Chapter 2

Occurrence, trends and analysis

Weight profiles

Prevalence of obesity in developing and developed countries

This overview on the prevalence of obesity is based on adult population surveys in which both weight and height have been measured. The WHO classification of obesity as BMI 30 kg/m² or over (see Chapter 1) is systematically used to allow comparison of different studies. Although extensive data exist on self-reported weight and height, since this information is often requested in questionnaires, they are known to be unreliable, especially in the obese, and thus would give an underestimate of the prevalence of obesity. Most of the data presented are from the last 10–15 years, since the prevalence of obesity has been changing rapidly all over the world and old data without time-trend information are not very useful. The surveys are arranged according to the six WHO Regions, with the exception of the MONICA Project.

The MONICA Project (Monitoring trends and determinants in cardiovascular disease) covered 54 study populations in 26 countries, mainly in Europe. Risk factor surveys were carried out through two or three independent cross-sectional surveys, each five years apart, ranging from the early 1980s to the 1990s. These surveys included random samples of at least 200 persons of each gender and for 10-year age groups for the age range 35–64 years, and optionally 25–34 years. Common standardized methods were applied for data collection and analyses, making these data an invaluable source for comparison between populations.

In this section, the data for each country had to have been drawn from some sort of representative national sample. Table 3 summarizes the prevalence of obesity (BMI 30 kg/m² or more) in all MONICA centres where 10-year trend data were available (http://www. ktl.fi/publications/monica). In men, the prevalence of obesity was lowest in China (3–4%) and highest (at least 20%) in Finland, Glasgow (United Kingdom), rural Germany, Strasbourg (France), Kaunas (Lithuania), Warsaw (Poland), the Czech Republic and Stanford (United States). There was an overall increase in the prevalence of obesity in men in most populations. The biggest increases in ten years (by at least 10 percentage points) took place in Glasgow and in Stanford. The only centres where the prevalence of obesity decreased were Ticino (Switzerland) and Moscow (Russian Federation). The overall prevalence of obesity in men in most European populations was 15–25%. In women, the prevalence of obesity was lowest (10% or lower) in Gothenburg (Sweden), Toulouse (France), Fribourg (Switzerland) and Beijing (China). A high prevalence of obesity (at least 20%) was found in 14 centres out of 29, the highest prevalences being in eastern Europe. There was an overall tendency of increasing prevalence of obesity over ten years also in women, the biggest increases being in Glasgow and in Stanford, while the prevalence of obesity in women decreased in the Russian Federation and Lithuania. The prevalence of obesity varies in women more than in men, from 10 to 35% within European populations.

Other survey data from European populations are summarized in Table 4. The Health Surveys for England show an extraordinary increase in the prevalence of obesity (Seidell, 2001) (Figure 12). In the late 1980s, 7% of men and 12% of women were obese, while the respective numbers in 1997 were 17% and 19%. The age ranges in the other studies vary and, thus, the prevalence data are not necessarily comparable. The low prevalence in the Netherlands (Seidell *et al.*, 1995) and Belgium (Moens *et al.*, 1999) are influenced by the inclusion of young people, the prevalence being about 10%. There is an increasing trend in the Netherlands. The EURALIM Project, covering six European countries (Beer-Borst *et al.*, 2000), shows big differences within countries such as Italy, where the prevalence of obesity is 37% in women in the Latina area and only 19% in Naples. However, the age ranges differ, which explains at least part of the difference.

In the United States, the prevalence of obesity is increasing rapidly (Table 5). The secular trends are based on national representative surveys: NHES I (1960–62), NHANES I (1971–74), NHANES II (1976–78) and NHANES III (1988–94). There are also racial differences in the prevalence of obesity (Flegal *et al.*, 1998). In the early 1990s, 20% of non-Hispanic white men, 21% of non-Hispanic black men and 23% of Mexican-American men were obese. The respective numbers for women were 22%, 37% and 34%. Of particular public health concern is the high prevalence (over 40%) of class II obesity (BMI 40 kg/m² or more) among non-Hispanic

Table 3. Prevalence (%) of obesity (BMI 30 kg/m^2 or more) in the WHO MONICA populations in the early 1980s (baseline) and the early 1990s

Area	Country	Centre	Men		Women	
			1980s	1990s	1980s	1990s
Northern Europe	Denmark	Glostrup	11	13	10	12
	Finland	Kuopio Province	18	24	19	26
	Finland	North Karelia	17	23	24	24
	Finland	Turku-Loimaa	19	22	17	19
	Iceland	Iceland	11	16	11	18
	Sweden	Gothenburg	7	13	9	10
	Sweden	Northern Sweden	11	14	14	14
Western Europe	United Kingdom	Glasgow	11	23	16	23
	United Kingdom	Belfast	11	14	14	16
	Germany	Bremen	14	16	18	19
	Germany	Augsburg	18	17	15	21
	Germany	Augsburg, rural	20	24	22	23
	Belgium	Ghent	11	13	15	16
	France	Lille	14	17	19	22
	France	Toulouse	9	13	11	10
	France	Strasbourg	22	22	23	19
	Switzerland	Ticino	20	13	15	16
	Switzerland	Vaud-Fribourg	13	17	13	10
Eastern Europe	Russian Federation	Novosibirsk	14	17	44	35
	Russian Federation	Moscow	13	8	33	22
	Lithuania	Kaunas	22	20	45	32
	Poland	Warsaw	18	22	26	29
	Poland	Tarnobrzeg V.	13	15	32	36
	Czech Republic	Czech Republic	21	23	32	30
Southern Europe	Spain	Catalonia	9	16	24	25
	Italy	Area Brianza	11	14	15	18
	Italy	Friuli	16	17	19	19
North America	United States	Stanford	10	20	14	23
Asia	China	Beijing	3	4	10	8

Source: www.ktl.fi/publications/monica

black women in the middle-aged groups.

In Canada, the prevalence of obesity is lower than in the United States, being about 15% in 1991 (Reeder *et al.*, 1992). An increasing trend, however, may have occurred from the late 1970s to the early 1990s, especially in men (Table 5).

Data from Brazil are also based on nationally representative nutrition surveys showing that increases in adult obesity have been occurring in both men and women. The most recent data show that about 7% of men and 13% of women are obese (Monteiro *et al.*, 2000). The prevalence is high in the Caribbean, especially in women in Barbados, Cuba, Jamaica and St Lucia (Forrester *et al.*, 1996). However, since these data were not reported using the cut-off value of BMI 30 kg/m^2, the numbers are not comparable with those from other countries. In the Dutch Caribbean Island of Curaçao, 36% of women older than 18 years are obese (Grol *et al.*, 1997).

