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Symposium on 'The challenge of translating nutrition research into public health nutrition'

Session 1: Public health nutrition
Nutrition and social disadvantage in Ireland

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There is now considerable evidence from several data sources, including the National Surveys of Lifestyles, Attitudes and Nutrition, that dietary patterns vary according to social position in the Republic of Ireland and those individuals in situations of social disadvantage experience barriers to consuming a healthy diet according to recommended guidelines. Obesity is a major impending public health problem related in part to social position that requires concerted inter-sectoral policy action. The Life-ways Cross-generation Cohort Study of >1000 Irish families has been followed prospectively since antenatal recruitment in 2001. Published findings to date indicate considerable social variability in food consumption and BMI patterns during pregnancy in the case of the maternal cohort. The present paper reports nutrient intake across the four family cohorts related to a key variable of interest, means-tested General Medical Services eligibility.

Life-course: Nutrients: Pregnancy

The extent to which inequalities in health status are mediated through nutritional pathways in individuals and across population groups has received extensive attention in recent years[1]. It is well established in the international literature that such health inequalities exist across different socio-demographic groups, and Ireland exhibits a similar variability[2,3], with a pattern that stretches back decades[4,5]. The concentration on escalating obesity trends in particular has generated considerable discussion as it becomes apparent that social position relates to likelihood of becoming obese[6,7]. The World Health Organization has highlighted the global scale of food poverty, which sees some individuals still deprived of basic foods and nutrients and others with more than adequate energy supplies but from energy-dense relatively-nutrient-poor sources[6].

As to why some individuals are at more health disadvantage than others is controversial. Most immediate proximal explanations are differences in lifestyle. Disadvantaged individuals consume qualitatively-less-adequate foods, are more likely to smoke and on average, particularly middle-aged and older individuals, take less exercise[2,3]. However, it is not as simple as individual-level choice. The health promotion literature indicates that health-related decisions are highly contextual and influenced by a variety of factors, both in the immediate environment and associated with consequences of public policy. This position is most clearly demonstrated in relation to food choices[7]. The present paper will address the question of nutrition and disadvantage in the contemporary Republic of Ireland, highlighting the context in that country but also with wider application to the health inequalities literature. It is presented in four sections. First, there is an overview of the context of disadvantage in Ireland, followed by a summary of recent social trends in eating patterns in Ireland, with particular reference to obesity. The third section will address the concept of

Abbreviations: GMS, General Medical Services; SLAN, National Survey of Lifestyles, Attitudes and Nutrition.
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nutrition across the life-course as a preamble to the final section, which reports on the Life-ways Cross-generation Cohort Study and its findings.

Context of disadvantage in Ireland

Ireland, North and South, has experienced enormous social change over the last two decades, particularly the Republic of Ireland, which went from an economic position of great disadvantage and decades of net emigration to a boom period of wealth generation so that it is now the 10th richest country in the world, as measured by income *per capita*[8,9]. Nonetheless, it still has not demonstrated the level of health gain commensurate with that prosperity, so that life expectancy is 78.9 years, ranking 29th in the UN comparison database[8]. The pattern of urbanisation that has developed has seen net immigration but still considerable inequality, so that the gap between richest and poorest remains amongst the widest in Europe[9].

A review for the Combat Poverty Agency in 2004 has summarised the available data on food and dietary patterns in the Republic of Ireland[10]. The focus was particularly on affordability, access and choice, and it was concluded that achieving a healthy diet posed a major challenge to those living in poverty for a variety of logistical, practical and financial reasons. Access to good quality, reasonably priced and nutritious food is a real issue for many low-income families. This situation results in household purchasing patterns with a concentration on high-energy basically palatable foods but a lower intake of commodities such as fruits and vegetables, so that the poor eat qualitatively less well. They also spend relatively more of their weekly income on food. At the time of the review a two-parent two-child family on the lowest income band spent 40% weekly on food, compared with 17% similarly spent in the highest income group. Such a gradient has long existed. Indeed, it has also been shown, using data from Ireland's Household Budget Surveys from 1951 to 1994, that whilst food expenditure:total expenditure has fallen there is a persistent class gradient to this pattern and the percentage expenditure on fresh fruit is highest in the highest social groups[5]. Other indicators of food poverty are included as part of the Health Behaviour in School-aged Children international survey, most notably children who go to bed or to school hungry. A rate of 16% of children who report such food poverty has been documented and it is associated with poorer diet generally, and more frequent mental and somatic symptoms, poorer self-rated health and lower life satisfaction[11]. Notably in that analysis it was found that the pattern is not confined to the most disadvantaged and stretches across social classes. Modern family eating patterns are altering profoundly and affect everyone.

