

# Physical activity of subjects aged 50–64 years involved in the European Prospective Investigation into Cancer and Nutrition (EPIC)

M Haftenberger<sup>1,\*</sup>, AJ Schuit<sup>2</sup>, MJ Tormo<sup>3</sup>, H Boeing<sup>1</sup>, N Wareham<sup>4</sup>, HB Bueno-de-Mesquita<sup>2</sup>, M Kumle<sup>5</sup>, A Hjartaker<sup>6</sup>, MD Chirlaque<sup>3</sup>, E Ardanaz<sup>7</sup>, C Andren<sup>8</sup>, B Lindahl<sup>9</sup>, PHM Peeters<sup>10</sup>, NE Allen<sup>11</sup>, K Overvad<sup>12</sup>, A Tjønneland<sup>13</sup>, F Clavel-Chapelon<sup>14</sup>, J Linseisen<sup>15</sup>, MM Bergmann<sup>1</sup>, A Trichopoulou<sup>16</sup>, P Lagiou<sup>16</sup>, S Salvini<sup>17</sup>, S Panico<sup>18</sup>, E Riboli<sup>19</sup>, P Ferrari<sup>19</sup> and N Slimani<sup>19</sup>

<sup>1</sup>German Institute of Human Nutrition, Department of Epidemiology, Arthur Scheunert Allee 114–116, D-14558 Potsdam-Rehbrücke, Germany; <sup>2</sup>Centre of Chronic Diseases Epidemiology, National Institute of Public Health and the Environment, Bilthoven, The Netherlands; <sup>3</sup>Council for Health and Social Affairs of Murcia, Spain; <sup>4</sup>Department of Public Health and Primary Care, School of Clinical Medicine, University of Cambridge, UK; <sup>5</sup>Institute of Community Medicine, University of Tromsø, Norway; <sup>6</sup>Section for Medical Statistics, University of Oslo, Norway; <sup>7</sup>Institute of Public Health, Regional Government of Navarra, Spain; <sup>8</sup>Department of Medicine, Lund University, Malmö University Hospital, Sweden; <sup>9</sup>Department of Public Health and Clinical Medicine, Umeå University, Sweden; <sup>10</sup>Julius Center for General Practice and Patient Oriented Research, University of Utrecht, The Netherlands; <sup>11</sup>Cancer Research UK, Epidemiology Unit, University of Oxford, UK; <sup>12</sup>Department of Epidemiology and Social Medicine, University of Aarhus, Denmark; <sup>13</sup>Danish Cancer Society, Copenhagen, Denmark; <sup>14</sup>INSERM, E3N–EPIC Group, Institute Gustave Roussy, Villejuif, France; <sup>15</sup>Division of Clinical Epidemiology, German Cancer Research Centre, Heidelberg, Germany; <sup>16</sup>Department of Hygiene and Epidemiology, School of Medicine, University of Athens, Greece; <sup>17</sup>Molecular and Nutritional Epidemiology Unit, CSPO, Scientific Institute of Tuscany, Florence, Italy; <sup>18</sup>Department of Clinical and Experimental Medicine, Federico II University, Naples, Italy; <sup>19</sup>International Agency for Cancer Research, Lyon, France

## Abstract

**Objective:** To describe physical activity of participants in the European Prospective Investigation into Cancer and Nutrition (EPIC).

**Design:** A cross-sectional analysis of baseline data of a European prospective cohort study.

**Subjects:** This analysis was restricted to participants in the age group 50–64 years, which was represented in all EPIC centres. It involved 236 386 participants from 25 centres in nine countries. In each EPIC centre, physical activity was assessed by standardised and validated questions. Frequency distribution of type of professional activity and participation in non-professional activities, and age-adjusted means, medians and percentiles of time dedicated to non-professional activities are presented for men and women from each centre.

**Results:** Professional activity was most frequently classified as sedentary or standing in all centres. There was a wide variation regarding participation in different types of non-professional activities and time dedicated to these activities across EPIC centres. Over 80% of all EPIC participants engaged in walking, while less than 50% of the subjects participated in sport. Total time dedicated to recreational activities was highest among the Dutch participants and lowest among men from Malmö (Sweden) and women from Naples (Italy). In all centres, total time dedicated to recreational activity in the summer was higher than in the winter. Women from southern Europe spent the most time on housekeeping.

**Conclusions:** There is a considerable variation of physical activity across EPIC centres. This variation was especially evident for recreational activities in both men and women.

**Keywords**  
EPIC study  
Physical activity  
Activity patterns  
Recreational activity  
Home activity  
Europe

Physical activity plays an important role in the prevention of certain cancer types and other chronic diseases<sup>1</sup>. There is convincing evidence for a protective effect of physical activity on the risk of colon cancer, while no association

has been observed between physical activity and the risk of rectal cancer<sup>2–4</sup>. Prospective cohort studies and case–control studies have also shown an inverse relationship between physical activity and the risk of breast<sup>2,3,5–9</sup>,

\*Corresponding author. Email [haftenb@mail.dife.de](mailto:haftenb@mail.dife.de)

uterine<sup>2,3</sup> and lung cancer<sup>2,10</sup>. Whether physical activity reduces the risk of prostate cancer is still unclear<sup>2,11,12</sup>. There are only a limited number of studies showing inconsistent results regarding the effect of physical activity on other cancer sites<sup>2</sup>.

Prospective studies are needed in order to establish further scientific evidence for the relation between physical activity and the risk of different cancer types and other chronic diseases. The European Prospective Investigation into Cancer and Nutrition (EPIC), which was established primarily to study the relationship between diet and other lifestyle factors and chronic diseases, particularly cancer, is a large-scale prospective multi-centre cohort study. EPIC used standardised methods to assess physical activity at the baseline examination<sup>13</sup>. The high expected variation in both physical activity and disease risk within the EPIC study population makes this cohort particularly valuable for further studies of the relationship between physical activity and disease risk.

This paper describes the variation in physical activity for EPIC participants aged 50–64 years. It aims to describe both professional and non-professional activities, and the amount of time dedicated to non-professional activities by men and women from the different EPIC centres. The intention of this analysis is to identify the physical activity patterns of the different EPIC study populations rather than to rate the physical activity of subjects in terms of scores or classifications. Approaches to classifying EPIC participants according to their levels of total physical activity are currently under discussion and will be presented in the future.

## Methods

### Subjects

The EPIC study is a multi-centre prospective study involving 23 administrative study centres in 10 countries. Initially, the EPIC study was set up by study groups from France, Germany, Greece, Italy, Spain, The Netherlands and the UK; it was subsequently joined by already existing cohorts from Naples (Italy), Sweden, Denmark and Norway with a similar set of procedures and study variables. Over 500 000 middle-aged men and women are involved in the EPIC study. The baseline data were collected between 1992 and 2000. The EPIC study populations were not intended to be representative of the general population. The choice of study populations was influenced largely by practical possibilities of obtaining adequate participation and ensuring long-term follow-up<sup>13</sup>. In France, Norway, Naples (Italy) and Utrecht (The Netherlands), only women were examined. The EPIC centre Bilthoven covers study populations from three Dutch towns: Amsterdam, Doetinchem and Maastricht. EPIC study populations were either population-based (Bilthoven, The Netherlands; Greece; Germany; Sweden; Denmark; Norway; part of the population from the UK,

Spain and Italy) or represented special groups – namely, participants in breast cancer screening programmes (Utrecht, The Netherlands; Florence, Italy), blood donors (Spain; Ragusa and Turin, Italy), teachers and school workers (France), employees (Turin, Italy), medical test users (Turin, Italy) and vegetarians, vegans and other health-conscious individuals recruited in collaboration with vegetarian societies and magazines (part of the population studied in the UK). Study populations, recruitment and characteristics of the populations are described in more detail elsewhere in this supplement<sup>14</sup>. The age range of participants varied between EPIC study centres. In order to reduce heterogeneity due to different age ranges between centres, the present analysis was restricted to 84 515 men and 166 065 women aged 50–64 years old. This age group was included in all study centres. This analysis did not include participants from Norway, since physical activity data from Norway were not comparable with data from the other centres.

### Assessment of physical activity

In each centre, professional and non-professional physical activity was assessed as a part of the standardised lifestyle questionnaire<sup>13,14</sup>. The physical activity questions were part of the EPIC core protocol and are shown in Appendix A. In the different EPIC centres, the questions on physical activity were incorporated in face-to-face interviews or self-administered questionnaires. In the Malmö (Sweden) centre and the Italian centre of Naples, which joined EPIC after study inception, physical activity was inquired in a different way, but the data could subsequently be transformed into the EPIC core categories of physical activity (Appendix A). The physical activity questions being asked in the Umeå (Sweden) and Norway centres were different from the EPIC core questions and are not presented here.

The core question on actual professional activity was solicited in most EPIC centres. In the centres in France, Italy, the UK, Germany, The Netherlands, Greece and Sweden, employment status and type of physical activity at work were solicited. In the Danish centres, the question focused only on current type of work activity. Subjects of these centres who did not answer the question were categorised as non-working. In the Spanish centres, all participants were classified into one of the categories of work activity independent of employment status. House-keeping activities were categorised as standing most of the time. Subjects were classified regarding physical activity at work as: non-worker, sedentary, standing, manual, heavy manual and unknown activity at work. Different questions were used in Norway, which was therefore not included in the analysis.

