The midday samples were placed in a single container and kept at +4°C pending the arrival of the evening meal samples for reconstruction of the student's DFI and stored in a freezer (- 18°C) before analysis. Before homogenization and subsequent instrumental analysis the edible matter was determined in the laboratory to obtain the net weight, shown in the lists in the Tables I - II. The dry weight was determined on the day's sample after homogenization and mixing with quartz sand kept in an oven at 105°C for 7 hours. The analysis has been conducted at Chemical Laboratory Neotron (Vignola, Mo) and assessed: experimental calorie value (ECV) by means of a Mahler-Berthelot Kroecker bomb calorimeter, total protein (TP) by the method of Kijeldal, total carbohydrates (TC) by the method of Fehling and UV enzymatic method (Mannheim-Boehringer),total lipids (TL) by acid hydrolysis of the dried sample followed by hot ether extraction in a round-bottomed volumetric flask in a Soxhlet extractor for 8 consecutive hours (4).The computerized food data were compared with those recorded in the laboratory and both with the recommended daily energy and nutrient intake for the Italian population(LARN: italian RDA, recommended daily allowance) (5,6). This comparison was made using the RDA for a male and female student aged 18-29 years with an average expenditure of energy. In both cases the reference standard envisaged subjects of average height and weight. Classing students' work as light, we arrive at a reduction of the RDA energy requirement of less than 15% for males (M) and of less than 5% for females (F) (Table 3). Drinks available in the cafeteria, breakfast and snacks were excluded from the investigation. The statistical analysis was carried out with the paired Student test and Dunnet test multiple comparison.

Table 1

Winter Weekly Menu

Midday Meal	Weight (g)	Evening Meal	Weight (g)
Monday			
Minestrone	343.33	Pasta with tomato sauce	377.8
Roast Chicken	216.68	Buffalo cheese	133.48
Green Salad and tomatoes	116.99	Cauliflower au gratin	146.72
Apple	150.23	Orange	141.20
Wholemeal bread	71.85	Bread	72.43
Tuesday			
Pasta with butter	200.66	Pasta with tomato and chili sauce	331.66
Paillard	79.83	French fries	102.6
Carrots	80.45	Pear	261.99
2 Tangerines	166.78	Bel Paese cheese	126.78
Bread	69.16	Bread	73.60
Oil	10.6		
Wednesday			
Cabbage and sauce risotto	325.10	Broth with egg and pasta	285.82
Meat & cheese pasty	141.88	Cutlet of flat fish	120.25
Boiled potatoes	181	Green salad	60.24
Orange	173.05	Apple	194.52
French bread	75.99	Oil	10.42
Thursday			
Gnocchi with tomato	239.61	Rice and chickpeas	222.14
Vegetable omelette	120.50	Rissoles of cream of mushrooms	205.20

Carrots	143.2	Tomatoes-Red chicory	99.18
Fruit salad	135.16	William pear	263.48
Wholemeal bread	71.60	Special bread	66.71
Sunflower oil	7.76		
Friday			
Polenta with meat sauce	569.28	Celery with ham	264.14
Cured pig's neck	71.79	Calves' liver cooked in butter with cream	120.53
Fresh pineapple	238.94		
French bread	71.75	Wholemeal bread	73.42
Oil	4.78	Orange	141.63
Saturday			
Pasta with meat sauce	292.08	Pasta and haricot beans	385.28
Breast of turkey with mushrooms	152.84	Fillet of sole	78.50
Baked beetroot	152.70	Boiled potatoes with parsley	154.15
Golden apple	183.58	William pear	244.15
French bread	73.55	Wholemeal bread	67

Table 2

Summer Weekly Menu

Midday Meal	Weight (g)	Evening Meal	Weight (g)
Monday			
Noodles with courgettes and parsley	314.6	Minestrone	390.29
Mixed vegetables and cheese	322.14	Grilled breast of chicken	116.82
French beans in oil	146.65		
Lemon cake	59.94	Apricots	165.00
Wholemeal bread	90.00	French bread	90.00
Oil	5.66	Oil	5.82
Salt	0.22	Salt	0.32

Tuesday

Thin noodles with olives	234.40	Rice minestrone	204.20
Octopuses and peas	244.63	Spring omelette	125.20
Boiled potatoes with parsley	134.44	Corn on the cob with oil and parsley	127.27
Cherries	137.04	Water-melon	158.64
French bread	90.00	Wholemeal bread	91.34
Oil	5.42	Oil	4.97
Salt	0.23	Salt	0.27

Wednesday

Noodles Old Modena style	215.21	Cream of mushrooms with croutons	195.52
Courgette souffle	203.27	Roast-beef	69.47
Peach	114.28	Fruit salad	149.87
Organic bread	90.71	Wholemeal bread	89.58
Oil	3.26	Oil	8.71
Salt	0.10	Salt	0.18