Recent trends in eating patterns in Ireland

The health and lifestyle patterns of the Irish population have been recorded through the National Survey of Lifestyles, Attitudes and Nutrition (SLAN) on three occasions since 1998[2–4,12]. These surveys have consistently shown social gradients at the level of recommended intakes of the various shelves of the Food Pyramid, Ireland's public education tool on food and nutrition[13]. The most recent SLAN survey in 2007 shows a steep inverse class gradient for fried-food consumption and a persisting positive gradient for fruit and vegetable consumption[12]. Over the period since 1998 cereal, bread and potato consumption has been declining in both men and women and fruit and vegetable consumption is increasing. There has been no notable shift in the percentage of the population consuming the top-shelf high-salt and high-sugar commodities, with only 14% overall achieving the recommended amount. The demographic picture is consistent with secular trends away from the traditional diet for everyone and the least affluent having the most difficulty in achieving the recommended guidelines.

There are also continuing upwards trends in both self-reported overweight and obesity in both genders. Estimates from SLAN 2002 suggest that one-third of overweight and of obese individuals mis-classify themselves downwards[14]. The consensus nonetheless (corroborating the findings of various examination databases) is a shift across the distribution of BMI in the population, which means more overweight as well as obese individuals. The consequence is a major increase in morbidity from particular conditions, with increased rates of diabetes likely. It is also probable that the secular declines in CVD may be reversed as the shift upwards in BMI occurs. These patterns are related both to education and social class in Ireland, as elsewhere.

A logistic model of self-reported obesity (BMI >30 kg/m^2) based on the SLAN 2002 dataset[15] indicates that lower or primary school level of educational attainment (OR 2·50, $P<0·001$), not having a physically-active job (OR 1·54, $P<0·001$), higher fried-food consumption (OR 1·43, $P=0·004$) and failure to meet the cereal, breads and potato recommendations (OR 1·29, $P=0·049$) or the fruit and vegetable recommendations (OR 1·49, $P=0·002$) each remain independently predictive. Conversely, those individuals undertaking regular light housework (OR 0·53, $P<0·0001$) and meeting the dairy-shelf recommendations (OR 0·69, $P=0·01$) are less likely to do so.

The 2005 National Taskforce on Obesity report sets out a wide-ranging framework for action on obesity that deals with the environmental and social determinants and recommends a high level inter-sectoral strategy to tackle the growing problem[7]. To date the strategy has not been implemented fully. The country's Health Service Executive has undertaken various initiatives but a definitive implementation plan has not been realised by the Irish Government. This trend is not easily reversed and what is certain is that continued inaction will lead to continued upwards trends in BMI. A key scientific question is at what point in the life-course dietary habits influence outcomes such as obesity.

Nutrition across the life-course

The importance of early-life influences on later-life growth and development was re-invigorated by the retrospective

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cohort study work in Hertfordshire undertaken in the mid 1990s[16]. This work has established that growth *in utero* and in the first year of life remains independently predictive of adult health outcomes, even when later lifestyle factors are taken into account. This work in turn has generated considerable discussion on the underlying mechanistic factors at play. A critical early-life experience model was favoured, which suggests that second and third trimester growth patterns programme patho-physiological patterns contributing ultimately to clinical outcomes such as hypertension, CHD and diabetes in adulthood. A large volume of literature has corroborated the empirical observation that early-life development is important to adult health outcomes, whether it works at a critical period in purely patho-physiological terms or is associated with, for instance, a cumulative series of life exposures leading to an ultimate health outcome, or is a trigger for a particular life trajectory[17–22]. The retrospective cohort studies have the considerable advantage that major contemporary health outcomes can be related to past exposures. They can suffer, however, from the quality of available risk factor or exposure data from the past as the understanding of the bio-psycho-social nature of risk becomes more apparent. Health behaviours, for instance, may be a function of social forces that drive particular choices but at a mechanistic level may cause particular patho-physiological outcomes.