In the EPIC centres in France, Italy (except Naples), Spain, the UK, The Netherlands, Greece and Germany, which contributed to EPIC from the beginning, and in the Danish centres, non-professional physical activity was

assessed by using the core questions regarding specific recreational physical activities, comprising cycling, walking, gardening and sports, and specific home activities, comprising housekeeping and home repair (do-it-yourself). Information on duration of recreational activities was obtained for both summer and winter seasons. This enables analyses of summer and winter differences in recreational activities in the different EPIC study populations. In the Italian centres, household activities were only solicited for women. In the Dutch centres, participants were also asked about the duration of home activities for both summer and winter seasons.

A study of the reproducibility and relative validity of a set of questions closely approximating the EPIC core questions for non-professional activity was performed in a sample of 126 men and women aged 20–70 years from The Netherlands. This study showed that these questions were inappropriate for estimating energy expenditure on an absolute level, but the reproducibility and relative validity of ranking the subjects were within acceptable ranges<sup>15</sup>.

In Naples (Italy), physical activity questions differed slightly from the EPIC core questions. Cycling was not queried as a separate activity, but included in the question on sports/exercise. Participants were asked about the duration of walking, gardening and sports/exercise referring to the entire year and not to summer and winter separately. An evaluation of the differences in these activities between the summer and winter was therefore not possible for the EPIC Naples centre.

In Malmö (Sweden), a variant of the Minnesota Leisure Time Physical Activity Questionnaire was used to assess leisure-time physical activity. This questionnaire asked about participation and duration (hours per week) of 16 recreational activities in all four seasons and included one open-ended question for additional activities (see Appendix B). Different activity items were regrouped according to the EPIC categories (walking, cycling, gardening and sports). The duration of each activity category was calculated and expressed as h week<sup>-1</sup>. For this centre, the mean duration of spring and summer activity represented the EPIC variable for duration of an activity in summer, while that of autumn and winter represented the EPIC variable of winter. In addition, a question was asked regarding housework in the Malmö questionnaire that was comparable with the EPIC core question. The question on climbing stairs did not match with the EPIC core question and home repair activity was not solicited by the Malmö physical activity questionnaire.

In the Italian centres, the duration of non-professional activities was solicited by means of various categories: 0, less than 1, 1–2, 3–4, 5–6, 7–8, 9–10 and 11 or more h week<sup>-1</sup> for recreational activity and home repair; and 0, less than 1, 1–2, 3–4, 5–6 and 7 or more h day<sup>-1</sup> for household activities. These categories were transformed to continuous values by using the mean of each category;

for example, 1–2 h week<sup>-1</sup> was replaced by 1.5 h week<sup>-1</sup>. The maximum category, e.g. 11 or more h week<sup>-1</sup>, was replaced by the sex-specific median value from the participants of the other centres with a duration of more than the penultimate category.

When all physical activity variables were missing, implying that subjects did not answer the physical activity questionnaire, the duration of an activity was set to missing. If at least one of the questions was answered, missing values for other activity items were converted to zero, assuming that the subject completed the questionnaire, but did not participate in that particular activity.

The duration of each separate physical activity was calculated as the mean time dedicated to each activity in summer and winter, expressed as h week<sup>-1</sup>. The duration of total recreational physical activity was calculated as the sum of time dedicated to each of the four leisure activities (walking, cycling, gardening and sports/exercise).

Data on physical activity were available for 77 853 men and 158 533 women aged 50–64 years. The proportion of missing values for the various physical activity items was generally lower than 10% in all centres except in Bilthoven (The Netherlands), where data on professional activity were missing for 21% of the men and 18% of the women; the general population of the UK, where data on professional activity were missing for 11% of the men and 14% of the women; and Asturias (Spain) where data on professional activity were missing for 18% of the men and 9% of the women. In Bilthoven (The Netherlands), the EPIC physical activity questionnaire was used only from the second year onwards, resulting in missing information for 1534 subjects aged 50–64 years who were recruited in the first study year.

### **Statistical analyses**

For the present analysis, the administrative centres were regrouped into 27 EPIC study centres, as described elsewhere<sup>16</sup>. These centres generally refer to geographical regions, except for the centres in the UK, which refer either to a sample of the general population or to a sample of subjects with a health-conscious lifestyle. Since no comparable data for Norway were available, only 25 centres are described here.

Frequency distributions of type of professional activity and participation in non-professional activities are presented for men and women in each centre. For those subjects participating in the different non-professional activities, the mean and standard deviation, and the 10th, 50th (median) and 90th percentiles of the time dedicated to these activities are presented. These statistical measures were adjusted for age, using the residuals of linear regression with age as the independent variable and the duration of each activity as the dependent variable.

Seasonal variation of total duration in recreational activity was analysed by calculating the median difference of duration of total recreational activity in summertime

**Table 1** Frequency distribution of type of professional physical activity in men and women aged 50–64 years in the European Prospective Investigation into Cancer and Nutrition (EPIC) centres

Country and centre	n	Men					Women							
		Professional activity					Professional activity							
		Non-worker (%)	Sedentary worker (%)	Standing worker (%)	Manual worker (%)	Heavy manual (%)	Non-worker (%)	Sedentary worker (%)	Standing worker (%)	Manual worker (%)	Heavy manual (%)	Unknown (%)		
Greece	3739	26.2	23.5	16.8	30.9	2.8	0.0	6040	70.0	7.1	11.3	12.5	0.1	0.0
Greece														
Spain														
Granada	904	0.0	35.3	36.3	15.7	7.9	4.9	2597	0.0	9.7	88.2	1.0	0.0	1.1
Murcia	1291	0.0	35.7	33.6	12.3	9.4	9.1	2331	0.0	9.0	86.4	1.8	0.3	2.5
Navarra	1917	0.0	32.7	32.1	23.6	4.4	7.2	1745	0.0	5.4	85.5	1.0	0.0	8.1
San Sebastian	2147	0.0	32.9	34.3	27.9	3.0	1.9	1639	0.0	8.1	89.6	1.8	0.0	0.4
Asturias	1360	0.0	26.2	42.1	11.0	3.2	17.6	1962	0.0	6.2	82.3	2.6	0.1	8.9
Italy														
Ragusa	1103	24.5	30.1	22.9	7.5	10.7	5.2	967	56.6	23.6	12.0	3.1	1.8	3.0
Naples*	—	—	—	—	—	—	—	2306	65.4	23.4	4.3	5.0	2.0	0.0
Florence	1717	33.3	32.5	18.1	9.2	5.3	1.6	6554	57.9	22.7	12.4	4.7	1.3	0.9
Turin	2886	42.7	28.4	13.2	7.8	2.8	5.1	2446	68.0	12.9	7.9	3.2	2.0	6.1
Varese	1589	43.3	23.1	16.4	12.5	4.0	0.7	4476	73.4	11.6	8.8	4.3	1.3	0.7
France														
South coast*	—	—	—	—	—	—	—	5720	45.6	13.5	33.7	1.8	0.0	5.4
South*	—	—	—	—	—	—	—	10130	44.2	12.9	35.8	1.9	0.0	5.1
North-west*	—	—	—	—	—	—	—	6070	48.2	11.3	33.9	1.7	0.0	4.9
North-east*	—	—	—	—	—	—	—	16750	40.1	17.2	35.4	1.7	0.0	5.7
Germany														
Heidelberg	7235	31.5	42.1	19.3	6.5	0.7	0.1	6442	47.9	27.4	20.7	2.4	0.1	1.5
Potsdam	6139	42.5	33.4	18.1	5.4	0.4	0.1	7418	52.2	29.3	16.4	1.9	0.1	0.1
The Netherlands														
Bilthoven	3233	35.5	20.3	11.6	6.8	4.3	21.3	3560	65.0	10.2	7.6	2.4	1.7	13.0
Utrecht*	—	—	—	—	—	—	—	13479	45.7	18.8	17.3	10.7	6.7	0.8
United Kingdom														
General population	7414	29.7	22.8	12.8	18.8	5.4	10.5	10451	44.7	16.2	16.3	8.8	0.1	13.9
'Health-conscious'	2486	37.3	36.0	14.9	8.2	1.7	1.8	8548	43.4	28.0	22.0	4.2	0.3	2.1
Denmark														
Copenhagen	18526	15.3	41.1	16.0	19.7	7.9	0.0	20884	26.0	35.6	16.8	20.1	1.6	0.0
Aarhus	8323	15.9	36.1	18.8	20.9	8.3	0.0	8600	31.3	25.8	19.8	21.6	1.5	0.0
Sweden														
Malmö	7312	28.4	34.8	25.1	8.3	2.9	0.5	9333	31.8	30.9	30.9	5.5	0.3	0.6
Umeå	5191	28.0	16.2	31.9	19.9	3.2	0.9	5585	25.2	16.4	29.3	22.9	5.1	1.1

\* Only women.

minus wintertime and its 95% confidence interval. Differences between physical activity in summer- and wintertime were assumed to be significant when zero was not included in the confidence interval.

## Results

Table 1 shows the frequency distribution of type of professional activity in men and women from the different EPIC centres. Since the question on professional activity used in the centres from Spain deviated from that used in the remaining centres, professional activity data from these centres are described separately below. In the remaining centres, the proportion of non-workers varied from 15% (Copenhagen, Denmark) to 43% (Varese and Turin, Italy; Potsdam, Germany) in men and from 25% (Umeå, Sweden) to 73% (Varese, Italy) in women. In all EPIC centres, a sedentary or standing professional activity was most common. There was a considerable variation in

the proportion of subjects who did manual and heavy manual work across the centres. Relatively high proportions of participants with a manual or a heavy manual professional activity were observed in men and women from the centres of Greece, Umeå (Sweden) and Denmark, and in women from the centre of Utrecht (The Netherlands).