Obesity is still uncommon (1–3%) in Japan and China, but slightly more

Table 4. Prevalence (%) of obesity (BMI 30 kg/m^2 or more) in European populations

Population	Period	Age (yrs)	Men	Women	Reference
United Kindom, national surveys	1987/89	16+	7	12	Seidell, 2001
	1993		13	16	
	1994		14	17	
	1995		15	17	
	1996		16	18	
	1997		17	19	
Belgium (Flanders and Brussels)	1994	18–64	11	9	Moens *et al.*, 1999
The Netherlands, national surveys	1987–91	20–59	7	9	Seidell *et al.*, 1995
	1993		8	10	
	1994		10	11	
Sweden	1963	> 50	6	–	Rosengren *et al.*, 2000
	1994	> 50	11	–	
Euralim study					
The Netherlands	1990–92	20–59	12	14	Beer-Borst *et al.*, 2000
France	1995–96	35–65	8	7	
Italy (Naples)	1993–96	30–69	–	19	
Italy (Latina)	1993–96	20–84	20	37	
Switzerland (Geneva)	1993–96	29–83	11	9	
UK (Belfast)	1991–92	25–65	15	16	
Spain (Catalonia)	1992	25–75	11	22	

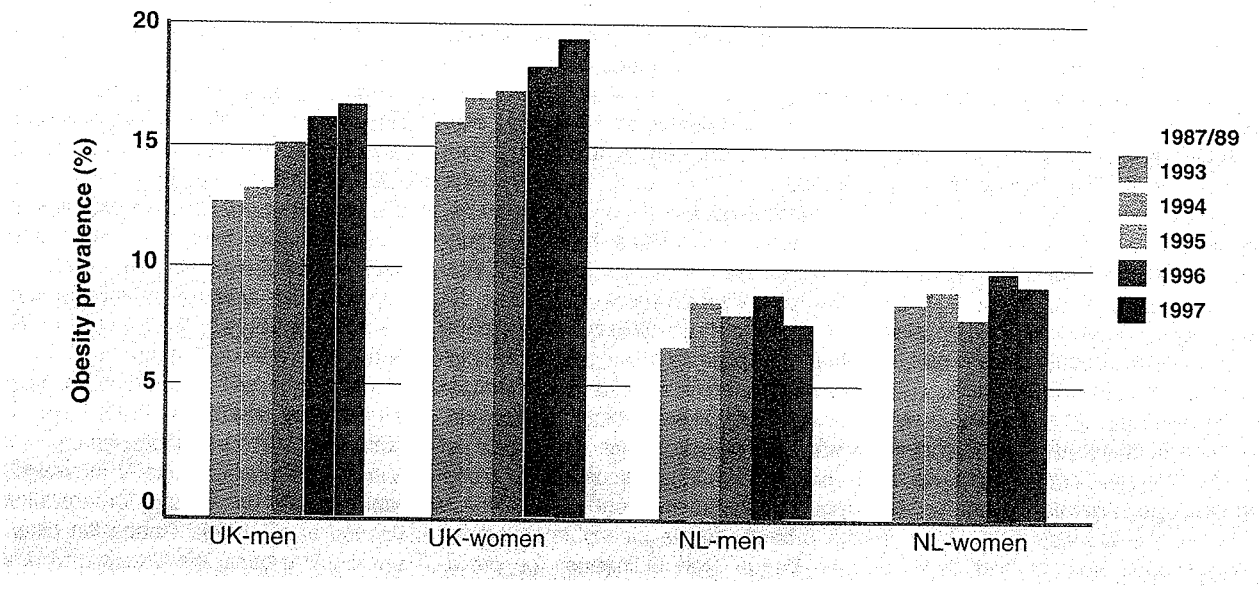

Figure 12 Time trends in the prevalence (%) of obesity in the United Kingdom (UK) and the Netherlands (NL)

Table 5. Prevalence (%) of obesity (BMI 30 kg/m² or more) in the American region

Population	Period	Age (yrs)	Men	Women	Reference
United States					
NHES I	1960–62	20–74	10	15	Flegal *et al.*, 1998
NHANES I	1971–74		12	16	
NHANES II	1976–78		12	17	
NHANES III	1988–94		20	25	
– non-hispanic white	1976–78	20–74	12	15	
	1988–94		20	22	
– non-hispanic black	1976–78	20–74	15	30	
	1988–94		21	37	
– Mexican-American	1976–78	20–74	15	25	
	1988–94		23	34	
Canada	1978	20–70	6.8	9.6	WHO Consultation on Obesity, 1998
	1981	20–70	8.5	9.3	
	1988	20–70	9.0	9.2	
National survey	1986–92	18–74	13	14	Reeder *et al.*, 1992
	1991	18–74	15	15	
Brazil, national surveys	1975	25–64	2.4	7.0	Monteiro *et al.*, 2000
	1989		4.7	12.0	
	1997		6.9	12.5	
Curaçao	1993–94	>18	19	36	Grol *et al.*, 1997

frequent in Thailand and Malaysia (4–8%) (Table 6). The MONICA Project showed an increase in prevalence of obesity among urban people in Beijing over ten years (www.ktl.fi/publications/monica). Nationwide nutrition surveys have shown the same phenomenon, but since the data-sets are not age-standardized and rarely use the WHO classification, the numbers are again non-comparable (WHO Consultation on Obesity, 1998). Similar trends can be seen in India, where obesity is increasing among urban middle-class people (Dhurandhar & Kulkarni, 1992).

The prevalence of obesity is about 10–15% in Australia and New Zealand. Among different ethnic groups in Australia, the prevalence is lowest (1–2%) in the Chinese (Hsu-Hage & Wahlqvist, 1993) and highest (25% in men and 38% in women) in the Aboriginals in the south-east (Guest *et al.*, 1993). The differences in prevalence between Aboriginal groups living in different areas apparently reflect different degrees of westernization.

The prevalence of obesity is very high in Polynesian populations. About 50–60% of men and up to 77% of women are obese (Hodge *et al.*, 1995). However, Polynesians have a higher ratio of lean mass to fat mass than Europeans (see Chapter 1) and so the prevalence of obesity is somewhat lower than that estimated using the BMI criteria developed for Caucasians (Swinburn *et al.*, 1999). There is an urban–rural difference, with a higher prevalence of obesity in urban areas, as well as a pronounced increasing trend. The influence of urbanization is clearly seen among the Papua New Guineans: the prevalence of obesity is only about 5% among those still living in the highlands but 36% in men and 54% in women living in urban areas.

Obesity is a severe problem in the Eastern Mediterranean Region (Table 7). Although most of the data are based on small studies except for the national surveys in Saudi Arabia (Al-Nuaim *et al.*, 1996), they show that the prevalence of obesity increases rapidly in women as they enter the childbearing age. Over 40% of adult women are obese. In contrast, obesity is not common in Iran, the prevalence being only 2.5% in men and 8% in women (Pishdad, 1996).