Appropriate biomarkers need to be identified to explain such final common pathways for risk, and increasingly the genetic and epigenetic pathways, particularly at nutrient level, must be explored. Risk has to be understood not only for the individual but also across generations, as patterns in early childhood may be associated with parental influences and may be both social and biological, or a combination of each factor[17]. In developed countries in which energy intake is adequate, micronutrients may be relatively deficient. Focus on pregnancy traditionally has been on the immediate proximal outcome of birth weight, but given the current understanding of life-course risk the question becomes more pressing. What is its relevance for the relationship between nutrition and disadvantage? If some of the relationship can be explained at a mechanistic level at different time points across the life-course, this information both serves to clarify current understanding but also may have policy implications for the timing and content of interventions.

Several recent studies have addressed the critical timing during pregnancy and early life that might predict obesity in childhood[23–26]. It is well established that the mother's BMI predicts her infant's birth-weight. Retrospective cohort data from the 1959–1972 Collaborative Perinatal Project suggests that the odds of overweight in offspring at age 7 years increases by 3% for every kilogram gestational weight gain[23]. It has also been suggested that obese mothers can give birth to normal-weight babies who later develop obesity and insulin resistance[24]. A Danish-based cohort study of >0·25 million children has revealed a clear relationship between birth-weight category and overweight in early childhood and suggests that the environmental influences operating in the early postnatal period must be critical to the obesity epidemic[25]. The timing of the adiposity rebound in early childhood is also likely to be highly relevant to tracking patterns during childhood[18]. It is suggested also that other conditions that are increasing in Western societies, including childhood asthma, may be related to the early childhood environment and merit further investigation.

The Life-ways Cross-generation Cohort Study

During the Millennium period a number of birth cohort studies were established in several countries, with varying specific objectives but with the generally shared aim of exploring with the most-up-to-date methodology how influences across the life-course affect longer-term health and well-being. The Life-ways Cross-generation Cohort Study was established in 2000 as part of the Health Research Board-funded Unit for Health Status and Health Gain[27–32]. The recruitment procedure has already been described and, as with the SLAN surveys, it uses the validated semi-quantitative FFQ designed to measure dietary intake[27]. The objectives were to determine the inter-relationship between health status, diet and lifestyle in a cohort of Irish mothers and their children, to establish any patterns across generations, to document primary healthcare utilisations across the social spectrum and to examine how indicators of social position, particularly means-tested General Medical Services (GMS) eligibility, influence health status during the first year of life. In Ireland comprehensive healthcare eligibility is robustly means tested and such eligibility has been shown to be a strong proxy indicator of general disadvantage.

Initially, 1124 mothers were recruited through two maternity hospitals in the East and West of Ireland, with 1094 babies later born, including twelve sets of twins. One-third of fathers and at least one available grandparent also agreed to take part. The data structure for the study included clinical hospital records, self-reported questionnaires at baseline and immunisation records. At 3-year follow up general practitioner records were examined for major end-points including asthma and health service utilisation patterns were recorded. During 2007–8 families were again followed up when the children had reached an average age of 5 years and examination data of height and weight for children and their mothers were obtained.

The participating mothers have been profiled in some detail[28–30], with two-thirds being from the east of the country, 64% married and 24% below the 60% poverty line, defined by the Combat Poverty Agency[33]. It was found that mother's self-rated health during pregnancy is related not only to her own social position, but to that of her parents. The mother's BMI is also related to both her age and social position and to the grandmother's reported BMI. Compliance with the healthy eating guidelines during early pregnancy was found to be variable, with most (76%) participants succeeding with those recommendations for fruits and vegetables, although this compliance in turn was shown to be highly related to a number of aspects of social position, mothers from more disadvantaged situations being less successful. Folic acid consumption was generally found to fall below the recommendations (based on

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Table 1. Daily macronutrient intakes of mothers, fathers, grandmothers and grandfathers participating in the Life-ways Cross-Generation Cohort Study according to General Medical Services (GMS) eligibility*