In the Spanish centres, where activity at work was asked about regardless of employment status, 26–36% of men stated their activity as sedentary, 32–42% as standing, 11–28% manual and 3–9% as heavy manual. Among the Spanish women, between 82% and 90% of the subjects did standing work.

Tables 2–5 show participation and time dedicated to recreational activities for men and women. Walking was the most common recreational activity in all EPIC centres. Participation in walking ranged from 68% (Malmö, Sweden) to 98% (Potsdam, Germany) in men and from 27% (Naples, Italy) to 99% (Potsdam, Germany) in women.

**Table 2** Walking in men and women aged 50–64 years in different European Prospective Investigation into Cancer and Nutrition (EPIC) centres: participation (*n*, %) and age-adjusted mean, standard deviation (SD), and 10th, 50th and 90th percentiles ( $P_{10}$ ,  $P_{50}$  and  $P_{90}$ ) of duration ( $\text{h week}^{-1}$ )

Country and centre	Men									Women						
	<i>n</i> *	Participation		Duration ( $\text{h week}^{-1}$ )					<i>n</i> *	Participation		Duration ( $\text{h week}^{-1}$ )				
		<i>n</i> †	%	Mean	SD	$P_{10}$	$P_{50}$	$P_{90}$		<i>n</i> †	%	Mean	SD	$P_{10}$	$P_{50}$	$P_{90}$
Greece																
Greece	3676	3505	95.4	7.0	5.1	2.1	6.2	13.6	5993	5773	96.3	6.0	3.9	1.9	5.2	10.5
Spain																
Granada	904	856	94.7	9.4	9.0	1.8	7.0	20.2	2597	2464	94.9	6.5	4.6	1.9	5.9	13.8
Murcia	1291	1085	84.0	8.9	8.1	2.2	7.0	17.6	2331	2069	88.8	6.8	5.8	2.0	6.7	13.8
Navarra	1917	1635	85.3	9.1	7.7	1.8	7.3	18.3	1745	1546	88.6	7.8	5.2	2.0	6.9	14.1
San Sebastian	2147	1936	90.2	10.6	8.1	2.7	8.1	20.6	1639	1486	90.7	9.4	6.6	2.7	7.3	17.3
Asturias	1360	1327	97.6	11.3	7.6	3.5	9.1	21.1	1962	1900	96.8	9.6	5.7	3.1	7.3	15.0
Italy																
Ragusa	1064	975	91.6	5.5	4.7	0.9	3.8	14.6	940	864	91.9	3.9	3.5	0.6	2.8	8.3
Naples‡	–	–	–	–	–	–	–	–	2306	617	26.8	2.2	2.3	0.5	1.6	5.5
Florence	1702	1639	96.3	5.1	4.2	1.0	3.8	12.0	6530	6367	97.5	5.2	4.0	1.2	3.7	11.8
Turin	2774	9164	97.1	5.6	4.2	1.2	4.3	12.5	2307	2270	98.4	5.6	4.3	1.3	4.4	12.4
Varese	1585	1507	95.1	4.3	4.0	0.6	2.9	10.2	4470	4236	94.8	3.9	3.7	0.7	2.6	9.4
France																
South coast‡	–	–	–	–	–	–	–	–	5717	5395	94.4	7.0	7.7	1.5	4.8	14.0
South‡	–	–	–	–	–	–	–	–	10 124	9581	94.6	6.7	7.3	1.4	4.6	13.6
North-west‡	–	–	–	–	–	–	–	–	6067	5765	95.0	6.7	7.4	1.5	4.7	13.7
North-east‡	–	–	–	–	–	–	–	–	16 736	15 924	95.2	6.9	7.4	1.4	4.8	14.2
Germany																
Heidelberg	7235	7103	98.2	7.0	6.1	1.6	5.3	14.3	6442	6352	98.6	7.3	6.0	1.8	5.8	14.2
Potsdam	6137	6068	98.9	8.7	6.8	2.1	6.9	17.9	7417	7354	99.2	9.2	6.6	2.5	7.4	17.6
The Netherlands																
Bilthoven	2510	2394	95.4	13.6	13.6	2.4	8.8	34.7	2669	2553	95.7	12.9	13.0	2.2	8.2	33.1
Utrecht‡	–	–	–	–	–	–	–	–	13 384	13 134	98.1	7.9	8.8	1.4	5.0	18.0
United Kingdom																
General population	6992	6476	92.6	9.3	10.9	1.6	5.8	20.3	9894	9288	93.8	8.4	9.0	1.9	5.9	17.3
'Health-conscious'	2476	2402	97.0	6.5	6.2	1.4	4.8	13.4	8510	8270	97.2	7.4	6.5	1.9	5.8	14.7
Denmark																
Copenhagen	18 477	16 988	91.9	4.7	5.6	1.0	3.0	9.8	20 856	19 567	93.8	4.7	4.9	1.1	3.2	9.8
Aarhus	8318	7 503	90.2	3.8	3.5	1.0	2.7	7.8	8 592	8061	93.8	4.1	3.5	1.1	3.1	8.1
Sweden																
Malmö	7288	4939	67.8	3.0	3.1	0.5	2.1	6.4	9 325	6812	73.1	3.5	3.1	0.8	2.8	7.0

\* Number of respondents.

† Number of active participants.

‡ Only women.

Among subjects who participated in walking, the median duration of walking was 7 h week<sup>-1</sup> or more in Bilthoven (The Netherlands), Potsdam (Germany) and most centres from Spain. In contrast, the median duration of walking was less than 3.5 h week<sup>-1</sup> in men and women from Varese and Naples (Italy), women from Ragusa (Italy) and in the centres from Sweden and Denmark. The participation in and time dedicated to cycling were the highest in the centres from The Netherlands. Participation varied from 69% to 87% and the median of duration of cycling varied from 3.1 to 3.6 h week<sup>-1</sup>. A high participation in cycling was also observed in the centres of Copenhagen (Denmark) and Heidelberg (Germany). Relatively low proportions of the study populations from Greece and Spain cycled (2–23%), although these participants spent a considerable time cycling. The proportions of subjects who participated in gardening varied from 22% (San Sebastian, Spain) to 89% (general population, UK) in men and from 13% (Naples, Italy) to 87% ('health-conscious' group, UK) in women. Although

the proportion of participants who gardened was relatively low in the Spanish centres, these participants spent a considerable time gardening; median time spent gardening was 8.1 h week<sup>-1</sup> in men from Asturias (Spain). In the 'health-conscious' group (UK), with the highest participation in gardening among the EPIC centres, the median time dedicated to gardening was 3 h week<sup>-1</sup>. In the EPIC cohort as a whole, less than 50% of the subjects participated in sports/exercise. However, there was a wide variation between centres, ranging from 15% (Granada, Spain) to 55% (Turin, Italy) in men and from 7% (Naples, Italy) to 63% (South coast of France) in women. The median time dedicated to sports and exercise of active participants varied from 1 to 3 h week<sup>-1</sup> in men and women. In the French centres having the highest participation in sports/exercise (53–67%), the median duration of these activities was 2 h week<sup>-1</sup>.

The median of total duration of recreational activity, shown in Table 6, varied for men between 5.0 h week<sup>-1</sup> (Malmö, Sweden) and 15.5 h week<sup>-1</sup> (Bilthoven, The

**Table 3** Cycling in men and women aged 50–64 years in different European Prospective Investigation into Cancer and Nutrition (EPIC) centres: participation (*n*, %) and age-adjusted mean, standard deviation (SD), and 10th, 50th and 90th percentiles (P<sub>10</sub>, P<sub>50</sub> and P<sub>90</sub>) of duration (h week<sup>-1</sup>)