Obesity is still uncommon in most African countries (Table 8). However, in countries in transition such as Mauritius, the prevalence is increasing rapidly with increasing urbanization (Hodge *et al.*, 1996). Among the different ethnic groups, the Creole have the highest prevalence (8% in men and 21% in women) and the Chinese the

Table 6. Prevalence (%) of obesity (BMI 30 kg/m^2 or more) in the Western Pacific Region and India

Population	Period	Age (yrs)	Men	Women	Reference
Japan, national surveys	1976	20+	0.7	2.8	WHO Consultation on Obesity, 1998
	1982		0.9	2.6	
	1987		1.3	2.8	
	1993		1.8	2.6	
Japan, national surveys	1990–94	35–64	1.9	2.9	Asia-Pacific Perspective, 2000
China, Beijing		35–64	3	4	www.ktl.fi/publications/monica
			10	8	
China, national survey	1992	20–45			Asia-Pacific Perspective, 2000
Urban			1.0	1.7	
Rural			0.5	0.7	
Thailand, national survey	1991	20+	4.0	5.6	Asia-Pacific Perspective, 2000
Malaysia		18–60	4.7	7.9	Ismail *et al.*, 1995
Urban			5.6	8.8	
Rural			1.8	2.6	
Indian				17.1	
Chinese				4.3	
New Zealand, national survey	1989	18–64	10	12	Ball *et al.*, 1993
Australia					
National surveys	1980	25–64	9.3	8.0	Bennett & Magnus, 1994
	1983		9.1	10.5	
	1989		11.5	13.2	
Australians	1990	20–64	9	11	Hsu-Hage & Wahlqvist, 1993
Melbourne Chinese	1989	25–69	0.8	2.3	
Newcastle	1986	35–65	15	16	Molarius *et al.*, 1997
Perth	1986	35–65	9	11	
South-east		25–64			Guest *et al.*, 1993
Aboriginals			25	38	
Europids			17	18	
Non-aboriginal	1980		6	9	Jones & White, 1994
Central aboriginal	1985		22	51	
West Kimberley aborig.	1986		–	17	
Yologu	1991		2	4	
Philippines		20+	1.7	3.4	Asia-Pacific Perspective, 2000
Nauru	1987	25–69	65	70	Hodge *et al.*, 1995

Table 6 (contd)

Population	Period	Age (yrs)	Men	Women	Reference
Samoa, urban	1978	25–69	39	59	Hodge *et al.*, 1995
	1991		58	77	
Samoa, rural	1978	25–69	18	37	
	1991		42	59	
Papua New Guinea	1991	25–69			Hodge *et al.*, 1995
Urban coastal			36	54	
Rural coastal			24	19	
Highlands			5	5	
Rodrigues, creoles	1992	25–69	10	31	Hodge & Zimmet, 1994
India, Bombay, middle class	1991	15–30	0.3	2.5	Dhurandhar & Kulkarni, 1992
		31–50	6.5	9.6	
		50+	8.1	9.8	

lowest (only 2% in men and 6% in women) (Hodge & Zimmet, 1994).

Age, sex, social class and education

A recent analysis of data from the MONICA Project shows that socioeconomic inequalities in health consequences associated with obesity may be widening in many countries (Molarius *et al.*, 2000). Among women, there was a statistically significant inverse association between educational level and BMI in almost all 26 populations. The difference between the highest and the lowest educational tertiles ranged from –3.1 to 0.4 kg/m² in the initial survey and from –3.3 to 0.6 kg/m² in the final survey. In men, the difference in BMI between the educational tertiles ranged from –1.2 to 2.2 kg/m² and from –1.5 to 1.2 kg/m² in the two surveys, respectively. In about two thirds of the populations, the differences in BMI between the educational groups increased over the 10-year period. There was no geographical pattern in women. In men, the association between educational level and BMI was positive in some eastern and central European populations and in Beijing, China. BMI was positively associated with education in populations with a low prevalence of obesity and negatively in affluent populations with high prevalence of obesity.

A strong educational gradient has been found in almost all western populations besides the MONICA centres. The prevalence of obesity is higher among those with low education compared with the highly educated groups, especially among women. In many countries (e.g., Denmark, Sweden), the prevalence is not increasing only in women with high education, whereas among men it is increasing in all educational groups (Peltonen *et al.*, 1998; Stam-Moraga *et al.*, 1998; Moens *et al.*, 1999; Heitmann, 2000; Lahti-Koski *et al.*, 2000). The same phenomenon is seen in Brazil, where a very recent trend is a decrease in the prevalence of obesity in urban women (Monteiro *et al.*, 2000). Highly educated women are more resistant to gradual weight gain with ageing than are other population groups.

Although surveys with self-reported height and weight are not generally included in this review, a recent survey among 15 239 individuals aged 15 years and over in the European Union is worth quoting since it has information on determinants of obesity (Martinez *et al.*, 1999a). The results concerning overweight (BMI 25–29.9 kg/m²) are also quoted because self-reporting of weight and height leads to underestimation of BMI. Subject selection was quota-controlled to make the sample nationally representative following a multi-stage stratified cluster sampling. Self-reporting and inclusion of persons from age 15 years explain the lower prevalence rates, which were highest in the United Kingdom (12%) and lowest in France, Italy, Sweden and Switzerland (about 7%). Individuals of higher social class and younger age in all groups had a lower risk for obesity. People with a higher level of education also had lower risk, and the interaction between educational levels and obesity was weaker for men than women.

Among males, the highest prevalence of overweight was found in those aged 45–54 years who had primary school education and those aged 65+ years who had tertiary education. For all educational levels, obesity was more prevalent among the older age groups, particularly among those with a low level of education. A strong inverse association between levels of obesity and education was apparent, with 55–64-year-old primary-educated women having four times

Table 7. Prevalence (%) of obesity (BMI 30 kg/m² or more) in the Eastern Mediterranean Region

Population	Period	Age (yrs)	Men	Women	Reference
Israel (Jerusalem)	1970	50–84	12	29	Gofin *et al.*, 1996
	1986	50–84	16	33	
	1986	50–64	18	36	
Cyprus	1989–90	35–64	19	24	Berrios *et al.*, 1997
Saudi Arabia	1990	18–25[a]	–	4.5	Rasheed *et al.*, 1994
		18–35[b]	–	20	
		15–35[b]	–	11	
National survey	1990–93	17+			Al-Nuaim *et al.*, 1996
Total			16	24	
Urban			18	28	
Rural			12	18	
	1992	Adults[b]	–	47	Ghannem *et al.*, 1993
Kuwait		Adults[b]	–	42	Rasheed *et al.*, 1994
	1994	18+[b]	32	44	Al-Isa, 1995
Bahrain	1991–92	20-65	10	30	Al-Mannai *et al.*, 1996
Iran	1989	20–59[c]	5	5	Ayatollahi & Carpenter, 1993
	1993–94	20–74	2.5	8	Pishdad, 1996
Morocco	1984/85		5.2		WHO Expert Committee, 1995
Tunisia, suburban	1991	20+	12	26	Ghannem *et al.*, 1993
Tunisia	1990		8.6		WHO Expert Committee, 1995