GMS status (yes or no)		*n*	Energy (kJ)	Protein (g)	Fat (g)	CHO (g)	– OL (ml)	MUFA (g)	PUFA (g)	SFA (g)	Chol (mg)	TS (g)	Starch (g)	Fibre (g)
Mothers		1112												
Yes	Mean	199	11 790	121	120	331	0·8	38·5	17·8	48·0	384	154	174	26·9
	SD		7813	119	87·4	193	1·7	30·0	14·6	36·5	337	97·2	115	19·8
	Median		10 379	104	100	306	0·0	32·8	14·6	40·3	336	142	160	23·9
No	Mean	913	10 648	108	101	315	1·8	32·4	16·0	39·7	333	147	166	27·3
	SD		6008	86·7	74·8	142	9·1	23·2	11·7	29·5	315	76·2	85·3	12·1
	Median		9787	98·6	89·5	294	0·0	28·5	13·7	34·2	292	136	150	25·9
Fathers		329												
Yes	Mean	15	10 908	110	120	279	4·6	39·2	13·8	50·2	375	120	156	21·1
	SD		5045	39·1	58·2	145	7·1	18·4	6·7	27·5	146	86·1	82·8	10·7
	Median		9492	110	116	272	1·4	36·5	14·4	52·7	363	112	142	21·2
No	Mean	314	10 828	109	110	293	8·6	37·3	15·4	43·0	344	134	157	22·0
	SD		4115	39·8	50·0	114	13·4	17·7	10·0	21·5	150	65·3	65·3	9·9
	Median		10 372	103	101	274	5·2	34·9	13·7	38·1	315	124	143	20·6
Grandmothers		441												
Yes	Mean	191	9188	96·7	90·3	257	3·9	29·2	13·5	33·5	328	116	139	20·6
	SD		6302	56·0	67·3	193	14·1	23·9	11·7	26·8	306	117	95·5	11·7
	Median		7946	88·0	77·0	229	0·0	24·5	10·6	28·4	295	98·8	119	17·3
No	Mean	250	9172	101	85·3	260	5·0	27·6	13·5	30·3	310	116	143	23·0
	SD		5793	70·2	70·3	149	15·6	24·6	12·0	26·0	309	72·2	95·7	13·0
	Median		8174	90·5	72·6	236	1·6	22·9	11·2	24·8	263	99·1	121	20·5
Grandfathers		257												
Yes	Mean	105	12 019	126	135	297	6·1	45·5	28·6	43·7	377	144	152	24·4
	SD		6050	63·3	69·5	165	10·4	23·0	12·8	26·9	249	93·3	93·8	13·0
	Median		11 116	118	128	285	1·6	43·9	28·2	38·5	341	123	133	22·2
No	Mean	152	12 484	125	134	321	10·6	45·0	27·6	42·7	389	15	166	26·5
	SD		6362	53·1	71·4	188	23·3	24·2	13·5	25·3	260	109	113	16·4
	Median		11 518	114	124	280	4·7	42·3	26·9	36·1	326	126	133	22·2

– OL, alcohol; Chol, cholesterol; TS, total sugars.
*For details of study, see text.

the health promotion campaign 'Folic acid, one of life's essentials' of 400 µg daily as well as consumption of a folate-rich diet; see Ward *et al.*[34]) and to be highly associated with social class.

Longitudinal follow-up at birth indicates that well-established maternal factors predict her infant's birth-weight, including her age, smoking status, GMS eligibility, marital status and BMI[30]. An analysis of predictors of general practitioner-diagnosed asthma by the age of 3 years was also conducted[31,32]. The children from families with GMS-eligibility cards were found to have a higher prevalence of asthma (19 %) than those without GMS eligibility (9 %). In a multi-variate analysis controlling for socio-economic factors that were all influential of this outcome, mothers in the highest quintile of fruit and vegetable consumption and of oily fish consumption as recorded at initial recruitment were shown to be less likely to have children with recorded asthma by the age of 3 years. Conversely, those mothers with a higher intake of added spreadable fats were found to have a higher probability of having children with reported asthma. These findings are supportive of a number of recently-published studies that relate various micronutrients with antioxidant properties to rates of asthma, suggesting a biologically-coherent pathway that merits further investigation[35].