Country and centre	Men								Women							
	<i>n</i> *	Participation		Duration (h week <sup>-1</sup> )					<i>n</i> *	Participation			Duration (h week <sup>-1</sup> )			
		<i>n</i> †	%	Mean	SD	P <sub>10</sub>	P <sub>50</sub>	P <sub>90</sub>		<i>n</i> †	%	Mean	SD	P <sub>10</sub>	P <sub>50</sub>	P <sub>90</sub>
Greece																
Greece	3676	145	3.9	4.5	6.9	0.9	3.1	8.2	5993	131	2.2	3.7	3.2	1.0	2.9	7.0
Spain																
Granada	904	129	14.3	4.5	4.1	0.9	3.1	10.4	2597	53	2.0	2.8	3.6	0.6	1.6	4.9
Murcia	1291	302	23.4	3.6	3.7	0.7	2.2	7.5	2331	208	8.9	3.2	3.3	0.6	2.1	6.9
Navarra	1917	301	15.7	3.2	3.0	0.7	2.3	6.9	1745	218	12.5	2.8	3.0	0.6	2.1	5.8
San Sebastian	2147	207	9.6	3.2	3.1	0.8	2.2	6.5	1639	73	4.5	2.3	2.3	0.6	1.6	4.9
Asturias	1360	227	16.7	4.6	4.2	1.0	3.2	9.8	1962	133	6.8	3.0	2.6	0.9	2.1	7.0
Italy																
Ragusa	1064	401	37.7	1.9	2.2	0.3	1.0	4.4	940	123	13.1	1.5	1.7	0.2	0.8	3.8
Florence	1702	955	56.1	2.6	3.1	0.3	1.4	6.6	6530	2122	32.5	2.6	2.8	0.3	1.6	6.4
Turin	2774	1563	56.4	2.5	3.1	0.3	1.4	6.7	2307	600	26.0	1.7	2.1	0.2	0.8	3.8
Varese	1585	1070	67.5	2.1	2.5	0.2	1.1	5.2	4470	2294	51.3	1.8	2.3	0.3	1.0	4.3
France																
South coast‡	–	–	–	–	–	–	–	–	5717	1158	20.3	3.0	5.4	0.5	1.4	6.9
South‡	–	–	–	–	–	–	–	–	10 124	2933	29.0	2.4	3.7	0.5	1.1	5.0
North-west‡	–	–	–	–	–	–	–	–	6067	1997	32.9	2.5	3.9	0.5	1.1	5.1
North-east‡	–	–	–	–	–	–	–	–	16 736	4740	28.3	2.4	4.1	0.5	1.1	5.1
Germany																
Heidelberg	7235	5064	70.0	3.2	3.3	0.6	2.1	7.1	6442	4046	62.8	3.5	3.2	0.6	2.5	7.4
Potsdam	6137	3315	54.0	3.4	3.4	0.6	2.3	7.3	7417	3845	51.8	3.6	3.4	0.6	2.6	7.6
The Netherlands																
Bilthoven	2510	1738	69.2	5.0	4.9	1.0	3.9	10.1	2669	1865	70.0	5.0	4.8	1.0	3.5	10.0
Utrecht‡	–	–	–	–	–	–	–	–	13 384	11 626	86.9	4.7	4.6	1.0	3.4	9.9
United Kingdom																
General population	6992	1687	24.1	3.0	4.3	0.6	1.8	6.2	9894	2324	23.5	3.0	4.1	0.6	1.9	6.1
'Health-conscious'	2476	783	31.6	3.1	3.5	0.6	1.9	7.2	8510	1765	20.7	2.8	3.3	0.6	1.9	6.0
Denmark																
Copenhagen	18 477	12 590	68.1	3.4	3.7	0.6	2.2	7.7	20 856	15 014	72.0	3.5	3.6	0.8	2.5	7.4
Aarhus	8318	4829	58.1	2.6	2.8	0.6	1.7	5.7	8592	5582	64.9	3.7	2.7	0.6	1.9	5.6
Sweden																
Malmö	7288	3474	47.7	2.4	2.6	0.4	1.6	5.2	9325	4735	50.8	2.5	2.2	0.5	1.9	5.1

\* Number of respondents.

† Number of active participants.

‡ Only women.

**Table 4** Gardening in men and women aged 50–64 years in different European Prospective Investigation into Cancer and Nutrition (EPIC) centres: participation (*n*, %) and age-adjusted mean, standard deviation (SD), and 10th, 50th and 90th percentiles (P<sub>10</sub>, P<sub>50</sub> and P<sub>90</sub>) of duration (h week<sup>-1</sup>)

Country and centre	Men									Women						
	Participation			Duration (h week <sup>-1</sup> )						Participation			Duration (h week <sup>-1</sup> )			
	<i>n</i> *	<i>n</i> †	%	Mean	SD	P <sub>10</sub>	P <sub>50</sub>	P <sub>90</sub>	<i>n</i> *	<i>n</i> †	%	Mean	SD	P <sub>10</sub>	P <sub>50</sub>	P <sub>90</sub>
Greece																
Greece	3676	1856	50.5	7.0	6.6	1.2	4.8	15.0	5993	4113	68.6	6.4	5.3	1.3	5.0	13.9
Spain																
Granada	904	302	33.4	8.6	9.2	1.4	6.0	19.9	2597	649	25.0	3.5	3.3	1.0	2.5	6.9
Murcia	1291	440	34.1	7.9	7.9	1.4	5.2	18.7	2331	442	19.0	3.1	3.7	0.6	2.0	6.9
Navarra	1917	722	37.7	9.1	8.8	1.5	6.3	20.9	1745	406	23.3	3.5	4.4	0.7	2.2	7.2
San Sebastian	2147	481	22.4	8.1	8.4	1.3	5.6	18.9	1639	228	13.9	4.8	5.2	0.8	3.1	11.7
Asturias	1360	501	36.8	11.7	9.9	2.1	8.1	26.5	1962	502	25.6	7.9	7.8	1.1	4.8	20.2
Italy																
Ragusa	1064	705	66.3	5.4	5.1	0.8	3.5	15.7	940	445	47.3	2.5	2.6	0.5	1.6	5.6
Naples‡	–	–	–	–	–	–	–	–	2306	298	12.9	2.1	3.0	0.2	1.1	5.6
Florence	1702	868	51.0	4.5	4.6	0.3	2.8	12.0	6530	3141	48.1	2.3	2.5	0.3	1.4	5.2
Turin	2774	1243	44.8	4.1	4.0	0.5	2.8	10.4	2307	908	39.4	2.3	2.5	0.3	1.4	5.9
Varese	1585	1135	71.6	4.3	4.0	0.5	2.9	10.4	4470	2755	61.6	2.1	2.3	0.2	1.4	4.8
France																
South coast‡	–	–	–	–	–	–	–	–	5717	3822	66.9	4.0	4.9	0.7	2.4	8.6
South‡	–	–	–	–	–	–	–	–	10124	7144	70.6	3.6	4.2	0.7	2.2	8.0
North-west‡	–	–	–	–	–	–	–	–	6067	4417	72.8	3.5	4.1	0.6	2.1	8.0
North-east‡	–	–	–	–	–	–	–	–	16736	11001	65.7	3.4	4.2	0.6	2.1	7.6
Germany																
Heidelberg	7235	4962	68.6	4.2	5.3	0.5	2.5	9.8	6442	3903	60.6	3.2	3.5	0.5	2.1	7.3
Potsdam	6137	4489	73.2	6.8	5.7	1.3	5.2	14.3	7417	4853	65.4	5.2	4.4	1.1	3.9	10.8
The Netherlands																
Bilthoven	2510	1549	61.7	3.7	4.1	0.6	2.4	8.1	2669	1411	52.9	2.8	3.0	0.6	1.9	5.7
Utrecht‡	–	–	–	–	–	–	–	–	13384	9179	68.6	2.5	2.8	0.5	1.7	5.4
United Kingdom																
General population	6992	6197	88.6	5.4	6.0	0.8	3.7	11.8	9894	8081	81.7	4.5	4.8	0.8	3.0	10.0
'Health-conscious'	2476	2164	87.4	4.4	4.8	0.7	3.0	9.6	8510	7418	87.2	4.3	4.1	0.9	3.1	9.3
Denmark																
Copenhagen	18477	13840	74.9	3.3	3.5	0.6	2.4	6.9	20856	13400	64.3	2.8	2.8	0.6	2.0	5.9
Aarhus	8318	7081	85.1	3.2	3.2	0.7	2.4	6.5	8592	6405	74.6	2.8	2.9	0.6	1.9	5.8
Sweden																
Malmö	7288	3797	52.1	2.5	3.0	0.4	1.9	5.5	9325	3790	40.6	2.4	2.6	0.3	1.7	5.3

\* Number of respondents.

† Number of active participants.

‡ Only women.

Netherlands) and for women between zero (Naples, Italy) and 14.1 h week<sup>-1</sup> (Bilthoven, The Netherlands). The proportion of subjects who did not participate in any recreational activities was less than 10% in all centres, except in the centres of Naples (Italy) and Malmö (Sweden).

Analysis of the difference in duration of total recreational activity between summer and winter seasons showed that, for all centres, time dedicated to recreational activity was higher in the summer than in winter. As shown in Table 7, the differences between summer and winter seasons were more pronounced for the centres from northern Europe than for the centres in southern Europe. The difference between summer- and wintertime was clearest for gardening. There was also a clear difference for duration of cycling between summertime and wintertime, especially in the centres from The Netherlands, Germany, Sweden and Denmark. For walking and for sports/exercise, only a small difference between

summer and winter was observed in most centres (data not shown).

Table 8 shows participation in and time dedicated to household activities among men and women from the different EPIC centres. Almost all women performed household activities, while there were substantial variations in the proportions of men who performed household activities between centres. In the Spanish centres, about one-third of the men took part in housework, whereas in the centre of Malmö (Sweden), almost all men participated in household activities. In men of all centres, the median duration of household activities was less than 7 h week<sup>-1</sup>. In women, time spent on household activities was the highest in the centres of the Mediterranean countries, with a median duration of 23–39 h week<sup>-1</sup>. Among women from the British, German, Swedish and Dutch centres, the median duration of household activities was between 10 and 20 h week<sup>-1</sup>. The median duration of household activities was less than

**Table 5** Sports/exercise in men and women aged 50–64 years in different European Prospective Investigation into Cancer and Nutrition (EPIC) centres: participation (*n*, %) and age-adjusted mean, standard deviation (SD), and 10th, 50th and 90th percentiles (P<sub>10</sub>, P<sub>50</sub> and P<sub>90</sub>) of duration (h week<sup>-1</sup>)