[a] Female medical students
[b] Adults attending primary health care or private clinics
[c] Parents of schoolchildren

Table 8. Prevalence (%) of obesity (BMI 30 kg/m² or more) in the African region

Population	Period	Age (yrs)	Men	Women	Reference
Congo	1986/87		3.4		WHO Expert Committee, 1995
Ghana	1987/88		0.9		
Mali 1991			0.8		
Tanzania	1986–89	35–64	0.6	3.6	Berrios *et al.*, 1997
Mauritius	1987	25–74	3.4	5.3	Hodge *et al.*, 1996
	1992		5	15	
Asian Indian	1992	25–69	5	16	Hodge & Zimmet, 1994
Creole			8	21	
Chinese			2	6	
Rodrigues, creoles	1992	25–69	10	31	Hodge & Zimmet, 1994

the level of obesity of those in the same age group with tertiary education.

Risk of obesity rose steeply with increasing age, especially for the lowest social class, up to 45–64 years and declined among those over 65 years for all social classes. The highest risk of obesity was observed in 45–64-year-olds of low social class.

Survey data from Jerusalem show that in women the prevalence of obesity was lowest in the more educated and lower in those born in Europe or America than among those born in Israel (Gofin *et al.,* 1996).

Martorell *et al.* (2000a) have summarized the prevalence of overweight and obesity in women from population surveys carried out in 32 developing countries in the 1990s (Table 9, Figures 13 and 14). All the surveys were cross-sectional surveys of nationally representative samples (sample sizes from 773 to 10 747 women). Most were demographic health surveys in which women of child-bearing age (15–49 years) were interviewed and measured using standard survey instruments. These data are available through the Internet (http://www.macroint.com.dhs/). South Asian women were the leanest, with about 97.7% having a BMI less than 25 kg/m^2 and only 0.1% a BMI of 30 or over. The percentages of obese women were 2.5% in sub-Saharan Africa, 9.6% in Latin America and the Caribbean, 15.4% in the Central Eastern Europe/-Commonwealth of Independent States (CEE/CIS) region and 17.2% in the Middle East and North Africa. In very poor countries, mostly in sub-Saharan Africa, obesity is concentrated among urban and highly educated women. In more developed countries, such as those in Latin America and the CEE/CIS region, levels of obesity are more equally distributed across subgroups in each country.

For comparison, the authors also analysed the prevalence of obesity in different educational groups from the United States NHANES III survey (Martorell *et al.,* 2000a). Women were divided into four groups depending on the number of years of education completed: middle school or less (0–9 y), high school (10–12 y), university (13–16 y) and graduate work (>16 y). The prevalence of obesity in these groups was 20.1%, 24.1%, 18.9% and 9.2%, respectively.

Overweight and underweight people may co-exist in countries in transition, with underweight children living in families with overweight adults (Doak *et al.,* 2000). Data from three large national surveys from Brazil, China and the Russian Federation show that the prevalence of such households was 8% in China and Russia and 11% in Brazil. Even more important from the public health perspective is the finding that these 'underweight/overweight' households accounted for a high proportion of all households that had at least one underweight member (China, 23%; Brazil, 45%; Russian Federation, 58%). The prevalence of such underweight/overweight households was highest in urban areas in all three countries. The underweight child co-existing with an overweight non-elderly adult was the predominant pair combination in all three countries.

It is to be expected that increasing migration between countries and from rural to urban environments all around the world, and the consequent increasing urbanization, will create wider differences in the prevalence of obesity within populations as the mixture of cultural and educational factors come into play. The findings on the high prevalence of obesity in certain social groups raise questions about the possible structural causes – the roles of social, economic, cultural or environmental factors. How such factors may be acting to curtail physical activity and/or influence food habits remains unclear.

Obesity during childhood and adolescence

It is not possible to give an overview of the global prevalence of obesity in children or adolescents because there is no common agreement on the classification of obesity in different periods of growth. BMI cut-points for different ages have recently been proposed (Cole *et al.,* 2000). Obesity is mostly acquired during adulthood and its role in the etiology of cancer usually concerns middle-aged and older adults. However, childhood obesity seems to be increasing in all countries that have data on time trends and it usually persists into adulthood (Rudolf *et al.*, 2001).

Cross-sectional studies in Europe indicate that overweight and obesity are a growing problem (Livingstone, 2000). The prevalence varies in a complex manner with time, age, sex and geographical region. The prevalence of obesity in young children is lower than among adolescents. Gender differences in prevalence are inconsistent. The highest rates of obesity are observed in eastern and southern European countries, particularly in Greece, Hungary, Italy and Spain. In contrast, northern European countries tend to have lower rates that are broadly similar across countries.

In the United States between 1963 and 1994, prevalence of obesity in 6–17-year olds (defined as a BMI at or above the NHANES II 95th percentile) has increased from approximately 4% to 11%. A further 14% are currently at risk of becoming overweight (BMI between the 85th and 95th percentiles) and these rates are continuing to increase (Livingstone, 2000) (Figure 15). The prevalence of overweight and obesity has increased among young inner-city schoolchildren, for example this was reported in Montreal from the early to late 1990s (O'Loughlin *et al.*, 2000). Primary school children in Australia have also become more obese between 1985 and 1997 (Lazarus *et al.,* 2000). Similar

Table 9. Prevalence (%) of overweight (BMI 25–29.9 kg/m²) and obesity (BMI 30 kg/m² or more) in women 15–49 y in developing countries