Nutrient intakes in the Life-ways Cross-generation Cohort Study

Detailed nutrient intakes categorised according to GMS eligibility, are reported in Tables 1 (macronutrients) and 2 (micronutrients) for 1112 mothers, 329 fathers, 257 grandfathers and 441 grandmothers who completed the semi-quantitative FFQ at recruitment to the study. There are some similar trends across all four family-member cohorts. For instance, reported mean alcohol intake is higher in the male cohorts than in the female cohorts and lowest in the maternal cohort, of whom half consumed no alcohol at all. Mean alcohol intake is higher in the non-GMS groups in all four cases. There is a trend towards higher total fat intake and of subcategories of fat intakes amongst mothers, fathers and grandmothers, although not in the grandfathers, for whom there is no difference according to GMS status but absolute fat intakes are the highest.

In order to test the proposition that there is a significant difference between GMS-eligible and non-GMS-eligible respondents a formal statistical comparison was undertaken for three variables, total energy intake, vitamin C and total fat intake for all four cohort groups. The multivariate ANOVA test of difference between groups in overall

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Table 2. Daily micronutrient intakes of mothers, fathers, grandmothers and grandfathers participating in Life-ways Cross-Generation Cohort Study according to General Medical Services (GMS) eligibility*

GMS status (yes or no)		*n*	Retinol (μg)	Carotene (μg)	Retinol eq (μg)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Vit B_6 (mg)	Vit B_{12} (μg)	Folate (μg)	Vit C (mg)
Mothers		1112										
Yes	Mean	199	641	2417	1009	2·2	2·5	27·1	3·5	7·1	377	164
	SD		52	1599	637	1·5	1·7	24·7	2·7	8·3	225	132
	Median		46	2114	840	2·0	2·1	23·3	3·1	6·0	346	137
No	Mean	913	687	2970	1140	2·1	2·4	26·2	3·3	6·1	374	192
	SD		3456	1779	3504	1·4	2·0	21·9	1·8	17·1	186	116
	Median		448	2830	927	2·0	2·1	23·9	3·1	4·9	347	167
Fathers		329										
Yes	Mean	15	670	3286	1197	2·4	2·3	25·0	3·4	6·5	362	118
	SD		386	2107	527	1·2	1·1	11·6	1·4	3·0	185	73·8
	Median		658	3796	1102	2·4	2·0	23·1	3·3	6·0	341	119
No	Mean	314	645	2538	1028	2·1	2·4	25·7	3·2	6·2	326	117
	SD		651	1399	734	0·8	1·1	9·4	1·1	3·9	119	64·6
	Median		491	2585	890	2·1	2·2	24·0	3·0	5·5	321	106
Grandmothers		441										
Yes	Mean	191	675	2969	1114	2·2	2·1	22·5	2·7	6·1	337	122
	SD		749	3166	908	1·8	1·8	16·5	1·3	6·4	210	89·9
	Median		421	2586	877	1·9	1·8	19·2	2·5	4·8	280	101
No	Mean	250	712	3240	1200	2·2	2·1	23·8	3·0	6·4	343	143
	SD		1579	2347	1653	1·2	1·5	15·1	1·5	8·9	163	119
	Median		404	2875	922	2·0	1·7	21·1	2·7	4·9	314	120
Grandfathers		257										
Yes	Mean	105	775	1434	970	3·5	3·1	41·9	3·5	7·6	498	132
	SD		732	1716	928	2·1	1·9	19·0	1·9	4·8	321	112
	Median		503	1138	724	3·2	2·9	40·5	3·1	7·0	451	11·7
No	Mean	152	811	1338	976	3·6	3·2	42·1	3·6	7·2	518	142
	SD		794	1070	826	2·7	2·3	26·2	1·9	4·7	355	166
	Median		601	1106	765	2·9	2·7	37·9	3·1	6·3	435	108