Thursday

Pasta with gorgonzola	258.77	Egg pasta in broth	302.80
Mixed vegetables with tuna	321.74	Grilled horse steak	103.95
Onions in sweetened vinegar	168.10	Vegetable dip (oil + lemon + salt + pepper)	196.50
Pineapple cake	102.49	Apricots	144.11
French bread	88.34	Organic bread	89.66
Oil	6.15	Oil	9.47
Salt	0.18	Salt	0.24

Friday

Spaghetti with fish sauce	329.13	Vegetable soup	340.40
Baked fish	123.91	Pizza Margherita	226.70
Green salad and tomato	121.43	Spinach with butter	124.19
Plums	118.93	Fruit salad	151.64
French bread	89.07	Wholemeal bread	94.48
Oil	4.94		
Salt	0.23		

Saturday

Macaroni with ham and peas	253.31	Pasta with basil	235.75
Mixed sheep's milk	107.65	Mixed vegetables with wurstel	272.16
Boiled beetroot	140.65		
Cherries	129.83	Water-melon	322.31
Organic bread	95.05	Wholemeal bread	96.29
Oil	10.03		
Salt	0.23	Salt	0.17

Table 3

Recommended daily energy and nutrient requirement (RDA) for men and women aged 18-29 years (light work)

	Energy (Kcal/day)	Proteins (g/day)	Lipids (g/day)	Glucides (g/day)
Males	2543	65	72	241
Females	2043	51	57	332

RESULTS

Daily Energy Requirement (DER)

During the winter the daily energy requirement (DER) observed for the female student was 481 Kcal over the RDA value and for the male slightly under - 19 Kcal/day there was a difference of only 70 Kcal between the calorie value of the computerized study (2454 Kcal) and the laboratory study (2524 Kcal). In summer the daily energy intake was reduced to 2430 Kcal/day, the female student still having an excess, though less marked, of + 387 Kcal/day, while the male student showed a more marked deficiency than in winter, of - 113 Kcal/day.

We must remember that our investigation excluded breakfast, snacks and drinks, the average calorie value of which in Italy is between 500 and 1000 Kcal/day. It is therefore clear that for both periods considered and for both sexes this extra calorie intake, ranging from 500 Kcal (minimum) to 1000 (maximum) is in addition to the daily value. Thus the excess intake over the DER for a male student might range from 481 Kcal to 981 Kcal in winter and from 387 to 887 Kcal in summer and for a female student from 981 Kcal to 1481 Kcal in winter and from 887 to 1387 Kcal/day in summer.

Daily Protein Requirement (DPR)

The recommended RDA value is 65 g for M and 51 g for F, corresponding to 10% of the total DER. The mean daily protein value, supplied by the laboratory, in winter was borderline acceptable for both sexes with an excess of + 42 g/day for M and + 56 g for F. Further, the breakdown of the two protein fractions supplied by the PC was unbalanced with an excess of animal over vegetable protein, so that their ratio A/V was never under 1, 5. The mean laboratory value in summer reveals a daily protein intake much closer to the RDA value of 87 g/day in both sexes, with an excess for the female student of + 36 g/day and for male of + 22 g/day, anyway lower than the winter values. The most interesting point is the more balanced breakdown between animal and vegetable protein, the A/V ratio being close to 1 (7).

Daily Lipid Requirement (DLR)

The fat intake recommended by RDA is 25% of the DER, ie 72 g for the male and 57 g for the female student. The value in the laboratory on the winter sample was 80 g/day in total lipids, with an excess of + 8 g/day in M and + 23 g/day in F. The breakdown into the three classes of fats present in the daily food intake was balanced. The last datum was obtained from the computer analysis. In summer too the average daily lipid intake exceeded the recommended limit, it was of 93 g/day, with an excess of + 21 g for M and + 36 g for F.

Daily Carbohydrate Requirement (DCR)

The total daily carbohydrate requirement indicated by RDA is 421 g for M and 332 for F, equivalent to 65% of the total daily Kcal requirement of the population under study. The recommendation specifies that 85% of total carbohydrates should be in complex and 15% in simple carbohydrates. In winter our investigation found an average carbohydrate deficiency of - 88 g/day for M and within the recommended limit for F. The breakdown into carbohydrate subclasses showed a deficiency of the complex variety of - 91 g/day in M and of - 15 g/day in F and an excess of simple carbohydrates of + 3 g/day in M and of + 16 g/day in F. In summer the total carbohydrate intake was more deficient, the laboratory value being 289 g/day and so the deficiency became - 132 g/day for M and a small deficiency emerged for F, - 43 g/day. The breakdown between complex and simple carbohydrates in summer shown by the computer analysis did not differ significantly from the winter findings.

