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COHORT PROFILE

Cohort Profile: The Cork and Kerry Diabetes and Heart Disease Study

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Why was the cohort set up?

Cardiovascular disease (CVD) including ischaemic heart disease and cerebrovascular disease is among the leading causes of mortality worldwide,[1] and in Ireland, coronary heart disease death rates are among the highest in Europe.[2] Although it has previously been reported that only 50% of CVD can be attributed to traditional risk factors,[3,4] it is now recognized that these factors occur much more frequently in people with CVD,[5,6] with most of the population attributable risk of myocardial infarction due to risk factors such as smoking, hypercholesterolaemia, diabetes mellitus, hypertension and obesity.[7] To date, much of the focus in CVD prevention has been on determining the individual contribution of risk factors to the development of CVD and targeting individual risk factors.[8] However, it is increasingly recognized that it is the effect of these risk factors in combination and the consequent potential for prevention in terms of lifestyle changes that address these factors simultaneously that should be prioritized.[9–11] The original Cork and Kerry Diabetes and Heart Disease Study—Phase I, which was undertaken in 1998, was at that time, one of the first large population-based observational studies in Ireland.[12] The primary aim of the study was to estimate the prevalence of major CVD risk factors in a middle-aged population in Ireland and to estimate the proportion of the population at high risk according to Framingham criteria. The study included measurement of diet and physical activity and assessed the impact of these lifestyle factors on traditional CVD risk factors including hypertension and dyslipidaemia.[13–15]

Phase II of the Cork and Kerry Diabetes and Heart Disease Study began in 2008, with support from the Health Research Board Centre for Health and Diet Research.[16] The centre provided funding for long-term follow-up of the original Cork and Kerry cohort, including assessment of vital status and a rescreen of surviving cohort members as well as recruitment of a new cohort, the Mitchelstown cohort. Although the original cohort was recruited from across 17 different general practices in Cork and Kerry, the new cohort was recruited from a single large primary care centre, the Livinghealth Clinic in Mitchelstown, county Cork (Figure 1).

The aim of the Cork and Kerry Study—Phase II (Mitchelstown cohort recruited 2010–11) is to provide an updated profile of glucose tolerance status, cardiovascular health and their related factors in an Irish adult general population sample and to compare the findings with those obtained during baseline assessment of Phase I of the Cork and Kerry study (1998) and the rescreen (2008). Additional objectives include determining the prevalence of proximal risk factors, such as hypertension, dyslipidaemia, body mass index (BMI) and insulin resistance as well as of more distal risk factors of diet, smoking, alcohol consumption and physical activity, and the association between cardiovascular health and its risk factors with general measures of well-being and mental health. The new cohort includes collection of qualitative and quantitative data in an effort not only to describe the current health status of the cohort and assess individual level determinants but also to provide the appropriate context to interpret the role of behavioural factors and social circumstances on health.

Who is in the cohort?

The 1998 cohort were recruited from the practice lists of 17 (6 urban and 11 rural) general practices in Cork and Kerry in the south of Ireland. Stratified random sampling by age and sex was utilized to recruit equal