GMS status (yes or no)		*n*	Vit D (μg)	Vit E (mg)	P (mg)	Ca (mg)	Fe (mg)	Se (μg)	Zn (mg)	Na (mg)	K (mg)	Mg (mg)
Mothers		1112										
Yes	Mean	199	3·9	9·5	1919	1302	13·8	66·6	14·6	3666	4517	366
	SD		4·0	6·4	1368	853	12·0	57·3	19·6	2541	3356	240
	Median		3·0	8·2	1657	1062	12·0	57·0	11·6	3255	4081	338
No	Mean	913	3·6	9·5	1791	1223	13·6	62·5	12·2	3299	4289	358
	SD		3·0	5·4	1074	733	11·0	45·0	12·2	1983	2026	174
	Median		3·2	8·4	1616	1038	12·0	55·7	10·9	3014	4036	334
Fathers		329										
Yes	Mean	15	4·0	8·3	1662	1073	12·0	66·9	12·8	3401	4153	317
	SD		1·9	3·7	677	640	5·1	30·5	4·2	1460	1655	125
	Median		3·8	8·4	1398	773	12·6	70·4	11·2	3569	4387	335
No	Mean	314	3·5	8·7	1812	1229	12·5	62·0	12·4	3080	4159	356
	SD		2·0	4·8	718	696	4·9	28·5	5·2	1224	1462	137
	Median		2·9	7·7	1718	1055	11·9	57·2	11·9	2907	3965	335
Grandmothers		441										
Yes	Mean	191	3·3	8·1	1557	1019	12·0	54·4	11·5	3144	3742	320
	SD		2·8	6·3	952	751	8·1	28·8	9·1	2368	1838	183
	Median		2·7	6·5	1488	889	9·9	50·6	10·2	2661	3382	287
No	Mean	250	3·6	8·0	1591	1007	12·8	59·7	11·9	2940	3965	335
	SD		3·1	6·0	992	757	7·4	40·7	9·2	1734	1943	181
	Median		2·9	6·2	1395	814	11·0	51·8	10·2	2675	3497	301
Grandfathers		257										
Yes	Mean	105	4·0	11·2	1904	1102	15·6	65·6	14·8	3963	4348	446
	SD		2·8	6·0	1022	895	9·3	34·0	9·2	2129	2294	202
	Median		3·4	10·0	1754	877	13·6	59·7	13·3	3688	3944	418
No	Mean	152	3·9	11·6	1976	1148	17·3	63·8	14·6	3951	4669	470
	SD		2·7	6·5	1048	847	11·5	33·1	6·3	2739	2678	246
	Median		3·1	10·8	1761	916	14·9	57·1	13·2	3505	4185	428

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Table 2 (Continued)

GMS status (yes or no)		n	Cu (mg)	Cl (mg)	Mn (mg)	I (μg)	As (mg)	Cd (mg)	Sn (mg)	Hg (mg)	Pb (mg)	I (mg) FSAI
Mothers		1112										
Yes	Mean	199	1·3	5823	3·3	240	0·1	0·03	1·8	0·02	0·01	0·4
	SD		0·9	4123	1·8	174	0·1	0·02	3·4	0·01	0·01	0·3
	Median		1·2	5174	3·0	206	0·0	0·02	0·9	0·01	0·01	0·3
No	Mean	913	1·4	5252	3·5	217	0·1	0·03	1·5	0·02	0·01	0·3
	SD		2·3	2970	1·7	120	0·1	0·01	1·4	0·01	0·0	0·2
	Median		1·2	4808	3·2	192	0·0	0·02	0·9	0·01	0·01	0·2
Fathers		329										
Yes	Mean	15	1·2	5561	3·0	219	0·04	0·03	0·5	0·01	0·01	0·3
	SD		0·5	2365	1·4	131	0·04	0·01	0·8	0·01	0·0	0·3
	Median		1·3	5861	3·5	188	0·02	0·03	0·2	0·01	0·01	0·2
No	Mean	314	1·4	4951	3·3	220	0·1	0·02	0·5	0·02	0·01	0·3
	SD		0·7	1963	1·5	144	0·04	0·01	0·7	0·0	0·0	0·2
	Median		1·2	4622	3·1	193	0·04	0·02	0·2	0·01	0·01	0·3
Grandmothers		441										
Yes	Mean	191	1·3	5049	3·6	176	0·05	0·02	0·6	0·01	0·01	0·2
	SD		1·0	3446	1·9	104	0·1	0·02	0·8	0·01	0·01	0·2
	Median		1·1	4389	3·3	164	0·03	0·02	0·4	0·01	0·01	0·2
No	Mean	250	1·4	4752	3·9	189	0·1	0·02	0·7	0·01	0·01	0·2
	SD		1·2	2724	2·2	169	0·1	0·01	1·4	0·01	0·0	0·2
	Median		1·2	4229	3·4	150	0·04	0·02	0·2	0·01	0·01	0·2
Grandfathers		257										
Yes	Mean	105	1·8	6305	3·9	187	0·04	0·02	0·6	0·01	0·01	0·3
	SD		1·0	3448	1·9	118	0·1	0·02	1·2	0·01	0·00	0·2
	Median		1·7	5780	3·8	158	0·03	0·02	0·1	0·01	0·01	0·2
No	Mean	152	1·9	6219	4·2	183	0·04	0·02	0·5	0·01	0·01	0·2
	SD		1·0	4165	2·5	122	0·04	0·02	1·3	0·00	0·0	0·2
	Median		1·7	5668	3·8	146	0·03	0·2	0·1	0·01	0·00	0·2