Country (period)	% Overweight	% Obese				
		Total	Urban	Rural	High education	Low education
Sub-Saharan Africa						
Benin (1996)	6.9	2.1	3.5	1.4	8.7	1.7
Burkina Faso (1992/93)	5.9	1.0	3.5	0.6	7.1	0.8
Central African Republic (1994/95)	5.5	1.1	2.0	0.5	3.1	0.8
Comoros (1996)	15.9	4.4	9.6	2.7	7.0	4.0
Cote d'Ivoire (1994)	11.0	3.0	6.2	1.3	5.4	2.7
Ghana (1993)	9.3	3.4	8.1	1.5	12.2	2.9
Kenya (1993)	11.4	2.4	5.4	2.0	3.6	2.1
Malawi (1992)	8.1	1.1	–	–	8.3	0.8
Mali (1996)	7.2	1.2	3.5	0.4	6.5	1.0
Namibia (1992)	13.8	7.1	13.4	3.4	9.6	5.7
Niger (1992)	6.2	1.2	6.4	0.3	9.6	1.1
Senegal (1992/93)	12.0	3.7	7.2	1.9	9.7	3.4
Tanzania (1992/92)	9.3	1.9	4.1	1.2	9.6	1.6
Tanzania (1996)	10.8	2.6	6.0	1.7	8.4	2.3
Uganda (1995)	7.3	1.2	4.2	0.7	2.6	1.0
Zambia (1992)	11.8	2.4	4.5	0.4	3.9	1.9
Zambia (1996/97)	10.5	2.3	4.3	0.8	3.4	1.9
Zimbabwe (1994)	17.4	5.7	12.5	3.4	7.3	4.8
Middle East and North Africa						
Egypt (1992)	33.9	23.5	35.8	14.8	29.6	21.7
Egypt (1995/96)	31.7	20.1	30.0	26.1	13.0	17.0
Morocco (1992)	22.3	10.5	18.3	5.5	16.4	9.8
South Asia						
Bangladesh (1995/96)	2.2	0.6	2.7	0.4	1.9	0.3
Nepal (1996)	1.5	0.1	1.0	0.1	0.0	0.1
Latin America and Caribbean						
Bolivia (1994)	26.2	7.6	9.8	5.1	8.0	7.4
Brazil (1989)	25.0	9.2	9.4	8.0	13.4	8.7
Brazil (1996)	25.0	9.7	9.9	8.9	8.8	11.0
Colombia (1995)	31.4	9.2	9.2	9.1	8.7	9.9
Dominican Republic (1991)	18.6	7.3	8.8	4.7	7.8	6.9
Dominican Republic (1996)	26.0	12.1	13.4	9.6	10.0	13.8
Guatemala (1995)	26.2	8.0	12.9	5.2	13.1	7.1
Haiti (1994/95)	8.9	2.6	4.8	1.4	9.5	1.5
Honduras (1996)	23.8	7.8	13.0	4.8	6.6	8.1
Mexico (1987)	23.1	10.4	10.0	10.4	5.4	15.8
Peru (1992)	31.1	8.8	11.2	4.6	9.5	8.1
Peru (1996)	35.5	9.4	12.1	4.6	10.4	8.2
Central Eastern Europe/Commonwealth of Independent States (CEE/CIS)						
Kazakstan (1995)	21.8	16.7	17.5	15.6	–	–
Turkey (1993)	31.7	18.6	19.5	17.1	10.5	20.5
Uzbekistan (1996)	16.3	5.4	7.4	4.2	–	–

Source: adapted from Martorell *et al.*, 2000a

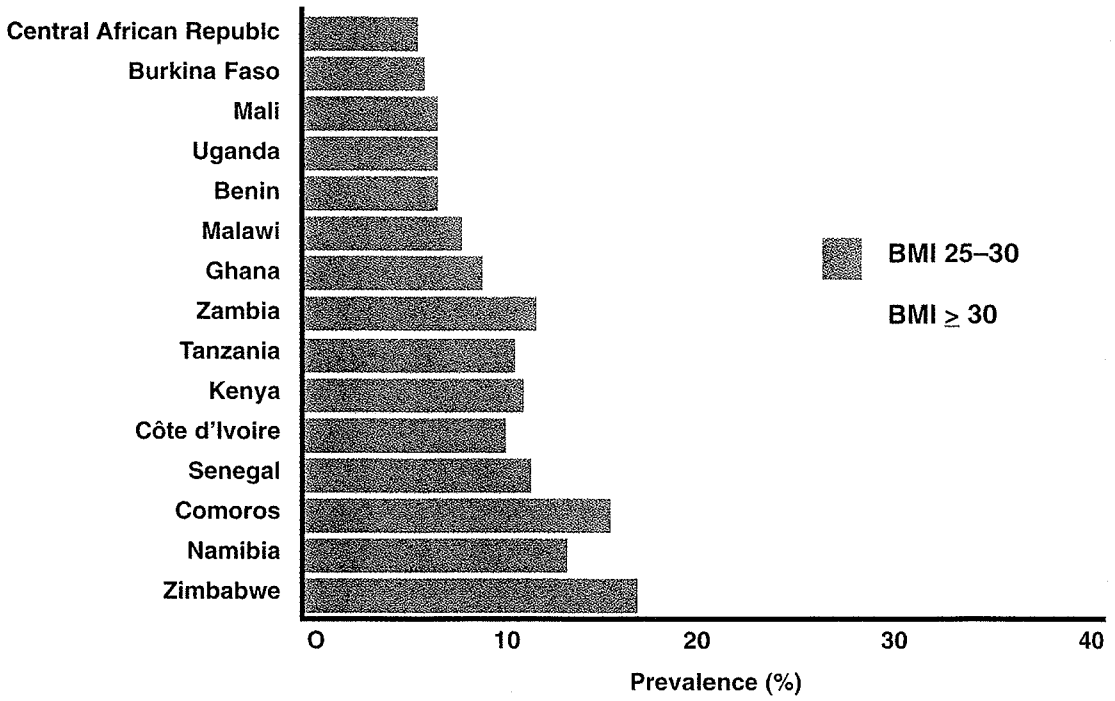

Figure 13 Obesity in women (15–49 yrs) in Sub-Saharan Africa
Adapted from Martorell *et al.*, 2000a

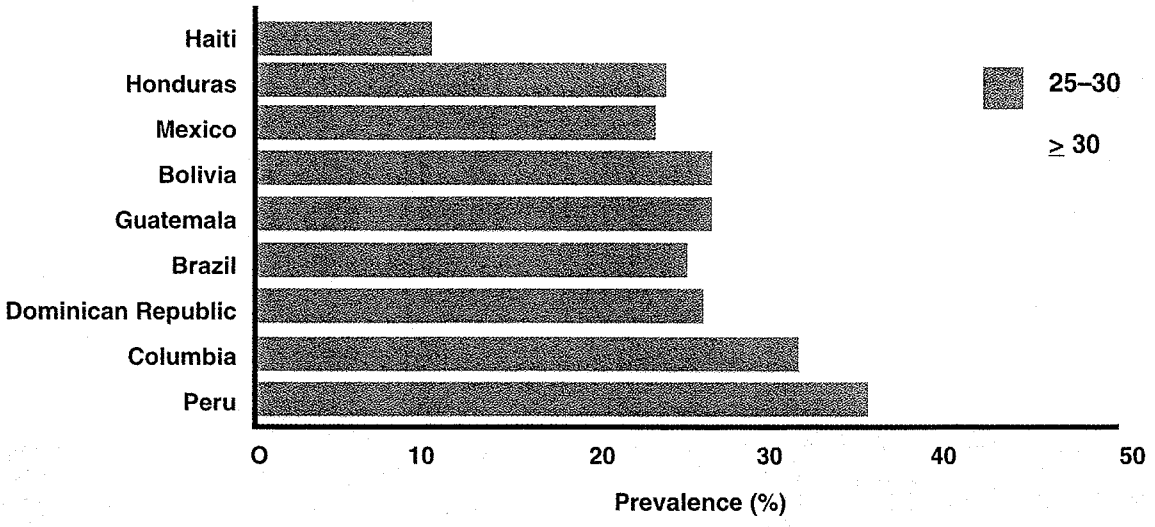

Figure 14 Obesity in women (15–49 yrs) in Latin America/Caribbean
Adapted from Martorell *et al.*, 2000a