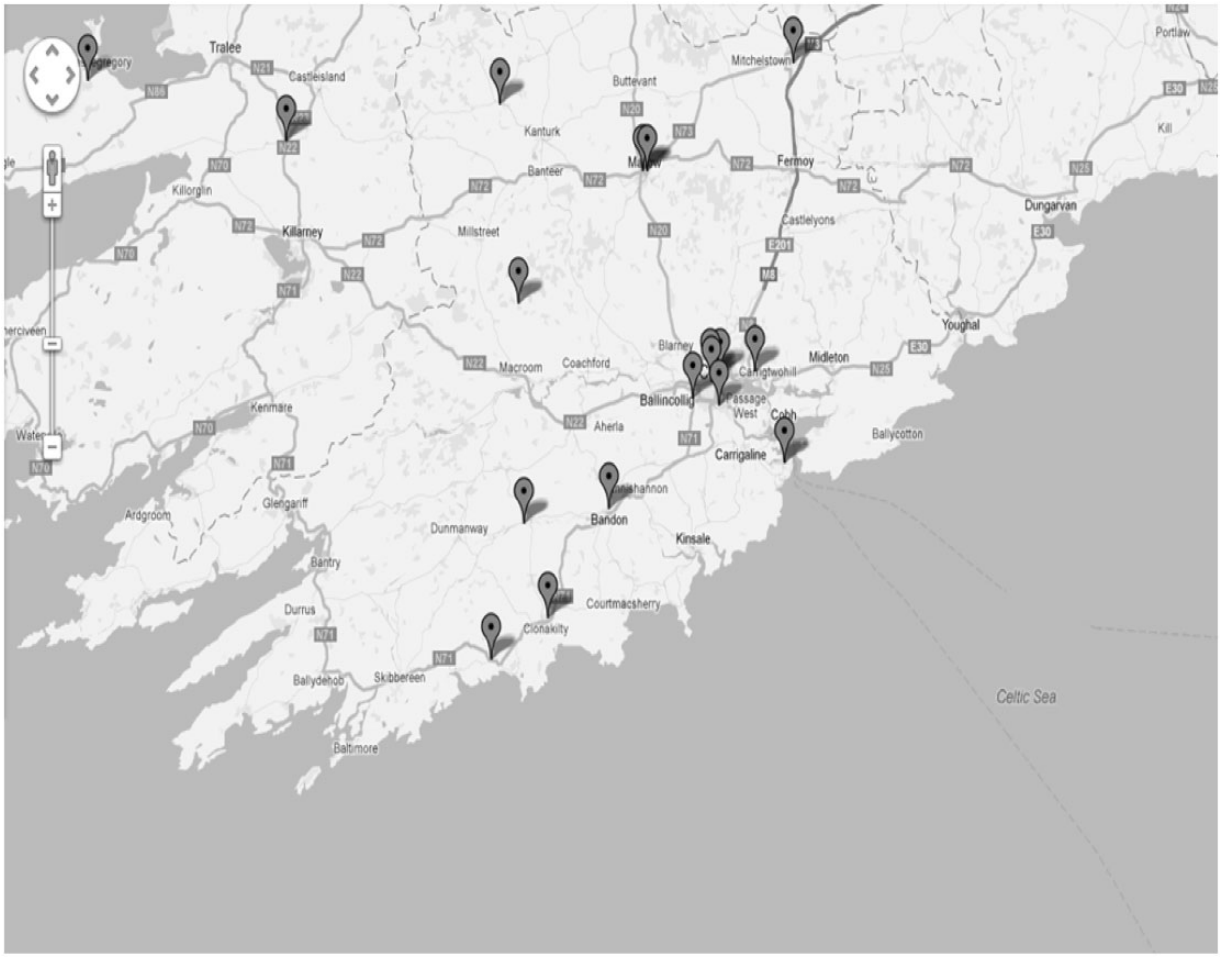

Figure 1 Map of Cork and Kerry general practices and Livinghealth Clinic in Mitchelstown

numbers of men and women aged between 50 to 69 years. Individuals with pre-existing CVD or diabetes were not excluded. Selected individuals were invited by letter, co-signed by their participating general practitioner (GP), explaining the aims of the study, and it was accompanied by a reply slip and detailed questionnaire. Non-responders were followed up with a phone call where possible and otherwise with a single postal reminder. A total of 1018 people aged 50–69 years attended for a study visit from 1473 who were invited to attend (response rate 69%). The socio-demographic characteristics of the participants and the background population are provided in Table 1. In 2011, recruitment was completed on a new cohort of 2047 men and women aged 50–69 years from patients attending a single large primary care centre, the Livinghealth Clinic in Mitchelstown, a town with a population of >3000 in county Cork. The Livinghealth Clinic includes eight GPs, and the practice serves a catchment area of ~20 000, with a mix of urban and rural residents. Participants were randomly selected from all registered attending patients in the 50–69-year age group. In total, 3807 potential participants were selected from the practice list, and after exclusion of duplicates, deaths and ineligibles, 3051 were invited to participate in the study. A letter signed by the contact GP in the practice was sent out to all selected participants with a reply slip indicating acceptance or refusal. Reminder letters were sent out by post after 4 weeks to initial non-responders. A telephone number was provided for potential participants to make contact with the research team or to ask questions. Of the 3051 individuals invited to participate, 2047 completed the questionnaire and physical examination components of the baseline assessment (response rate: 67%). The socio-demographic characteristics of the Mitchelstown participants and the background population are provided in Table 2. Ambulatory blood pressure (BP) monitoring was offered to all 2047 participants, and it was completed by 1189 (response rate: 58%). The questionnaire component of the study included the International Physical Activity Questionnaire, which was completed by all participants. Objective measurement of physical activity with the GeneActiv accelerometer was introduced in the later stages of the first

Table 1 Demographic characteristics of participants and background population at baseline—Cork and Kerry Study 1998