Country and centre	Men									Women						
	Participation			Duration (h week <sup>-1</sup> )						Participation			Duration (h week <sup>-1</sup> )			
	<i>n</i> *	<i>n</i> †	%	Mean	SD	P <sub>10</sub>	P <sub>50</sub>	P <sub>90</sub>	<i>n</i> *	<i>n</i> †	%	Mean	SD	P <sub>10</sub>	P <sub>50</sub>	P <sub>90</sub>
Greece																
Greece	3676	1061	28.9	2.2	2.4	0.5	1.1	5.0	5993	1373	22.9	2.5	2.4	0.5	1.5	5.0
Spain																
Granada	904	139	15.4	3.7	3.9	1.0	3.0	7.0	2597	370	14.3	2.7	3.0	1.0	2.0	5.0
Murcia	1291	242	18.8	3.8	3.5	1.0	3.0	7.5	2331	288	12.4	2.8	4.0	1.0	2.0	5.0
Navarra	1917	405	21.1	3.4	3.1	1.0	2.5	7.0	1745	348	19.9	2.5	2.4	1.0	2.0	5.0
San Sebastian	2147	611	28.5	4.1	4.1	1.0	3.0	9.0	1639	454	27.7	3.8	3.6	1.0	3.0	7.0
Asturias	1360	282	20.7	4.1	4.0	0.9	3.0	8.0	1962	332	16.9	2.9	2.4	1.0	3.0	6.0
Italy																
Ragusa	1064	265	24.9	2.1	2.4	0.3	1.5	4.8	940	224	23.8	1.8	2.0	0.5	1.5	3.7
Naples‡	–	–	–	–	–	–	–	–	2306	167	7.2	1.8	1.2	0.5	1.5	3.5
Florence	1702	840	19.4	2.9	3.0	0.5	1.6	6.5	6530	2673	40.9	2.2	2.2	0.5	1.5	4.8
Turin	2774	1531	55.2	3.0	3.3	0.5	1.5	7.5	2307	1080	46.8	2.2	2.2	0.5	1.5	4.5
Varese	1585	794	50.1	2.1	2.4	0.4	1.5	4.6	4470	1913	42.8	1.8	1.8	0.5	1.5	3.5
France																
South coast‡	–	–	–	–	–	–	–	–	5717	3582	62.7	3.6	4.8	1.0	2.0	7.5
South‡	–	–	–	–	–	–	–	–	10 124	5814	57.4	3.5	4.9	1.0	2.0	8.0
North-west‡	–	–	–	–	–	–	–	–	6067	3278	54.0	3.3	4.7	1.0	2.0	7.5
North-east‡	–	–	–	–	–	–	–	–	16 736	8925	53.3	3.6	5.2	1.0	2.0	8.0
Germany																
Heidelberg	7235	3598	49.7	3.2	2.8	1.0	2.4	6.4	6442	3488	54.1	2.6	2.5	1.0	2.0	5.0
Potsdam	6137	1805	29.4	2.6	2.3	1.0	2.0	5.0	7417	2743	37.0	2.0	1.6	1.0	1.5	4.0
The Netherlands																
Bilthoven	2510	1128	44.9	3.3	3.4	1.0	2.0	7.0	2669	1373	51.4	2.6	3.1	1.0	2.0	5.0
Utrecht‡	–	–	–	–	–	–	–	–	13 384	7492	56.0	2.5	2.5	1.0	2.0	5.0
United Kingdom																
General population	6992	2584	37.0	3.3	3.4	0.9	2.0	7.0	9894	4353	44.0	2.9	3.6	1.0	2.0	6.0
'Health-conscious'	2476	1292	52.2	3.4	3.2	1.0	2.1	7.0	8510	5008	58.9	3.1	3.3	1.0	2.0	6.0
Denmark																
Copenhagen	18 477	9146	49.5	2.9	2.6	0.9	2.0	6.0	20 856	12 127	58.2	2.2	2.0	0.5	1.5	4.5
Aarhus	8318	3801	45.7	2.6	2.4	0.6	2.0	5.0	8592	4992	58.1	2.0	2.0	0.5	1.5	4.0
Sweden																
Malmö	7288	2981	40.9	2.6	2.8	0.5	1.7	6.0	9325	3688	39.6	2.1	2.3	0.5	1.5	5.0

\* Number of respondents.

† Number of active participants.

‡ Only women.

10 h week<sup>-1</sup> for the women from the Danish and the French centres.

The proportion of subjects who did home repair (do-it-yourself) activities varied between EPIC centres from 11% (San Sebastian, Spain) to 89% (Varese, Italy) in men and from 2% (Naples, Italy) to 66% (Varese, Italy) in women (Table 9). Overall, the median duration of this activity was less than 1 hour daily in all centres. The proportion of women from the Spanish centres who did home repair was low compared with women from the other centres, although they spent the most time in this activity.

## Discussion

This study describes the types of physical activity and the amount of time dedicated to these activities in the different EPIC centres. Professional activities were mainly sedentary or standing in almost all centres. A higher proportion of

manual work was observed in participants from the centres of Greece, Umeå (Sweden) and Aarhus (Denmark), men from the Copenhagen (Denmark) centre and women from the Utrecht (The Netherlands) centre.

In men, the highest participation rates were found for walking, followed by gardening and home repair, and in women for household activities and walking. In most of the centres, participation in sports and cycling was lower than participation in other non-professional activities. Interesting deviations from this pattern were observed in some centres. In The Netherlands, cycling was more common than in most other centres, and in the French centres, the women participated in sports/exercise more frequently than women from the other centres.

Overall, the EPIC participants devoted only a limited time to their recreational activities. The median duration of activity was the highest (15 h week<sup>-1</sup>) in men from the centre of Bilthoven (The Netherlands), but in most centres



**Table 6** Total recreational activity in men and women aged 50–64 years in different European Prospective Investigation into Cancer and Nutrition (EPIC) centres: proportion of non-participants (%), and age-adjusted mean, standard deviation (SD), and 10th, 50th and 90th percentiles (P<sub>10</sub>, P<sub>50</sub> and P<sub>90</sub>) of duration (h week<sup>-1</sup>); and 10th, 50th and 90th percentiles of energy expenditure (kcal day<sup>-1</sup>)

Country and centre	Men											Women																		
	n*				Non-participants (%)				Duration (h week <sup>-1</sup> )			Energy expenditure (kcal day <sup>-1</sup> )			n*				Non-participants (%)				Duration (h week <sup>-1</sup> )			Energy expenditure (kcal day <sup>-1</sup> )				
	Mean	SD	P <sub>10</sub>	P <sub>90</sub>	Mean	SD	P <sub>10</sub>	P <sub>90</sub>	Mean	SD	P <sub>10</sub>	P <sub>50</sub>	P <sub>90</sub>	Mean	SD	P <sub>10</sub>	P <sub>50</sub>	P <sub>90</sub>	Mean	SD	P <sub>10</sub>	P <sub>50</sub>	P <sub>90</sub>	Mean	SD	P <sub>10</sub>	P <sub>50</sub>	P <sub>90</sub>		
Greece	3676	1.6	11.2	8.9	3.2	9.0	21.7	88.4	293.2	807.2	5993	1.0	10.9	6.9	3.5	9.7	20.4	102.6	339.1	764.6										
Spain																														
Granada	904	3.4	13.1	12.0	1.8	9.9	28.2	50.2	304.8	994.3	2597	3.5	7.5	5.9	1.7	6.7	14.6	44.7	177.3	455.3										
Murcia	1291	8.4	11.9	11.5	1.2	9.0	25.7	34.3	286.3	946.9	2331	9.3	7.3	7.1	0.7	6.6	14.3	16.6	174.8	451.1										
Navarra	1917	6.0	12.6	10.2	1.8	10.5	26.0	58.5	333.6	944.3	1745	6.1	8.6	6.5	1.3	7.3	17.1	37.0	215.1	533.6										
San Sebastian	2147	6.0	12.9	10.2	2.7	10.9	26.3	77.1	324.6	855.9	1639	6.7	10.4	8.1	1.9	8.8	19.6	55.9	264.1	632.8										
Asturias	1360	1.0	17.3	12.0	5.2	14.4	34.2	131.1	444.4	1265.8	1962	2.1	12.3	8.5	3.3	10.3	22.7	93.1	320.0	786.7										
Italy																														
Ragusa	1064	3.9	9.9	8.1	1.4	7.5	21.4	46.5	264.1	832.3	940	4.8	5.4	5.1	0.7	4.0	12.4	20.0	128.5	411.5										
Naples†	—	—	—	—	—	—	—	—	—	—	2306	60.3	1.0	2.1	0.0	0.0	3.3	0.0	0.0	96.5										
Florence	1702	1.2	10.1	7.8	2.2	8.2	20.5	75.8	299.0	846.3	6530	1.0	7.9	6.2	1.7	6.3	16.1	50.7	209.9	573.3										
Turin	2774	0.7	10.3	7.7	2.3	8.3	20.9	76.9	299.3	836.4	2307	0.9	7.9	5.9	1.7	6.3	15.9	50.6	207.0	532.2										
Varese	1585	0.8	9.6	7.6	1.8	7.4	19.6	70.0	292.1	780.4	4470	1.3	6.7	5.8	1.3	5.1	14.6	44.5	188.7	520.2										
France																														
South coast†	—	—	—	—	—	—	—	—	—	—	5717	2.0	12.2	12.0	3.0	9.2	23.6	100.4	336.3	897.2										
South†	—	—	—	—	—	—	—	—	—	—	10 124	1.9	11.6	10.8	2.8	8.7	22.7	96.9	313.4	859.2										
North-west†	—	—	—	—	—	—	—	—	—	—	6067	1.7	11.6	10.8	2.8	8.8	22.4	94.5	316.0	869.9										
North-east†	—	—	—	—	—	—	—	—	—	—	16 736	1.9	11.4	11.0	2.7	8.6	22.7	86.9	300.1	848.8										
Germany																														
Heidelberg	7235	5.0	13.5	9.9	4.1	11.2	25.8	140.2	427.2	1007.9	6442	0.3	12.8	8.6	4.3	11.0	23.7	144.4	402.2	897.0										
Potsdam	6137	0.2	16.1	10.4	5.2	13.8	30.2	175.8	503.7	1140.4	7417	0.1	15.2	9.0	5.7	13.4	27.1	184.9	462.4	980.8										
The Netherlands																														
Bilthoven	2510	1.2	20.2	16.0	5.1	15.5	42.7	184.3	575.8	1439.0	2669	1.5	18.6	15.4	4.6	14.1	39.9	162.1	510.5	1286.6										
Utrecht†	—	—	—	—	—	—	—	—	—	—	13 384	0.3	14.9	11.6	4.6	11.7	29.3	176.7	464.3	1102.7										
United Kingdom																														
General population	6992	1.6	15.4	13.8	3.6	11.7	31.8	122.6	429.9	1122.3	9894	2.1	13.6	11.7	3.5	10.6	26.6	118.5	378.7	953.8										
'Health-conscious'	2476	0.7	12.9	9.2	3.9	10.8	24.5	139.3	400.7	935.4	8510	0.7	13.4	9.4	4.3	11.3	24.9	151.2	404.1	926.3										
Denmark																														
Copenhagen	18 477	0.9	10.5	8.5	3.1	8.6	19.8	113.9	348.5	826.7	20 856	0.9	10.1	7.4	3.1	8.4	18.7	113.1	336.1	767.7										
Aarhus	8318	1.1	8.8	6.3	2.7	7.5	16.3	100.8	300.0	680.8	8592	1.0	8.8	6.1	2.8	7.4	16.3	99.2	291.1	665.9										
Sweden																														
Malmö	7288	16.2	5.8	5.2	0.0	5.0	12.5	0.0	202.4	536.3	9325	17.0	5.9	5.0	0.0	5.1	12.4	0.0	198.0	512.3										