DISCUSSION AND CONCLUSIONS

An evaluation of nutritional status requires an accurate estimate of the qualitative and quantitative dietary intake of nutrients. Indeed, if the food consumed by an individual or population in a set time-span are identified and the calorie value determined, it is possible by dietetic analysis to point out any nutritional errors and so formulate a balanced diet both for preventive purposes and for the dietological treatment of nutritional disease (8,9). For such an evaluation to be correctly interpreted, some basic problems have to be addressed. The first of these is to find a satisfactory instrument for measuring the habitual food intake of the individual and/ or population. None of the available methods for surveying eating habits is free from limitation or error. There are methods of recording from memory, either by interview or questionnaire, which are easy to carry out but, just because they are based solely on memory, are not very reliable. Then there are methods of recording by measurement in which all the food eaten in a given period of time are weighed and recorded in a special booklet (10,11). This is the more reliable approach and the one we used for assessing the actual daily food intake of the students. The second problem is the time factor: how long should a study be conducted for an accurate estimate of the food intake? We have followed the indication of Acheson and of other authors, who take a week as the most practical basis. After comparing periods of one to four weeks, they found that the food intake did not vary significantly and so concluded that the information yield of a period longer than a week is not significantly greater (2). Then there is the problem of type of analysis for identifying the individual nutrient fractions in the daily food intake. We conducted two analysis: chemical analysis in the laboratory and an analysis using a data bank based on nutrient breakdown tables (12-16). Our study showed that a computerized food analysis may be considered an acceptable means for defining the correct nutritional intake in man and that, given the low cost, it is useful as an a priori guideline before undertaking the more laborious and costly laboratory food analysis. On the evidence of our experimental findings, summarized in Table 4 for winter and Table 5 for summer, we may fulfil the other objectives we set ourselves: evaluation of any nutrient deficiencies or excesses in the student's DFI in summer and winter.

Table 4

Analysis of the daily food intake of the winter period*

		Energy (Kcal/day)	Proteins (g/day)	Lipids (g/day)	Glucides (g/day)
Males					
	RDA	2543	65	72	421 C 358 S 63
	Laboratory	2454	100 A 61 V39	88 M 30 P 30	316 C 248 S 68
	Difference	-19	+42	+8	-88
Females					
	RDA	2043	51	57	322 C 358 S 63
	Laboratory	2524	107	80	333
	Computer	2454	100 A 61 V 39	88 M 30 P 30 S 28	316 C 358 S 63
	Difference	+ 481	+56	+23	+1

*The relative excesses (+) or differences (-) have been assessed comparing the laboratory value with the RDA value (A = animal protein, V= vegetal protein, M = monounsaturated lipid, P = polyunsaturated lipid, C = complex carbohydrate, S = simple carbohydrate).

Table 5

Analysis of the daily food intake of the summer period*

	Energy (Kcal/day)	Proteins (g/day)	Lipids (g/day)	Glucides (g/day)
Males				
RDA	2543	65	72	421 C 358 S 63
Laboratory	2430	87	93	289
Computer	2470	85 A 42 V 41	96 M 37 P 30 S 29	334 C 264 S 70
Difference	-113	+22	+21	-132
Females				
RDA	2043	51	57	332 C 358 S 63
Laboratory	2430	87	93	289
Computer	2470	83 A 42 V 41	96 M 37 P 30 S 29	334 C 264 S 70
Difference	+ 387	+ 36	+ 36	+ 43

*The relative excesses (+) or differences (-) have been assessed comparing the laboratory value with the RDA value (A = animal protein, V= vegetal protein, M = monounsaturated lipid, P = polyunsaturated lipid, C = complex carbohydrate, S = simple carbohydrate).

One of the most striking errors found in the students' diet is the high calorie content, especially in F. This extra intake exceeds the daily energy expenditure, resulting in an unacceptable positive balance. Taking the nutrients singly, we found the greatest imbalance in proteins with an excess intake of 25-40% for M and 40-50% for F during both periods considered. The excess protein is thus on the borderline of acceptability. In quantitative terms, animal protein greatly exceeded vegetable protein, especially in winter, covering the whole of the daily protein requirement with consequent imbalance in the ratio A/V. In summer the ratio is more correct, undoubtedly because the menu contains less in the way of sausages and meat.

It should be remembered that an unduly high intake of animal protein means an equally high contribution of "hidden" fat, present in meat, delicatessen products etc. (17).

Our findings show also nutritional errors in fat and carbohydrate intake in the student diet. The lipid intake, although balanced in respect of the three classes, monounsaturated, poliunsatured and saturated, is unbalanced as a whole, being 10-20% in excess for M and 30-40% in excess for F in both periods (Tables I - II). This is probably the most important and significant error in the student diet. In fact, it accounts for the richness of the diet, with which a high calorie content is correlated. The daily carbohydrate intake is deficient for M, especially in summer, less so for F. There is, however, a difference in breakdown between the two classes of carbohydrates with M consuming too little of the complex variety - 25% and slightly too much of simple carbohydrates + 5% and F consuming about the right quantity - 5% of complex carbohydrates but too much + 32% in the way of simple carbohydrates. After this analysis of the various nutrients taken daily by the student, one would need to add the nutrients contained in breakfast and snacks plus the energy contribution of alcoholic drinks. The upshot is that the real food intake of both male and female students is certainly higher, because there is an additional intake of carbohydrates, especially simple, proteins and lipids (18).

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