	Participants			Background population[a]		
Demographic characteristics	Men (%)	Women (%)	Total (%)	Men (%)	Women (%)	Total (%)
Age[b]						
50–54 years	117 (23.9)	124 (23.6)	241 (23.8)	14 631 (30.9)	13 967 (29.7)	28 598 (30.3)
55–59 years	118 (24.1)	138 (26.3)	256 (25.2)	12 190 (25.8)	11 724 (24.9)	23 914 (25.4)
60–64 years	122 (24.9)	136 (25.9)	258 (25.4)	10 832 (22.9)	10 830 (23.0)	21 662 (23.0)
65–69 years	121 (24.7)	112 (21.3)	233 (23.0)	9614 (20.3)	10 469 (22.3)	20 083 (21.3)
Marital status						
Single	66 (13.5)	53 (10.1)	119 (11.7)	9212 (19.5)	5339 (11.4)	14 551 (15.4)
Co-habiting/married	390 (79.6)	364 (69.6)	754 (74.4)	34 555 (73.1)	32 297 (68.8)	66 852 (71.0)
Separated/divorced	11 (2.2)	22 (4.2)	33 (3.3)	1712 (3.6)	1773 (3.8)	3485 (3.7)
Widowed	23 (4.7)	84 (16.1)	107 (10.6)	1788 (3.8)	7521 (16.0)	9309 (9.9)
Age at which education was ceased[c]						
<15 years	142 (28.9)	109 (20.8)	251 (24.7)	41 572 (24.0)	35 975 (21.2)	77 547 (22.6)
15–16 years	129 (26.3)	135 (25.7)	264 (26.0)	50 620 (29.2)	46 015 (27.2)	96 635 (28.2)
17–19 years	89 (18.1)	152 (28.9)	241 (23.7)	54 399 (31.4)	68 235 (40.3)	122 634 (35.8)
20–21 years	14 (2.8)	21 (4.0)	35 (3.4)	11 563 (6.7)	6931 (4.1)	18 494 (5.4)
22–24 years	20 (4.1)	23 (4.4)	43 (4.2)	9959 (5.7)	8703 (5.1)	18 668 (5.4)
⩾25 years	97 (19.8)	85 (16.2)	182 (17.9)	5099 (2.9)	3395 (2.0)	8494 (2.5)

[a]Census 1996 SAPS (small area population statistics) themes by province, county and county Borough—Cork County, Cork Borough and Kerry County.
[b]Age calculated on date of birth and study year (1998); sum of total column is 988 because of exclusion in table of 26 individuals ⩾70 years and four missing age values.
[c]Background population aged ⩾15 years classified by age at which full-time education ceased—Cork County, Cork Borough and Kerry County.

Table 2 Demographic characteristics of participants and background population at baseline—Mitchelstown cohort

	Participants			Background population[a]		
Demographic characteristics	Men (%)	Women (%)	Total (%)	Men (%)	Women (%)	Total (%)
Age[b]						
50–54 years	249 (25.1)	261 (25.6)	510 (25.4)	11 025 (31.9)	10 521 (31.6)	21 546 (31.7)
55–59 years	285 (28.8)	272 (26.7)	557 (27.7)	9925 (28.7)	9532 (28.6)	19 457 (28.6)
60–64 years	260 (26.2)	289 (28.4)	549 (27.3)	7783 (22.5)	7567 (22.7)	15 350 (22.6)
65–69 years	197 (19.9)	196 (19.2)	393 (19.6)	5852 (16.9)	5686 (17.0)	11 538 (17.0)
Marital status						
Single	122 (12.4)	55 (5.3)	177 (8.8)	5331 (15.4)	2918 (8.8)	8249 (12.1)
Co-habiting/married	778 (78.9)	808 (78.5)	1586 (78.7)	25 553 (73.9)	24 217 (72.7)	49 770 (73.3)
Separated/divorced	62 (6.3)	71 (6.9)	133 (6.6)	2542 (7.3)	2654 (8.0)	5196 (7.6)
Widowed	24 (2.4)	95 (9.2)	119 (5.9)	1159 (3.3)	3517 (10.5)	4676 (6.9)
Education[c]						
Primary	310 (32.7)	227 (23.6)	537 (28.1)	19 346 (16.4)	16 512 (41.3)	35 858 (15.4)
Secondary	455 (48.0)	481 (50.1)	936 (49.1)	65 223 (55.3)	57 712 (50.0)	122 935 (52.7)
Tertiary	183 (19.3)	252 (26.3)	435 (22.8)	33 307 (28.2)	41 060 (35.6)	74 367 (31.9)

[a]Census 2006 SAPS (small area population statistics) themes by electoral division, county and province—Cork County.
[b]Age calculated on date of study participation—sum of total column is 2009 because of exclusion in table of 2 individuals <50 years, 36 ⩾ 70 years.
[c]Background population aged ⩾15 years and highest level of education completed—Cork County.

wave of the study. Of the 765 participants who were asked to wear an accelerometer, 464 agreed (response rate: 61%), most of whom wore the accelerometer for the full 7 days. A qualitative study was undertaken in a purposive sample of 100 participants and focused on dietary choices.

How often will they be followed up?

The Cork and Kerry Phase 1 study was originally designed as a cross-sectional survey, but in 2008, additional funding was obtained to recontact survey participants and undertake a 10-year rescreen. As the study was not designed as a cohort study, contact had not been maintained with participants during the decade between the first survey and the rescreen. Before making contact with the individual participants, contact was made with the GPs to check whether the participants were still alive, and to ascertain whether the rescreening examination was appropriate. Allowing for mortality rate of 12% ($n = 121$), 16% ($n = 166$) loss to follow-up (not currently with GP, moved from area) and a further 4% ($n = 41$) classified as too unwell to participate, an available sample of 690 subjects were invited to participate in the rescreen. After follow-up with and review of vital status and causes of death through linkage with the National Cancer Registry, the rescreen response rate was 52%. Non-responders for the follow-up were slightly older than the responders (aged 60.1 vs 58.4 years), more likely to be retired (30% vs 17%) and less likely to be married (71% vs 80%, $P \leqslant 0.02$).