\* Number of respondents.

† Only women.

**Table 7** Differences in duration of recreational activities between summer and winter (h week<sup>-1</sup>) in men and women aged 50–64 years in different European Prospective Investigation into Cancer and Nutrition (EPIC) centres: median, 95% confidence interval

Country and centre	Men				Women			
	n*	Difference of duration (h week <sup>-1</sup> ) summer – winter			n*	Difference of duration (h week <sup>-1</sup> ) summer – winter		
		Median	Lower confidence limit	Upper confidence limit		Median	Lower confidence limit	Upper confidence limit
Greece								
Greece	3676	1.1	1.0	1.3	5993	1.7	1.2	1.8
Spain								
Granada	904	0.3	0.2	0.4	2597	0.1	0.0	0.1
Murcia	1291	0.4	0.3	0.5	2331	0.0	0.0	0.1
Navarra	1917	0.7	0.7	0.8	1745	0.1	0.0	0.1
San Sebastián	2147	0.6	0.5	0.6	1639	0.1	0.1	0.1
Asturias	1360	0.6	0.5	0.6	1962	0.1	0.1	0.2
Italy								
Ragusa	1064	2.0	1.7	2.3	940	1.0	0.6	1.2
Florence	1702	2.6	2.4	2.6	6530	1.9	1.8	1.9
Turin	2774	3.8	3.6	4.0	2307	2.1	2.0	2.1
Varese	1585	4.4	4.1	4.8	4470	2.6	2.4	2.7
France								
South coast†	–	–	–	–	5717	2.2	2.1	2.2
South†	–	–	–	–	10 124	4.0	3.9	4.1
North-west†	–	–	–	–	6067	4.0	3.9	4.1
North-east†	–	–	–	–	16 736	4.1	4.0	4.2
Germany								
Heidelberg	7235	4.6	4.4	4.8	6442	4.1	4.0	4.2
Potsdam	6137	6.7	6.5	7.0	7417	6.1	6.0	6.2
The Netherlands								
Bilthoven	2510	5.5	5.0	5.7	2669	5.0	4.1	5.0
Utrecht†	–	–	–	–	13 384	5.0	4.9	5.1
United Kingdom								
General population	6992	5.2	5.1	5.4	9894	5.0	4.9	5.1
‘Health-conscious’	2476	4.5	4.2	4.7	8510	5.1	5.1	5.2
Denmark								
Copenhagen	18 477	3.9	3.9	4.0	20 856	3.8	3.8	3.9
Aarhus	8318	4.3	4.1	4.4	8592	4.0	3.9	4.1
Sweden								
Malmö	7288	0.7	0.7	0.8	9325	0.7	0.7	0.7

\* Number of respondents.

† Only women.

the duration was considerably lower. The variations in total time spent for recreational activities were mainly due to differences in time spent on walking and gardening. Cycling and sports were less common among participants from the southern European centres (Spain; Greece; Ragusa and Naples, Italy) compared with the central and northern European centres. A finding of a similar geographical distribution of recreational activity pattern was documented in a pan-European survey. In this study, physical activity and attitudes and beliefs about physical activity in the European Union were investigated<sup>17</sup>.

There was a clear difference in the duration of total recreational activity between summer and winter in almost all centres, which is consistent with common knowledge. Seasonal variation of recreational activity is clearly associated with environmental factors such as temperature and numbers of hours of daylight per day<sup>18</sup>. Unfavourable conditions for recreational activities are more pronounced in northern Europe than in southern Europe across the

seasons. This is in accordance with our finding of more apparent summer vs. winter differences in recreational activity in centres from northern and middle Europe (except in Malmö, Sweden) than in centres from southern Europe. Furthermore, gardening contributed the most to the seasonal differences, compared with the other recreational activities, across EPIC centres. This activity is highly dependent on weather conditions.

The regional distribution of physical activity may clearly be influenced by cultural conditions<sup>19</sup> and environmental factors. However, it can also be that the differences in responses to the core questions on physical activities in EPIC might partly be influenced by the local conditions. The EPIC questions were formulated in English and then translated into the local language. Therefore participants may have interpreted the questions differently in the various centres.

We are already aware of a number of limiting features of the data, mostly related to centre-specific differences. In

**Table 8** Household activity in men and women aged 50–64 years in different European Prospective Investigation into Cancer and Nutrition (EPIC) centres: participation (*n*, %) and age-adjusted mean, standard deviation (SD), and 10th, 50th and 90th percentiles (P<sub>10</sub>, P<sub>50</sub> and P<sub>90</sub>) of duration (h week<sup>-1</sup>)

Country and centre	Men									Women						
	Participation			Duration (h week <sup>-1</sup> )						Participation			Duration (h week <sup>-1</sup> )			
	<i>n</i> *	<i>n</i> †	%	Mean	SD	P <sub>10</sub>	P <sub>50</sub>	P <sub>90</sub>	<i>n</i> *	<i>n</i> †	%	Mean	SD	P <sub>10</sub>	P <sub>50</sub>	P <sub>90</sub>
Greece																
Greece	3676	2039	55.5	5.8	5.7	1.3	3.5	13.9	5993	5906	98.6	29.7	12.0	14.8	28.6	42.5
Spain																
Granada	904	239	26.4	6.0	6.4	0.9	3.7	14.1	2597	2584	99.5	37.3	14.2	19.9	35.5	56.0
Murcia	1291	319	24.7	6.8	6.8	1.4	4.2	14.3	2331	2293	98.4	36.3	16.3	14.5	35.3	56.4
Navarra	1917	521	27.2	6.2	6.7	1.1	4.1	14.0	1745	1727	99.0	37.4	16.0	14.2	39.3	56.5
San Sebastian	2147	708	33.0	7.2	7.0	1.4	5.2	14.4	1639	1605	97.9	34.9	17.2	13.1	35.0	56.5
Asturias	1360	412	30.3	7.3	7.2	1.4	5.5	14.4	1962	1924	98.1	31.8	13.4	13.9	34.5	49.1
Italy																
Ragusa‡	–	–	–	–	–	–	–	–	940	940	100.0	33.2	15.8	10.9	37.5	56.4
Naples‡	–	–	–	–	–	–	–	–	2306	2304	99.9	25.6	21.1	3.2	23.5	56.4
Florence‡	–	–	–	–	–	–	–	–	6530	6508	99.7	28.3	15.7	10.2	23.9	55.7
Turin‡	–	–	–	–	–	–	–	–	2307	2296	99.5	27.9	15.4	10.2	23.8	55.7
Varese‡	–	–	–	–	–	–	–	–	4470	4442	99.4	31.4	15.4	10.8	24.3	56.0
France																
South coast‡	–	–	–	–	–	–	–	–	5717	5441	95.2	6.5	4.2	2.5	4.5	13.0
South‡	–	–	–	–	–	–	–	–	10 124	9594	94.8	6.3	4.1	2.8	4.4	12.8
North-west‡	–	–	–	–	–	–	–	–	6067	5767	95.1	6.1	4.0	2.8	4.3	12.5
North-east‡	–	–	–	–	–	–	–	–	16 736	15 359	91.8	6.1	4.1	2.7	4.3	12.7
Germany																
Heidelberg	7235	5023	69.4	5.2	5.4	1.0	3.3	11.8	6442	6396	99.3	20.0	12.5	5.8	18.9	35.5
Potsdam	6137	4985	81.2	6.1	5.8	1.3	4.3	13.9	7417	7380	99.5	15.5	9.0	5.4	13.9	27.9
The Netherlands																
Bilthoven	2510	1728	68.8	6.5	6.8	1.2	4.4	14.2	2669	2637	98.8	21.3	14.1	5.9	19.7	40.2
Utrecht‡	–	–	–	–	–	–	–	–	13 384	13 322	99.5	19.3	11.4	5.9	17.5	35.7
United Kingdom																
General population	6992	3797	54.3	5.5	6.3	1.1	3.5	11.8	9894	9356	94.6	20.1	14.4	5.1	16.8	39.4
'Health-conscious'	2476	2045	82.6	6.4	6.1	1.2	4.4	14.1	8510	8292	97.4	16.7	12.4	4.2	14.0	30.8
Denmark																
Copenhagen	18 477	16 229	87.8	3.6	3.4	1.0	2.5	7.4	20 856	20 652	99.0	7.2	6.1	2.0	5.3	14.5
Aarhus	8318	6945	83.5	3.2	3.0	0.9	2.3	6.4	8592	8530	99.3	8.2	6.8	2.4	6.1	16.8
Sweden																
Malmö	7288	6818	93.6	6.8	4.8	1.7	5.4	14.3	9325	9111	97.7	17.3	9.5	6.4	15.6	29.9

\* Number of respondents.