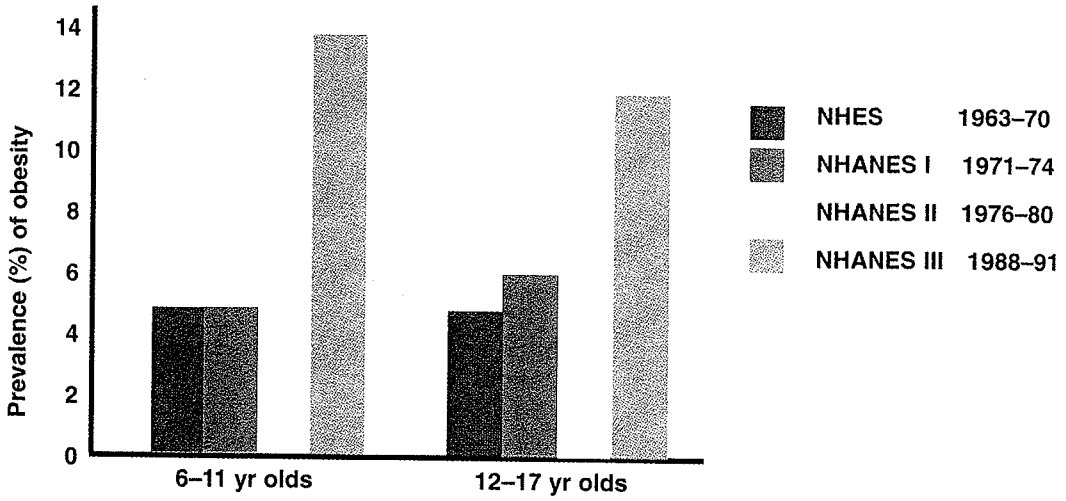

Figure 15 Prevalence (%) of obesity in 6–11-year-old and 12–17-year-old children in surveys in the United States from the 1960s to the late 1980s

trends have been reported from Denmark (Sørensen *et al.*, 1997; Thomsen *et al.*, 1999), the Netherlands (Fredriks *et al.*, 2000) and Portugal (de Castro *et al.*, 1998).

In a large analysis on overweight and obesity in preschool children in developing countries, 71 national nutrition surveys since 1986 from 50 countries were used (Martorell *et al.*, 2000b). For this analysis, overweight and obesity were defined as values >1 or >2 standard deviations above the WHO/NCHS mean weight-for-height. The prevalence of overweight and obesity was lowest in Asia and sub-Saharan Africa. Overweight was more common in urban areas, in children with mothers with high education, and in girls. In a number of countries in Latin America and the Caribbean, the Middle East and North Africa, and the CEE/CIS region, levels were as high as in the United States. A recent study of Bahraini school children found that the mean BMI for girls aged 13 years and above exceeded that of their American counterparts (Musaiger & Gregory, 2000).

Since fatness can change at a constant BMI, it is possible that children may be getting fatter at the expense of lean tissue, which may be decreasing as a result of diminishing physical activity.

Physical activity

Because physical activity is important in the prevention of a variety of diseases and conditions (US Department of Health and Human Services, 1996), it has been included as part of health behaviour monitoring in many countries.

Many countries monitor only leisure-time physical activity because national policies assume that individuals find this type of activity most amenable to intervention, and because occupational physical activity is now uncommon in westernized countries, which are the source of most comparative national data (Caspersen, 1994). However, individuals who perform large amounts of occupational activity would be misclassified as inactive if they performed little or no leisure-time activity. Even though countries may not employ a common survey assessment methodology, there is value in comparing existing data while carefully examining factors that may be responsible for differences in the estimates. Little information from developing countries is available.

National surveys

Seven countries have included questions on physical activity as part of national surveys during the 1990s. (1) Australia conducted a National Physical Activity Survey in 1997 and 1999 (Armstrong *et al.*, 2000); (2) Canada conducted a National Population Health Survey in 1994–95 and 1996–97 (Health Canada, 1999); (3) England conducted a National Health Survey in 1994–95 and 1998–99 (Prior, 1999); (4) Finland conducted a National Health Monitoring Survey annually from 1978 through 1999 (Helakorpi *et al.*, 1999); (5) Ireland conducted the Happy Heart National Survey in 1992 (Irish Heart Foundation, 1994); (6) New Zealand conducted the Life in New Zealand Survey in 1989–90 (Hopkins *et al.*, 1991; Russell & Wilson, 1991); and (7) the United States conducted the National Health Interview Survey (NHIS) in 1985, 1990 and 1991 (US Department of Health and Human Services, 1996). In addition, one multinational comparison of physical activity was conducted in 1997 among the 15

Table 10. Characteristics of national survey systems which include physical activity, their modes of administration, their samples and response rates

Country, survey name (reference) year(s) of survey	Sponsor	Type of survey sample	Mode of administration	Months of survey	Sample size	Age of sample	Response rate
Australia							
National Physical Activity Survey (Armstrong *et al.*, 2000), 1997, 1999	Australia Institute of Health and Welfare, Department of Health and Aged Care	Households randomly selected using electronic White Pages directory. Individuals of the household with the most recent birthdate were asked to participate.	Telephone interview	November–December	3841	18–75	49–58%
Canada							
National Population Health Survey (Health Canada, 1999), 1994–95, 1996–97	Health Canada	Target population was provincial residents aged 12 years and older, except those living on Indian reserves, Canadian Forces bases, and in remote areas of Ontario and Quebec	Household interview	June 1994–August 1995 and June 1996–August 1997	69 524	> 12	NR[a]
England							
National Health Survey for England (Prior, 1999), 1994–95, 1998–99	National Centre for Social Research, Department of Health	Multi-stage stratified random sample with households drawn from Postcode Address File. Sampled addresses selected from 720 postal sectors.	Computer-assisted household interview	January 1994–April 1995 and January 1998–April 1999	1908	≥ 16	63%
European Union[b]							
Pan-European Union Survey (European Commission, 1999; Kearney *et al.*, 1999), 1997	European Commission, Directorate-General for Employment, Industrial Relations and Social Affairs	Multi-stage stratified cluster sample with quota samples in 15 countries based on age, sex and social class	Household interview	March–April	1239	≥ 15	NR

Table 10 (Contd)