The rescreen included similar measurements as the initial survey with additional questions on job characteristics. Ongoing checks of vital status and causes of death will be undertaken through linkage with the National Cancer Registry.

Baseline assessment of the Mitchelstown cohort was undertaken for 1 year in 2010–11. The second wave of data collection is planned for 2014, and will include repeat measures of CVD risk factors including diet and physical activity and additional measurements, such as weighed food diaries, genetic profiles, metabolomics and assessment of subclinical vascular disease using non-invasive imaging. As the cohort is embedded in a single large primary care centre with electronic patient records, the electronic records of all members of the cohort have been flagged to facilitate ease of contact and follow-up. Therefore, in addition to the measures that were undertaken at baseline and that will be part of the rescreen and future waves of the study, it will be possible to access measurements undertaken at routine GP or nurse visits. These data will provide ongoing passive follow-up of participants between waves of active data collection. An annual screen of the practice electronic records will extract updated information on vital status, number of GP visits, new diagnoses, specialist referrals and medications.

Although data linkage has been recognized as an important tool for public health research,[17] in Ireland, we do not have a unique health identifier that can be used for research purposes. This makes linkage with other records, such as disease registries or death records, problematic. The Irish Health Information and Quality Authority has recommended that unique identifiers for health care professionals and organizations be introduced, and this will be addressed in a health information bill, but it is at present unclear when a health identifier will be in use.[18] For the follow-up of the Cork and Kerry Phase I study, record linkage was undertaken in collaboration with the National Cancer Registry, Ireland,[19] to determine cancer incidence, cancer mortality rate and cause-specific mortality rate for the cohort. As the Mitchelstown cohort was recruited from a single large group practice, this will facilitate long-term follow-up even in the absence of a unique identifier.

What has been measured?

All phases of the Cork and Kerry Heart Disease Study included a questionnaire component and physical examination, with collection of fasting blood samples and urine samples. All participants, were asked to fast from 12 midnight. Participants were invited to attend the general practice for sampling of blood between 8 and 10 A.M. (minimum of 8-h fast) and collection of urine samples. Analysis of blood samples included measurement of fasting glucose, lipoprotein profile, glycosylated haemoglobin, full blood count and biochemical profile. In addition, participants were asked to provide consent for long-term storage of blood. The questionnaire and physical examination measures for the baseline and follow-up surveys of Phase 1 and for baseline recruitment of Phase 2 (Mitchelstown cohort) are summarized in Tables 4 and 5. Physical activity was measured in all participants in both phases of the study using questionnaires, and an objective measurement was obtained in a subsample of participants in the Mitchelstown cohort using the GeneActiv accelerometer. Approximately one-quarter of the cohort wore the GeneActiv accelerometer for a week. The GeneActiv can be used to estimate daily activity in metabolic equivalent of task (METs) and in combination with weight can be used to estimate daily kilocalorie (kcal) consumption. In addition, the GeneActiv provides information on the sleep–wake cycle, and this output will be used to assess the relationship between sleep patterns and health outcomes. The qualitative study around consumer response to food will be analysed using NVivo software (QSR International).

Table 3 Baseline demographic, health and lifestyle characteristics of Cork and Kerry 1998 cohort stratified by response status in 2008