† Number of active participants.

‡ Only women.

the centres from Spain, at present, work activity data do not distinguish between working and non-working participants. Therefore, professional activity described for these centres is not directly comparable with this activity in the remaining centres. In Spain, participants were asked about their main work-like activity, which corresponds to the main activity of the day rather than to work activity. For most individuals, however, the main activity of the day is consistent with work activity. Nevertheless, a much higher proportion of women from Spain reported a standing work activity compared with women from the other centres. This is probably due to classification of subjects who mainly did housekeeping activities as having a standing work activity. For men in the Spanish centres, the reported type of activity is more likely to be in agreement with work activity.

In Malmö, the recreational physical activity data were solicited through a different mode and subsequently

re-coded into the four EPIC recreational activity categories: sports, cycling, walking and gardening. On the whole, the comparability of the EPIC questions and the Malmö questions is not yet known. The comparability of both questions will be tested in a sample of the EPIC Malmö cohort during follow-up in the future. The present analysis showed that participation in and duration of most recreational activities were relatively low in the Malmö centre compared with other centres from northern Europe such as the Danish centres. These differences may represent differences in activity level between Malmö and the other centres, but may also represent differences due to the application of a different mode of inquiry.

Also, in Naples (Italy), questions other than the core EPIC questions were used to assess non-professional activity. Participation in and time dedicated to recreational activity were much lower for Naples than for all other centres. This may be due to differences between centres as

**Table 9** Home repair (do-it-yourself) activity in men and women aged 50–64 years in different European Prospective Investigation into Cancer and Nutrition (EPIC) centres: participation (*n*, %) and age-adjusted mean, standard deviation (SD), and 10th, 50th and 90th percentiles (P<sub>10</sub>, P<sub>50</sub> and P<sub>90</sub>) of duration (h week<sup>-1</sup>)

Country and centre	Men								Women							
	Participation			Duration (h week <sup>-1</sup> )					Participation			Duration (h week <sup>-1</sup> )				
	<i>n</i> *	<i>n</i> †	%	Mean	SD	P <sub>10</sub>	P <sub>50</sub>	P <sub>90</sub>	<i>n</i> *	<i>n</i> †	%	Mean	SD	P <sub>10</sub>	P <sub>50</sub>	P <sub>90</sub>
Greece																
Greece	3676	755	20.5	3.9	4.1	1.0	2.5	8.4	5993	281	4.7	2.5	2.8	0.7	1.7	5.2
Spain																
Granada	904	119	13.2	6.4	8.5	1.0	3.5	14.6	2597	159	6.1	5.5	8.0	1.0	2.8	13.4
Murcia	1291	208	16.1	6.7	9.4	1.0	2.8	15.2	2331	73	3.1	6.9	10.4	1.1	3.3	20.4
Navarra	1917	299	15.6	4.9	6.6	0.8	2.6	10.7	1745	255	14.6	10.1	10.2	1.4	6.6	21.5
San Sebastian	2147	237	11.0	5.5	7.2	1.1	2.6	14.0	1639	59	3.6	6.3	8.6	1.3	3.5	14.6
Asturias	1360	248	18.2	7.4	9.4	0.9	3.6	19.4	1962	48	2.5	6.7	9.2	0.8	2.8	21.3
Italy																
Ragusa	1064	689	64.8	2.9	4.2	0.2	1.4	7.8	940	557	59.3	4.7	4.8	0.6	2.9	14.9
Naples‡	–	–	–	–	–	–	–	–	2306	56	2.4	2.2	4.1	0.1	0.8	5.5
Florence	1702	1453	85.4	3.4	4.5	0.3	1.8	8.6	6530	4231	64.8	2.8	3.3	0.4	1.6	7.1
Turin	2774	2421	87.3	3.8	4.7	0.5	2.0	9.4	2307	1453	63.0	3.1	3.6	0.4	1.6	7.6
Varese	1585	1417	89.4	4.4	5.4	0.4	2.1	17.3	4470	2970	66.4	3.0	3.7	0.4	1.6	7.7
France																
South coast‡	–	–	–	–	–	–	–	–	5717	2817	49.3	4.0	5.3	0.9	2.4	9.1
South‡	–	–	–	–	–	–	–	–	10 124	5257	51.9	4.1	5.4	0.9	2.4	9.1
North-west‡	–	–	–	–	–	–	–	–	6067	3205	52.8	4.3	5.6	0.9	2.4	10.1
North-east‡	–	–	–	–	–	–	–	–	16 736	8507	50.8	4.4	5.8	0.9	2.4	10.0
Germany																
Heidelberg	7235	4696	64.9	4.8	6.8	0.8	2.4	10.7	6442	1279	19.9	3.1	5.4	0.6	1.5	6.2
Potsdam	6137	3675	64.8	6.4	7.8	1.0	3.4	15.2	7417	1009	13.6	3.5	5.4	0.7	1.7	7.4
The Netherlands																
Bilthoven	2510	1746	69.6	6.4	6.9	1.2	3.9	14.8	2669	642	24.1	4.4	5.6	1.0	2.4	10.2
Utrecht‡	–	–	–	–	–	–	–	–	13 384	3900	29.1	3.8	4.7	0.9	2.3	8.5
United Kingdom																
General population	6992	4919	70.4	5.2	6.4	0.9	2.8	10.7	9894	2073	21.0	4.7	7.4	0.8	2.2	10.4
'Health-conscious'	2476	1913	77.3	4.6	5.8	0.8	2.6	10.5	8510	3470	40.8	3.7	5.0	0.8	2.1	8.4
Denmark																
Copenhagen	18 477	15 512	84.0	3.7	4.3	0.8	2.4	8.2	20 856	8766	42.0	2.3	2.8	0.6	1.4	4.6
Aarhus	8318	7181	86.3	3.6	4.2	0.9	2.4	7.7	8592	3625	42.2	2.2	2.8	0.6	1.4	4.3

\* Number of respondents.

† Number of active participants.

‡ Only women.

well as to the use of different questions. The comparability of the physical activity questions used in the EPIC Naples centre and the EPIC physical activity questions has not yet been studied.

This study was not intended to show differences in energy expenditure across centres or to rank subjects and centres based on their activity level. Calculation of total time dedicated to physical activities is a different concept to the energy cost of activities. Nevertheless, Table 6 shows, alongside information on total duration of activities, estimates of energy expenditure calculated using the energy cost coefficients of Schofield and James<sup>20</sup>. It illustrates a discrepancy between rankings of the centres based on duration of activity and energy expenditure.

In EPIC, the information on intensity of non-professional physical activity is limited. Analysis based on duration of non-professional activity with a moderate-to-high intensity such as sports and cycling showed a low participation in these activities among participants from

the Greek and Spanish centres and from Ragusa and Naples (Italy). Intensity of physical activity was also solicited in EPIC by inquiring about duration of non-professional activities done vigorously enough to cause sweating and/or a faster heart beat (Appendix A). We did not present the results here because we felt that this variable may be confounded with other factors such as temperature<sup>21</sup>. In addition, subjects with a low degree of fitness may experience sweating and/or a faster heart beat earlier than fitter individuals.

A further limitation of our analysis was the restriction to the age group of 50–64 years. This group is relatively heterogeneous with respect to time dedicated to any kind of physical activity, since it involves both subjects who still have a profession and those who are retired. Non-workers have quite different activity patterns from employed subjects. Employed workers dedicate less time to recreational activities, sports and gardening, and household activities (data not shown). Physical activity of the younger age groups may also be of interest, since a

different effect of physical activity on breast cancer risk has been observed in premenopausal women compared with postmenopausal women<sup>9</sup>.

Although the comparability of the physical activity data may be restricted, the EPIC study does enable description of the variation of a number of different types of activities, covering the main activities during the day and differences in duration of recreational physical activity, for a large number of subjects from various study populations across Europe. This may be of interest for other study groups. However, since the EPIC study populations were not intended to be representative of geographical regions, generalisation of the results of our analysis in terms of regional differences in physical activity are not appropriate, and the current analysis should be considered primarily as the description of activity patterns in the EPIC study centres.