Country, survey name, (reference) year(s) of survey	Sponsor	Type of survey sample	Mode of administration	Months of survey	Sample size	Age of sample	Response rate
Finland							
National Health Behaviour Monitoring System (Helakorpi *et al.*, 1999), 1978–99	National Public Health Institute	Random sample selected from the National Population Register	Postal survey	April	3371	15–64	68%
Ireland							
Happy Heart National Survey (Irish Heart Foundation, 1994), 1992	Irish Heart Foundation	Household address chosen at random from Electoral Register. Interviewers chose remainder of households within the cluster. Additional sample quotas by age and sex.	Household interview	November	1798	30–69	N/R
New Zealand							
Life in New Zealand Survey (Hopkins *et al.*, 1991; Russell & Wilson, 1991), 1989–90	Hillary Commission for Recreation and Sport	Random sample drawn from 97 electoral rolls of 1988. Mailing sent to about 10 persons per month	Phase I: Postal survey Phase II: Interviewer–administered survey at health examination	April 1989–March 1990	11 295	≥ 15	45%
United States							
National Health Interview Survey (USDHHS, 1996), 1985, 1990, 1991	National Center for Health Statistics	Stratified multi-stage probability design with oversampling of African-Americans and Hispanics	Household interview	January–December	36 399–43 732	≥ 18	83–88%

a NR, not reported.

[b] The 15 countries included in the European Union survey were Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.

Table 11. Characteristics of physical activity surveys, data collection and resulting data

Country, survey name (reference), year(s) of survey	Recall period	Total survey items	Method of activity probing	Type of physical activity and nature and detail of survey data	Activity summary score
Australia					
National Physical Activity Survey (Armstrong *et al.*, 2000), 1999	Past week	8	Open-ended	Recall of number of times and total time spent doing: 1. walking for recreation/ exercise or transport (≥ 10 minutes) 2. moderate-intensity activities (gentle swimming, social tennis, golf) 3. vigorous activities (jogging, cycling, aerobics, competitive tennis) to make one breathe hard, puff or pant 4. vigorous gardening and heavy yard work	Sufficient time (≥ 150 minutes/week) and sessions (≥ 5 sessions/ week) Sum of minutes/week spent doing walking and moderate activity plus vigorous activity (weighted by 2)
	Average week in past 6 months	3	Open-ended		
Canada					
National Population Health Survey (Health Canada, 1999), 1996–97	Past 3 months	NR[a]	List-specific	Recall of average frequency and average duration from list of activities using a modifed version of the Minnesota Leisure Time Physical Activity Questionnaire (Taylor *et al.*, 1978) Leisure (non-working activity) Non-leisure time (at work, commuting to/from work or school, doing daily chores)	Physical activity index: Inactive: < 1.5 kcal/kg/day Moderate: 1.5–2.9 kcal/kg/day Active: ≥ 3.0 kcal/kg/day
England					
National Health Survey for England (Prior, 1999), 1998	Past 4 weeks	24	Close-ended	Non-work Recall of frequency (days/4 weeks) and usual duration in heavy housework, gardening, heavy manual work, walking, and sports/exercise. Used cards showing examples of types of activity	Group I (low activity) ≤ 3 occasions/4 weeks of moderate or vigorous activity for ≥ 30 minutes Group 2 (medium activity) 4–19 occasions/4 weeks of moderate or vigorous activity for ≥ 30 minutes Group 3 (high activity) ≥ 20 occasions/4 weeks of moderate or vigorous activity for ≥ 30 minutes

Table 11 (contd)

Country, survey name, (reference), year(s) of survey	Recall period	Total survey items	Method of activity probing	Type of physical activity and nature and detail of survey data	Activity summary score
	Past 4 weeks	5	Close-ended	Work Combination of Standard Occupational Classification code and perception of degree of physical activity on the job (mainly sitting down/standing up/walking about, doing any climbing (excluding climbing stairs), lifting/carrying heavy loads. Work coded as vigorous if on a selected list of vigorous occupations.	Three non-independent groups: 1. Mainly sitting or standing 2. Climbing 3. Lifting/carrying heavy loads
European Union[b]					
Pan-European Union Survey (European Commission, 1999; Kearney *et al.*, 1999), 1997	Average week	18 activities (17 listed, 1 'other')	List-specific	Leisure Recall of hours/week in 18 activities spent in 7 categories of duration: ≤ 0.5, 1, 1.5, 2, 3, 4 ≥ 5 h/week	Sum of time/week spent in 18 activities. Summarized into 4 groups: none, < 1.5, 1.5–3.5, > 3.5 h/week
	Typical day at work, college, in office or at home	3 activities	List-specific	Work Recall of hours/day spent in 3 intensity levels of work activity (sitting, standing/walking, physical work) for 10 categories of duration ranging from 0–≥ 8 h/day	Time/day spent in each of 3 work intensity levels. Summarized into 4 groups: none, < 2, 3–6, > 6 h/day
Finland					
National Health Behaviour Monitoring System (Helakorpi *et al.*, 1999), 1999	Past year	1	Close-ended	Leisure Physical activities performed for at least one half hour and that at least causes light sweating or breathlessness	Categories of a few times a year or less, 2–3 times a month, once a week, 2–3 time/week, 4–6/per week, and daily (noted those who cannot exercise)
	Usual work day	1	Close-ended	Work 'How physically demanding is respondent's job ?'	Categories included: 'Job mainly involves sitting', 'Work involves quite a lot of walking,' 'Work involves much walking and lifting,' and 'Work is very physically demanding'
	Usual work day	1	Close-ended	Transportation[c] Time spent travelling to and from work by walking or cycling	Categories of 15, 15–30, 30–60, ≥ 60 minutes/day

Table 11 (contd)

Country, survey name, (reference), year(s) of survey	Recall period	Total survey items	Method of activity probing	Type of physical activity and nature and detail of survey data	Activity summary score
Ireland					
Happy Heart National Survey (Irish Heart Foundation, 1994), 1992	NR	NR	NR	Leisure NR	Times/week
	Usual work day	NR	NR	Work NR	Times/week
	NR	NR	NR	Outside of work NR	Times/week
	N/R	NR	NR	Watching television, playing video games NR	Hours/day spent viewing television and playing video games
New Zealand					
Life in New Zealand Survey (Hopkins *et al.*, 1991; Russell & Wilson, 1991), 1990	Past 4 weeks	2	Close-ended	Mild/moderate and vigorous/ strenuous activity Usual time spent (hours/day) in these intensity groupings	High ≥ 2 occasions/week in high-intensity activity for total of ≥ 1 h/week Moderate Not in high group but had ≥ 21 h/week of medium/ low-intensity activity Low Not in moderate or high group
		2	Close-ended	Selected activities and sports Times/week spent in selected activities (lawn mowing, gardening, chopping wood, house repair, washing car, walking, running/ jogging, cycling, fitness classes, fitness exercises at home) and as many as seven 'other' activities	
		1	Close-ended	Work Days/week and time/day spent in physical work or labour	
		1	Close-ended	Transportation Days/week and time/day spent walking to or from work	
		1	Close-ended	Housework Houses/day spent in 'on the move' housework	