Variable	Non–responder, *n* (%)	Responder, *n* (%)	Deceased, *n* (%)	Too ill to participate, *n* (%)	Lost to follow-up, *n* (%)
Sex					
Male subjects	158 (48.5)	168 (51.5)	73 (14.8)	16 (3.3)	77 (15.7)
Female subjects	173 (47.5)	191 (52.5)	48 (9.1)	25 (4.8)	89 (16.9)
General health					
Excellent	55 (41.0)	79 (59.0)	13 (7.1)	5 (2.7)	31 (16.9)
Good	211 (50.0)	211 (50.0)	66 (10.7)	30 (4.8)	102 (16.5)
Fair	53 (48.2)	57 (51.8)	37 (20.8)	5 (2.8)	26 (14.6)
Poor	1 (33.3)	2 (66.7)	4 (36.4)	0 (0)	4 (36.4)
Self-report doctor-diagnosed hypertension	84 (48.3)	90 (51.7)	34 (13.3)	9 (3.5)	39 (15.2)
Self-report doctor-diagnosed diabetes	7 (46.7)	8 (53.3)	10 (31.3)	2 (6.3)	5 (15.6)
Present smoker	68 (57.6)	50 (42.4)	30 (15.8)	11 (5.8)	31 (16.3)
Physically active in comparison with others of the same age					
Much more active	61 (45.2)	74 (54.8)	20 (10.3)	8 (4.1)	32 (16.4)
More active	72 (42.9)	96 (57.1)	26 (10.9)	12 (5.0)	33 (13.8)
Similar	105 (46.9)	119 (53.1)	35 (10.8)	10 (3.1)	54 (16.7)
Less active	63 (60.6)	41 (39.4)	23 (13.9)	8 (4.9)	30 (18.2)
Much less active	10 (41.7)	14 (58.3)	15 (28.3)	3 (5.7)	11 (20.8)
Marital status					
Single	37 (51.4)	35 (48.6)	16 (13.5)	6 (5.0)	25 (21.0)
Married	233 (44.9)	286 (55.1)	87 (11.5)	29 (3.9)	119 (15.8)
Divorced/separated	13 (61.9)	8 (38.1)	4 (12.1)	0 (0)	8 (24.2)
Other	46 (61.3)	29 (38.7)	14 (13.1)	5 (4.7)	13 (12.2)
Fried food at home					
Daily	10 (66.7)	5 (33.3)	5 (20.0)	2 (8.0)	3 (12.0)
1–3 times per week	101 (45.7)	120 (54.3)	40 (12.7)	10 (3.2)	44 (14.0)
4–6 times per week	20 (48.8)	21 (51.2)	5 (8.3)	3 (5.0)	11 (18.3)
<1 time per week	128 (44.8)	158 (55.2)	46 (10.9)	18 (4.3)	74 (17.5)
Add salt at the table					
Always	112 (50.2)	111 (49.8)	34 (10.8)	11 (3.5)	48 (15.2)
Usually	42 (45.2)	51 (54.8)	15 (11.0)	6 (4.4)	22 (16.2)
Sometimes	43 (44.3)	54 (55.7)	18 (12.4)	4 (2.8)	26 (17.9)
Rarely	45.0 (36)	44 (55.0)	21 (16.4)	5 (3.9)	22 (17.2)
Never	32 (37.2)	54 (62.8)	11 (8.9)	8 (6.4)	19 (15.3)
Mean HbA1c	5.0	4.9	5.4	5.0	4.9
Mean glucose	5.4	5.4	6.0	5.4	5.4
Mean total cholesterol	5.9	5.8	5.7	6.0	5.9
Mean HDL cholesterol	1.5	1.5	1.4	1.7	1.5
Mean diastolic BP	80.8	80.2	81.0	81.5	79.4
Mean systolic BP	135.4	135.3	137.7	137.2	132.7
Mean BMI	27.7	27.7	27.4	27.2	27.6
BMI category					

(continued)

Table 3 Continued

Variable	Non–responder, *n* (%)	Responder, *n* (%)	Deceased, *n* (%)	Too ill to participate, *n* (%)	Lost to follow-up, *n* (%)
Normal weight	87 (49.7)	87 (49.7)	36 (13.4)	12 (4.5)	46 (17.1)
Overweight	152 (46.3)	152 (46.3)	47 (10.0)	19 (4.0)	75 (16.0)
Obese	89 (50.0)	89 (50.0)	34 (13.0)	8 (3.1)	41 (15.7)
Central obesity					
Normal	89 (49.7)	90 (50.3)	44 (15.2)	16 (5.5)	50 (17.3)
Central obesity	242 (47.5)	268 (52.6)	77 (10.6)	25 (3.4)	116 (15.9)

HDL, high-density lipoprotein.

What has been found?

The first phase of the Cork and Kerry Diabetes and Heart Disease Study reported on the prevalence of CVD risk factors in middle-aged men and women in Ireland and has provided estimates of the proportion of individuals at high risk of vascular events in a general practice setting.[12] The study has assessed the prevalence and lifestyle determinants of the metabolic syndrome,[14,15] and it has demonstrated an association between six core protective factors (normal BMI, waist hip ratio (WHR) below the current threshold for central obesity, never smoking, light alcohol consumption, a prudent diet and regular physical activity) and the prevalence of hypertension and dyslipidaemia and glucose intolerance and insulin resistance.[13,20] Cluster analysis identified three different dietary patterns (traditional Irish, alcohol and convenience foods and prudent), and it was found that prudent diet was associated with the lowest risk of insulin resistance.[21,22] Current work on the stability of the dietary patterns using latent class analysis has found that stability of a healthy diet and transition to a healthy diet was significantly associated with higher education and better health outcomes compared with those who remained stable in an unhealthy dietary pattern group. The mortality rate at follow-up was 13%, and an article on cancer incidence, cancer death and cause-specific mortality rate is in preparation.

The Mitchelstown cohort provides updated estimates of the prevalence of CVD risk factors in middle-aged men and women in Ireland and the lifestyle determinants of such factors, allowing a more comprehensive assessment of the relationship between lifestyle factors and more proximal risk factors for CVD and diabetes. Table 6 summarizes the cardiovascular risk factor profile of the two populations over time. Analyses of the data are ongoing, but a number of clear patterns are emerging. There is a high prevalence of overweight and obesity, with only one-fifth of participants in the normal weight (BMI < 25 kg/m^2) category.[23] Similarly, a high proportion of respondents had evidence of glucose intolerance, with ~9% meeting the criteria for diabetes and another 18% having pre-diabetes.[23] The potential impact of using ambulatory BP monitors to measure BP is evidenced by the findings of a large discordance in hypertension categorization based on clinic vs ambulatory BP recordings. Approximately 50% of individuals who were classified as hypertensive based on clinic BP readings were recategorized as normotensive.[24] Strong inverse relationships were found between dietary quality and clinic and ambulatory BP. Data from the original Cork and Kerry Diabetes and Heart Disease cohort were used to explore trends in cardiovascular mortality rate in Ireland,[25] and this work will be updated with the findings of the Mitchelstown cohort.