Retinol eq, retinol equivalent; Vit B_6, vitamin B_6, Vit B_{12}, vitamin B_{12}; Vit C, vitamin C; Vit D, vitamin D; Vit E, vitamin E; FSAI, Food Safety Authority of Ireland.
*For details of study, see text. All values were derived using McCance and Widdowson's food composition tables[37], except I, which was estimated from FSAI tables[38].

Table 3. Regression coefficients for prediction of total fat (g/d) and vitamin C intake (mg/d) at the 20th and 80th quantiles, adjusting for total energy intake (kJ/d) General Medical Services (GMS) eligibility, gender (male or female) and age (*n* 2100)

	Coefficient	SE	$P>t$ value	95% CI
Total fat (g/d)				
20th quantile				
GMS	6·2	1·05	0·000	4·20, 8·32
Gender	−9·3	1·14	0·000	−11·6, −7·10
Age	−0·06	0·028	0·053	−0·11, 0·001
Total energy	0·009	0·000	0·000	0·009, 0·010
Regression constant	−2·31	2·25	0·303	−6·72, 2·09
80th quantile				
GMS	7·59	1·39	0·000	4·87, 10·31
Gender	−8·74	1·44	0·000	−11·6, −5·92
Age	0·062	0·044	0·158	−0·024, 0·15
Total energy (kJ)	0·012	0·000	0·000	0·011, 0·013
Regression constant	−6·35	4·15	0·126	−14·5, 1·79
Vitamin C (mg/d)				
20th quantile				
GMS	−11·7	3·88	0·003	−19·3, −4·13
Gender	27·6	3·51	0·000	20·8, 34·5
Age	−0·25	0·10	0·015	−0·46, −0·05
Total energy (kJ)	0·006	0·000	0·000	0·005, 0·007
Regression constant	18·4	6·78	0·007	5·04, 31·6
80th quantile				
GMS	−30·3	7·63	0·000	−45·3, −15·4
Gender	77·1	7·07	0·000	63·2, 91·0
Age	−0·25	0·25	0·307	−0·74, 0·23
Total energy (kJ)	0·014	0·001	0·000	0·012, 0·016
Regression constant	34·4	15·5	0·026	4·03, 64·8

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intake of energy (kJ), fat (g) and vitamin C (mg) using Wilks' Lambda criteria is significant for mothers (F(3,1108) 10·03; $P<0·0001$) and for grandmothers (F(3,437) 2·70; $P=0·0451$).

Follow-up Mann–Whitney tests for difference in intake of energy (kJ), fat (g) and vitamin C (mg) between the parental groups reveal that GMS-ineligible mothers consume less energy (z –2·517; $P=0·119$) and fat (z –3·975; $P<0·0001$), than GMS-eligible mothers. Conversely, GMS-ineligible mothers (z 3·929; $P=0·0001$) and grandmothers (z 2·498; $P=0·0125$) consume more vitamin C than their GMS-eligible counterparts.

Regression coefficients from a quantile regression model for the total cohort are presented in Table 3 with the 95% CI constructed from 1000 bootstrap samples[36]. These models, for both total fat intake (g/d) and total vitamin C intake (mg/d) take account of the intake of total energy (kJ) and the demographic variables age, gender and GMS eligibility, all of which are significantly associated with both outcome variables of interest. This nutrient pattern is in keeping with the food-level consumption patterns previously reported in earlier analyses[29,32].

In conclusion, the Life-ways Cross-generation Cohort Study has already demonstrated a number of important relationships between social position and health outcomes and should serve as a useful means of elucidating patterns of relationships between nutrition and disadvantage well established at empirical level in other cross-sectional Irish datasets. In the present analysis a relationship between nutrient status and disadvantage, as measured by means-tested GMS eligibility, has been confirmed.

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