### Acknowledgements

The work described in this paper was carried out with financial support of the 'Europe Against Cancer Programme' of the European Commission (SANCO); Ligue contre le Cancer (France); Société 3M (France); Mutuelle Générale de l'Éducation Nationale; Institut National de la Santé et de la Recherche Médicale (INSERM); Institute Gustave Roussy; German Cancer Aid; German Cancer Research Centre; German Federal Ministry of Education and Research; Danish Cancer Society; Health Research Fund (FIS) of the Spanish Ministry of Health; the Spanish Regional Governments of Andalucía, Asturias, Basque Country, Murcia and Navarra; Cancer Research UK; Medical Research Council, UK; Stroke Association, UK; British Heart Foundation; Department of Health, UK; Food Standards Agency, UK; Wellcome Trust, UK; Greek Ministry of Health; Greek Ministry of Education; Italian Association for Research on Cancer; Italian National Research Council; Dutch Ministry of Public Health, Welfare and Sports; Dutch Prevention Funds; LK Research Funds; Dutch ZON (Zorg Onderzoek Nederland); World Cancer Research Fund; Swedish Cancer Society; Swedish Scientific Council; Regional Government of Skane, Sweden; Norwegian Cancer Society; Norwegian Research Council. Partial support for the publication of this supplement was provided by the Centre de Recherche et d'Information Nutritionnelles (CERIN).

In addition, we wish to thank all study participants for their co-operation and all interviewers who participated in the fieldwork studies in each EPIC centre.

### References

- 1 US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, The President's Council of Sports and Physical Fitness. *Physical Activity and Health: A Report of the Surgeon General*. Washington, DC: Office of the Surgeon General, 1996.
- 2 Friedenreich CM. Physical activity and cancer prevention: from observational to intervention research. *Cancer Epidemiol. Biomark. Prev.* 2001; **10**: 287–301.
- 3 Vainio H, Bianchini F, Cheney J. *IARC Handbook of Cancer Prevention. Vol. 6. Weight Control and Physical Activity*. Lyon: IARC Press, 2002.
- 4 Colbert LH, Hartman TJ, Malila N, Limburg PJ, Pietinen P, Virtamo J, *et al.* Physical activity in relation to cancer of the colon and rectum in a cohort of male smokers. *Cancer Epidemiol. Biomark. Prev.* 2001; **10**: 265–8.
- 5 Shoff SM, Newcomb PA, Trentham-Dietz A, Remington PL, Mittendorf M, Greenberg ER, *et al.* Early-life physical activity and postmenopausal breast cancer: effect of body size and weight change. *Cancer Epidemiol. Biomark. Prev.* 2000; **9**: 591–5.
- 6 Verloop J, Rookus MA, van der Kooy K, van Leeuwen FE. Physical activity and breast cancer risk in women aged 20–54 years. *J. Natl. Cancer Inst.* 2000; **92**: 128–35.
- 7 Friedenreich CM, Thune I, Brinton LA, Albanes D. Epidemiologic issues related to the association between physical activity and breast cancer. *Cancer* 1998; **89**(Suppl. 3): 600–10.
- 8 Gammon MD, John EM, Britton JA. Recreational and occupational physical activities and risk of breast cancer. *J. Natl. Cancer Inst.* 1998; **90**: 100–17.
- 9 Thune I, Brenn T, Lund E, Gaard M. Physical activity and the risk of breast cancer. *N. Engl. J. Med.* 1997; **336**: 1269–75.
- 10 Lee I-M, Sesso HD, Paffenberger RS. Physical activity and risk of lung cancer. *Int. J. Epidemiol.* 1999; **28**: 620–5.
- 11 Clarke G, Whittemore AS. Prostate cancer risk in relation to anthropometry and physical activity: The National Health and Nutrition Examination Survey I. Epidemiological Follow-Up Study. *Cancer Epidemiol. Biomark. Prev.* 2000; **9**: 875–81.
- 12 Liu S, Lee I-M, Linson P, Ajani U, Buring JE, Hennekens CH. A prospective study of physical activity and risk of prostate cancer in US physicians. *Int. J. Epidemiol.* 2000; **29**: 29–35.
- 13 Riboli E, Kaaks R. The EPIC Project: rationale and study design. European Prospective Investigation into Cancer and Nutrition. *Int. J. Epidemiol.* 1997; **26**(Suppl. 1): S6–14.
- 14 Riboli E, Hunt KJ, Slimani N, Ferrari P, Norat T, Fahey M, *et al.* European Prospective Investigation into Cancer and Nutrition (EPIC) study: study populations and data collection. *Public Health Nutr.* 2002; **5**(6B): 1113–24.
- 15 Pols MA, Peeters PHM, Ocké MC, Slimani N, Bueno-de-Mesquita HB, Collette HJA. Estimation of reproducibility and relative validity of the questions included in the EPIC physical activity questionnaire. *Int. J. Epidemiol.* 1997; **26**(Suppl. 1): S181–9.
- 16 Slimani N, Kaaks R, Ferrari P, Casagrande C, Clavel-Chapelon F, Lotze G, *et al.* European Prospective Investigation into Cancer and Nutrition (EPIC) calibration study: rationale, design and population characteristics. *Public Health Nutr.* 2002; **5**(6B): 1125–45.
- 17 Vaz de Almeida MD, Gracia P, Aonso C, D'Amicis A, Lappalainen R, Damkjaer S. Physical activity levels and body weight in a nationally representative sample in the European Union. *Public Health Nutr.* 1999; **2**: 105–13.
- 18 Matthews CE, Freedson PS, Hebert JR, Stanek EJ III, Merriam PA, Rosal MC, *et al.* Seasonal variation in household, occupational, and leisure time physical activity: longitudinal analyses from the seasonal variation of blood cholesterol study. *Am. J. Epidemiol.* 2001; **153**: 172–83.
- 19 Kafatos A, Manios Y, Markatji I, Giachetti I, Vaz de Almeida MD, Engstrom LM. Regional, demographic and national influences on attitudes and beliefs with regard to physical activity, body weight and health in a nationally representative

- sample of the European Union. *Public Health Nutr.* 1999; **2**: 87–95.
- 20 James WPT, Schofield EC. *Human Energy Requirements: A Manual for Planners and Nutritionists*. Oxford/New York/Tokyo: Oxford University Press, 1990.
- 21 Domínguez-Berjón F, Borrell C, Nebot M, Plasència A. Physical activity assessment in population surveys: can it really be simplified? *Int. J. Epidemiol.* 1999; **28**: 53–7.

## Appendix A – EPIC physical activity questions

### 1. Work

We would like to know the type and amount of physical activity involved in your work. Please check what best corresponds with your present occupation from the following four possibilities:

- Sedentary occupation \_\_\_\_\_  
You spend most of your time sitting (such as in an office)
  - Standing occupation \_\_\_\_\_  
You spend most of your time standing and walking. However, your work does not require intense physical effort (e.g. shop assistant, hairdresser, guard, etc.)
  - Manual work \_\_\_\_\_  
This involves some physical effort including handling of heavy objects and use of tools (e.g. plumber, electrician, carpenter, etc.)
  - Heavy manual work \_\_\_\_\_  
This implies very vigorous physical activity including handling of very heavy objects (e.g. docker, miner, bricklayer, construction worker, etc.)
2. In a typical week during the past year, how many hours did you spend per week on each of the following activities:

- walking, including walking to work, shopping and leisure time  
in summer \_\_\_\_\_ hours per week  
in winter \_\_\_\_\_ hours per week
  - cycling, including cycling to work, shopping and leisure time  
in summer \_\_\_\_\_ hours per week  
in winter \_\_\_\_\_ hours per week
  - gardening  
in summer \_\_\_\_\_ hours per week  
in winter \_\_\_\_\_ hours per week
  - do-it-yourself activities at home  
\_\_\_\_\_ hours per week
  - physical exercise such as fitness, aerobics, swimming, jogging, tennis, etc.  
in summer \_\_\_\_\_ hours per week  
in winter \_\_\_\_\_ hours per week
  - housework, such as cleaning, washing, cooking, child care, etc.  
\_\_\_\_\_ hours per week
3. In a typical week during the past year, did you engage in any of these activities vigorously enough to cause sweating or faster heart beat?  
No \_\_\_\_\_ Yes \_\_\_\_\_
- If yes, for how many hours per week in total did you perform vigorous activity?  
\_\_\_\_\_ hours per week
4. In a typical week during the past year, how many flights of stairs did you climb per day?  
\_\_\_\_\_ floors per day

**Appendix B – Malmö physical activity questions****Physical activity during leisure time and transportation between workplace and home**

The question concerns both activities during leisure time and the way you transport yourself between workplace and home, but **not** activities during working hours.

Specify in the table below how many minutes per week you spend (on average) per week at different activities during different seasons. If any activity is missing you can add it at the end of the table.

<b>Activities</b>	<b>Spring</b>	<b>Summer</b>	<b>Autumn</b>	<b>Winter</b>
Racket ball (minutes/week)				
Table tennis (minutes/week)				
Football/Handball (minutes/week)				
Golf (minutes/week)				
Jogging/Running (minutes/week)				
Aerobics/Gymnastics (minutes/week)				
Orienteering (minutes/week)				
Swimming (minutes/week)				
Tennis (minutes/week)				
Cycling (minutes/week)				
Walking (minutes/week)				
Climbing stairs (minutes/week)				
Folk dancing (minutes/week)				
Ballroom dancing (minutes/week)				
Grass cutting (minutes/week)				
Digging (minutes/week)				
Gardening (minutes/week)				
_____ (minutes/week)				