What are the main strengths and weaknesses of the study?

One of the main strengths of the study is a focus on the lifestyle determinants of health and disease, with measurement of physical activity and diet in all phases of the study. Detailed dietary information is provided by a modified version of the Willett Food Frequency Questionnaire.[26] In addition to the quantification of different dietary intakes using the Wilett Food Frequency Questionnaire, the decisions around food choices and the factors that may impact on these choices were assessed in a subsample of participants as part of a qualitative study.[27] Physical activity was measured by self-report using a standardized physical activity questionnaire for Phases 1 (baseline and follow-up) and 2 of the study. In Phase 2 of the study, in addition to the self-report measure of physical activity (International Physical Activity Questionnaire), which may be subject to significant reporting bias,[28] objective physical activity was measured using the GeneActiv accelerometer. To the best of our knowledge, the Mitchelstown cohort is one of the first general population-based cohort studies internationally to include an accelerometer-based objective measure of physical activity and may be the first cohort study worldwide to include ambulatory BP monitoring and accelerometery.

Table 4 Summary of questionnaire data

Cork and Kerry studies	1998	2008	2010–11
Demographics			
Age	✓	✓	✓
Gender	✓	✓	✓
Marital status	✓	✓	✓
Socio-economic			
Household composition	✓	✓	✓
Financial assets	✓	✓	✓
Education	✓	✓	✓
Pension type	✓	✓	✓
Health insurance cover	✗	✓	✓
GP/medical card	✗	✓	✓
Present circumstance			
Employment status/history	✓	✓	✓
Job characteristics	✗	✓	✓
Neighbourhood characteristics	✗	✗	✓
Personal health behaviours			
Smoking (status, type, frequency)	✓	✓	✓
Alcohol (status, type, frequency)	✓	✓	✓
Physical activity	✓	✓	✓
Activities of daily living	✗	✓	✓
Aids to activities of daily living	✗	✓	✗
Personal health history			
Self-rated health status	✓	✓	✓
Conditions affecting the heart and treatment followed	✓	✓	✓
Disease conditions for some common conditions	✓	✓	✓
Operation history	✓	✓	✗
Hearing/eyesight	✓	✓	✗
Regular prescriptive treatment followed	✓	✓	✓
Multi-vitamins and minerals	✓	✗	✓
Medical history	✓	✓	✓
Self-reported weight and weight change	✓	✓	✗
Disability	✓	✗	✗
Mental health and well-being	✗	✓	✓
Adverse childhood events in first 18 years of life	✗	✗	✓
Food life			
Frequency and consumption of 10 food groups	✓	✓	✓
Milk consumption	✓	✗	✓
Fried food consumption	✓	✗	✓
Cooking methods	✓	✗	✗
Salt consumption	✓	✗	✓
Location of meal consumption	✗	✗	✓
Food life and satisfaction	✗	✓	✗
Reproductive history (women)			
Age at first and last menstrual period	✓	✗	✓
History of contraceptive pill use	✓	✗	✓
History of HRT	✓	✗	✓
History of pregnancy and complications	✓	✗	✓

HRT, hormone replacement therapy.

Major potential limitations of any cohort study are biases because of initial non-response or attrition over time. Both cohorts were recruited from general practice, and the characteristics of the study participants compared with the source population according to census data are provided in Tables 1 and 2. The original Cork and Kerry study was designed as a cross-sectional survey, and there was no contact between participants and the study team until a postal questionnaire was sent to the participants in 2007, followed by the rescreen in 2008. Although recontact was made through the GPs, the level of response was low and raises the problem of attrition bias. Table 3 provides detailed information on the differences in baseline characteristics of the study population according to follow-up status after 10 years. Responders had better self-rated health, and they were more likely to be physically active and make healthy dietary choices.

As the Mitchelstown cohort is embedded in a population registered with a single large group general practice, a major strength of the study is that data collected routinely in primary care can be combined with the information obtained during formal waves of data collection. At the baseline study visit, information on the most recent GP or nurse visit BP recording was included in the patient file along with the BP measured during the study visit. These BP measurements provide an assessment of visit to visit BP variability. Further interrogation of the effect of time of measurement on BP is the inclusion of ambulatory BP monitoring. All participants were invited to wear a 24-h ambulatory BP device, and with a response rate to this component of the study of 58%, we have a measure of BP variability for a much shorter period for a large subset of the cohort.

Although much of the focus of the study is on the quantification of health and disease states, the study does benefit from a qualitative component that complements the information collected in the quantitative survey and physical examination. A subset of

Table 5 Summary of physical measurements

Year	1998	2008	2010–11
Height (cm)			
Harpenden stadiometer (Seritex)	✓	✗	✗
Portable Seca/Leicester height/length measure (Seca)	✗	✓	✓
Number of measurements	1	1	1
Weight (kg)			
Fieldwork digital weighing scales (Soehnle model, Soehnle)	✓	✗	✗
Portable electronic Tanita WB-100MA (TANITA) weighing scale	✗	✓	✓
Number of measurements	1	1	1
Heart rate over 30 secs			
Watch (second hand)	✓	✓	✓
Number of measurements	1	1	1
M.A.C. (cm)			
Measuring tape	✓	✓	✓
Number of measurements	1	1	1
Blood pressure (mm Hg)			
Omron HEM705CP digital BP monitor (Omron)	✓	✗	✗
Omron 705IT digital BP monitor (Omron)	✗	✓	✗
Omron M7 digital BP monitor (Omron)	✗	✗	✓
Number of measurements	3	3	3
Waist circumference (cm)			
Measuring tape	✓	✗	✗
Seca 200 measuring tape (Seca)	✗	✓	✓
Number of measurements	2	2	2
Hip circumference (cm)			
Measuring tape	✓	✗	✗
Seca 200 measuring tape (Seca)	✗	✓	✓
Number of measurements	2	2	2
Pelvic width (cm)			
Calipers	✗	✗	✓
Number of measurements			2
ECG			
12-lead electrocardiograph machine (Siemens–Eclipse 850i (Spacelabs Burdick))	✓	✓	✓
Number of measurements	1	1	1
Physical activity (SI units)			
GeneActive accelerometer (Unilever Discover) tri-axial	✗	✗	✓
Number of measurements			every 10 s at 100 Hz (7 days)
ABPM			
Meditech ABPM–05 (Meditech)	✗	✗	✓
Number of measurements			24 h (every 30 min)

ECG, electrocardiograph; ABPM, ambulatory BP monitoring; M.A.C., mid arm circumference.

participants completed a study on food choices through the lifecourse and the impact of different health states on these choices.[27] This combination of qualitative and quantitative methods will facilitate a more comprehensive assessment of the diet and lifestyle determinants of health and disease in the population. Although the Mitchelstown cohort is relatively large compared with other Irish studies, it is a small

Table 6 Prevalence of cardiovascular risk factors at baseline in Cork and Kerry (1998) and Mitchelstown (2010) cohorts

Cardiovascular risk factor	Definition	Cork and Kerry 1998			Mitchelstown 2010		
		Overall, % (n), ($n=1018$)	Male subjects, % (n), ($n=492$)	Female subjects, % (n), ($n=526$)	Overall, % (n), ($n=2047$)	Male subjects, % (n), ($n=1008$)	Female subjects, % (n), ($n=1039$)
Smoking status	Current smoker	19.1 (190)	21.0 (102)	17.3 (88)	14.8 (292)	14.9 (144)	14.9 (148)
Obese	BMI $>30\,kg/m^2$	25.6 (261)	25.3 (124)	26.0 (137)	32.8 (668)	36.7 (368)	28.9 (300)
Hypertension	BP $\geqslant$ 140/90 mm Hg or on anti-hypertensive medication	39.8 (404)	44.6 (219)	35.4 (185)	29.9 (609)	30.2 (302)	29.7 (307)
Physical inactivity	No or less than moderate activity (1998), IPAQ (2010)	43.3 (406)	40.6 (177)	45.7 (229)	48.6 (932)	42.7 (394)	54.0 (538)
Cholesterol	Total cholesterol >6 mM/l or on cholesterol-lowering medication	38.4 (390)	29.7 (146)	46.6 (244)	21.0 (410)	16.1 (154)	25.7 (256)
Diabetes	Self-report or HbA1c $\geqslant$6.5%	3.7 (37)	4.9 (24)	2.5 (13)	8.7 (174)	11.3 (112)	6.1 (62)

IPAQ, International physical activity questionnaire.

study on an international scale. The study has been developed in collaboration with national and international partners, and this will facilitate the combined analysis of data from other sources including the earlier Cork and Kerry Phase I study,[12] the Irish Longitudinal Study on Ageing[29] and the Survey of Lifestyle, Attitudes and Nutrition.[30]

Can I get hold of the data? Where can I find out more?

All collected source data are maintained and stored at the study research office, in the Department of Epidemiology and Public Health, University College Cork. Specific proposals for future collaboration would be welcomed. Further information can be found on the research centre website, http://www.ucc.ie/en/hrbc/projects/cluster3/ or through email to patricia.kearney@ucc.ie.

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References

[1] Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. *PLoS Med* 2006;**3:** e442.
[2] Codd MB. *50 Years of Heart Disease in Ireland*. Dublin: Irish Heart Foundation, 2001.
[3] Wilson PW, D'Agostino RB, Levy D, Belanger AM, Silbershatz H, Kannel WB. Prediction of coronary heart disease using risk factor categories. *Circulation* 1998;**97:** 1837–47.
[4] Ridker PM, Rifai N, Rose L, Buring JE, Cook NR. Comparison of C-reactive protein and low-density lipoprotein cholesterol levels in the prediction of first cardiovascular events. *N Engl J Med* 2002;**347:**1557–65.
[5] Greenland P, Knoll MD, Stamler J *et al*. Major risk factors as antecedents of fatal and nonfatal coronary heart disease events. *JAMA* 2003;**290:**891–97.
[6] Khot UN, Khot MB, Bajzer CT *et al*. Prevalence of conventional risk factors in patients with coronary heart disease. *JAMA* 2003;**290:**898–904.
[7] Yusuf S, Hawken S, Ounpuu S *et al*. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *Lancet* 2004;**364:**937–52.
[8] Capewell S, Hayes DK, Ford ES *et al*. Life-years gained among US adults from modern treatments and changes

in the prevalence of 6 coronary heart disease risk factors between 1980 and 2000. *Am J Epidemiol* 2009;**170:** 229–36.
[9] Daviglus ML, Lloyd-Jones DM, Pirzada A. Preventing cardiovascular disease in the 21st century: therapeutic and preventive implications of current evidence. *Am J Cardiovasc Drugs* 2006;**6:**87–101.
[10] Mendis S. The contribution of the Framingham Heart Study to the prevention of cardiovascular disease: a global perspective. *Prog Cardiovasc Dis* 2010;**53:**10–14.
[11] Perk J, De Backer G, Gohlke H *et al*. European Guidelines on cardiovascular disease prevention in clinical practice (version 2012). *Eur Heart J* 2012;**33:**1635–701.
[12] Creagh D, Neilson S, Collins A *et al*. Established cardiovascular disease and CVD risk factors in a primary care population of middle-aged Irish men and women. *Ir Med J* 2002;**95:**298–301.
[13] Villegas R, Kearney PM, Perry IJ. The cumulative effect of core lifestyle behaviours on the prevalence of hypertension and dyslipidemia. *BMC Public Health* 2008; **8:**210.
[14] Villegas R, Perry IJ, Creagh D, Hinchion R, O'Halloran D. Prevalence of the metabolic syndrome in middle-aged men and women. *Diabetes Care* 2003;**26:**3198–99.
[15] Villegas R, Creagh D, Hinchion R, O'Halloran D, Perry IJ. Prevalence and lifestyle determinants of the metabolic syndrome. *Ir Med J* 2004;**97:**300–03.
[16] University College Cork. HRB Centre for Health and Diet Research. http://www.ucc.ie/en/hrbc/ (12 June 2012, date last accessed).
[17] Jutte DP, Roos LL, Brownell MD. Administrative record linkage as a tool for public health research. *Annu Rev Public Health* 2011;**32:**91–108.
[18] Health Information and Quality Authority. *Recommendations for Health Identifiers for Healthcare Practitioners and Organizations*. Dublin: Health Information and Quality Authority, 2011.
[19] *The National Cancer Registry*. http://www.ncri.ie/ncri/index.shtml (12 June 2012, date last accessed).
[20] Perry IJ, Villegas R, Salim A, Flynn A. Clustering of protective factors for glucose intolerance and insulin resistance: a cross-sectional study. *Diabet Med* 2005;**22:**1091–97.
[21] Villegas R, Salim A, Collins MM, Flynn A, Perry IJ. Dietary patterns in middle-aged Irish men and women defined by cluster analysis. *Public Health Nutr* 2004;**7:** 1017–24.
[22] Villegas R, Salim A, Flynn A, Perry IJ. Prudent diet and the risk of insulin resistance. *Nutr Metab Cardiovasc Dis* 2004;**14:**334–43.
[23] Kearney PM, Madden J, Harrington J, McCarthy V, Fitzgerald A, Perry IJ. Ideal cardiovascular health in Ireland. In: *Europrevent*. Dublin: European Society of Cardiology, 2012.
[24] Kearney PM, Madden J, Harrington J *et al*. Blood Pressure Variability. In: *Europrevent*. Dublin: European Society of Cardiology, 2012.
[25] Bennett K, Kabir Z, Unal B *et al*. Explaining the recent decrease in coronary heart disease mortality rates in Ireland, 1985-2000. *J Epidemiol Community Health* 2006; **60:**322–27.
[26] Harrington J, Perry IJ, Lutomski J. Survey of lifestyles, attitudes and nutrition in Ireland. In: *Dietary Habits of the Irish Population*. Dublin: The Stationery Office, 2008.
[27] Delaney M, McCarthy M. Food choice and health across the life course: a qualitative study examining food choice in older Irish adults. In: *A Resilient European Food Industry and Food Chain in a Challenging World*. Paper prepared for presentation at 113th EAAE Seminar. Chania, Crete, Greece, 2009.
[28] Sallis JF, Saelens BE. Assessment of physical activity by self-report: status, limitations, and future directions. *Res Q Exerc Sport* 2000;**71(Suppl 2):**S1–14.
[29] Kearney PM, Cronin H, O'Regan C *et al*. Cohort profile: the Irish Longitudinal Study on Ageing. *Int J Epidemiol* 2011;**40:**877–84.
[30] Morgan K, McGee H, Watson D *et al*. SLÁN 2007: survey of lifestyles, attitudes and nutrition in Ireland. In: *Main Report*. Dublin: Department of Health and Children, 2008.