Table 11 (contd)

Country, survey name, (reference), year(s) of survey	Recall period	Total survey items	Method of activity probing	Type of physical activity and nature and detail of survey data	Activity summary score
United States					
National Health Interview Survey (USDHHS, 1996), 1991	Past 2 weeks	24 activities (22 listed, 2 'other')	List-specific	Leisure Recall of average frequency, average duration, and perceived degree of increase in breathing or heart rate (i.e., none, small, moderate or large)	No leisure-time physical activity No reported activity during the previous 2 weeks Regular, sustained activity ≥ 5 times per week and ≥ 30 min per occasion of physical activity of any type and at any intensity Regular, vigorous activity ≥ 3 times per week and ≥ 20 min per occasion of physical activity involving rhythmic contractions of large muscle groups (e.g., jogging or running, racket sports, competitive group sports) performed at ≥ 50% of estimated age- and sex-specific maximum cardiorespiratory capacity[d]

[a] NR = not reported

[b] The 15 countries included in the European Union survey were Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.

[c] Response included those who did not work or worked at home.

[d] The two regression equations used to estimate the respondent's maximum cardiorespiratory capacity (expressed in metabolic equivalents, METs) are: [60–0.55 x age (years)] 3.5 for men, and [48–0.37 x age(years)] 3.5 for women (Jones & Campbell, 1982).

Figure 16 Finlandia Ski Race, with thousands of participants

member states of the European Union (EU) (European Commission, 1999; Kearney *et al.*, 1999; Margetts *et al.*, 1999; Vaz de Almeida *et al.*, 1999). To be considered in this section, the data for each country had to have been drawn from some sort of representative national sample and had to offer sufficient details of the physical activity survey and mode of administration to allow to understanding of the summary scores that were presented.

The methods used for these surveys are summarized in Table 10 and show the following common features: the surveys in most countries except Ireland had governmental sponsors; each country used some form of random sampling strategy to derive a population sampling frame; and the most common mode of survey administration was a household interview, except for a telephone interview (Australia) and postal surveys (Finland and New Zealand). Many countries conducted surveys in several different seasons of the year, although Canada, England, New Zealand and the United States collected data for 12-month periods. Although countries had different sample sizes that paralleled the sizes of their populations, they tended to have different lower age bounds for their samples but generally no upper age bound, except for Australia (age 75), Finland (age 64) and Ireland (age 69). Overall survey response rates varied from 49–58% for Australia to 88% for the United States.

The summary of the characteristics of physical activity surveys in Table 11 shows that the recall period varied from a usual work day to the prior year (both for Finland); the total survey items ranged from four single-item queries with closed-ended responses (Finland) to batteries of listed activities with questions on average frequency, duration and intensity of activity participation (United States). Each country assessed leisure-time physical activity, while four countries (England, Finland, Ireland and New Zealand) and the EU assessed work activity, and two countries (Finland and New Zealand) assessed transport to and from work. The wording of the activity questions varied in many ways from survey to survey. Although countries had collected physical activity data via self-reported questionnaires having less than ideal reliability and validity (see also Chapter 1), more accurate, meaningful and cost-effective physical activity measures are not available for representative, population-based samples.

Physical activity summary scores ranged from selecting one or combining several closed-ended response options (Finland), to scoring specific patterns of frequency and duration of leisure-time physical activity (England and the United States) or estimating daily expenditure of energy (per kg body weight) (Canada). At the highest levels of activity (see Table 12), summary scores usually reflected energy expenditure (regular activity at least five times per week and lasting ≥30 minutes duration) or the likelihood of enhancing and maintaining aerobic capacity (vigorous activity performed at least three times per week and lasting ≥20 minutes duration) – the traditional exercise prescription (Caspersen *et al.*, 1994). Most countries could be compared according to the lowest levels of physical activity, which ranged from physical inactivity in leisure time to ≤6.3 kJ (1.5 kcal)/kg/day of total estimated energy expenditure (Canada). Summary scores for work activity focused on prolonged times spent sitting on the job (EU and Finland) to participation in jobs requiring a lot of walking, lifting or physically demanding tasks (Finland). Generally, higher prevalence of the lowest levels of activity, regardless of whether this reflected leisure, work or transportation activities, were most likely to be considered as risk factors for disease or as detrimental to health.

Total prevalence of physical activity

In the surveys, the country-specific prevalence of the lowest activity levels in leisure time varied greatly (Table 12). The lowest prevalence was associated with restrictive activity definitions that were hard to meet, such as performing leisure-time activity for only a few times a year or

being unable to exercise (10.7% for Finland), or performing absolutely no physical activity during the previous week (14.6% for Australia) or during leisure-time (24.3% for the United States). The prevalence was highest for Canada (56.7%), where the definition (<6.3 kJ (1.5 kcal)/kg/day) could be easily satisfied by either doing no activity or even small amounts of physical activities. All other country-specific prevalence estimates were intermediate between those from these countries with extremes in definitions.

The country-specific prevalence for the highest activity levels in leisure time also varied widely (Table 12), being lowest for large amounts of vigorous activity such as running for ≥3 hours per week (12.7% for Ireland). The prevalence of regular participation in vigorous physical activity during the prior two weeks was 16.4% in the United States. In contrast, the highest prevalence was 59.0% (EU countries) for those reporting >3.5 hours/week in 18 leisure activities and 62.8% (Finland) for those participating in as little as two episodes per week of physical activity producing light sweating or breathlessness lasting ≥30 minutes (Figure 17). The prevalence for other countries varied between 20.6% (Canada) and 45.2% (Australia). Estimates of persons who reported that they did not participate in any recreational activities were compiled for the 15 individual member countries of the EU (Figure 18). The lowest prevalence (8.1%, average for men and women) was in Finland and the highest (59.8%) in Portugal, a nearly three-fold difference. The average for all EU countries was 30.9%, with countries of more northerly latitude having lower prevalence and Mediterranean countries and those of more southerly latitude having higher prevalence than the average.

Four countries assessed work-related physical activity (Table 12); the lowest prevalence (19.0%) for the lowest work levels was noted for EU countries reporting at least six hours of sitting at work. The highest prevalence was for Finland (50.9%) for work that involves mainly sitting. The prevalence of the highest levels of work-related physical activity that had definitions most indicative of more physically demanding jobs was 31.6% for active or very active work in Ireland, and 45.0% for lifting and/or carrying heavy loads in England.

Only Finland assessed activity associated with travel to or from work (Table 12), with 46.0% of employed adults reporting the use of car or bus for transport and 39.0% walking or cycling for at least 15 minutes per day.

Prevalence of physical activity according to sociodemographic characteristics

Within a data-set, differences in cross-sectional prevalence between sexes (Table 12), age groups (Figure 19) or levels of socioeconomic status (Table 13) are described by the absolute size of the difference in percentage points (in

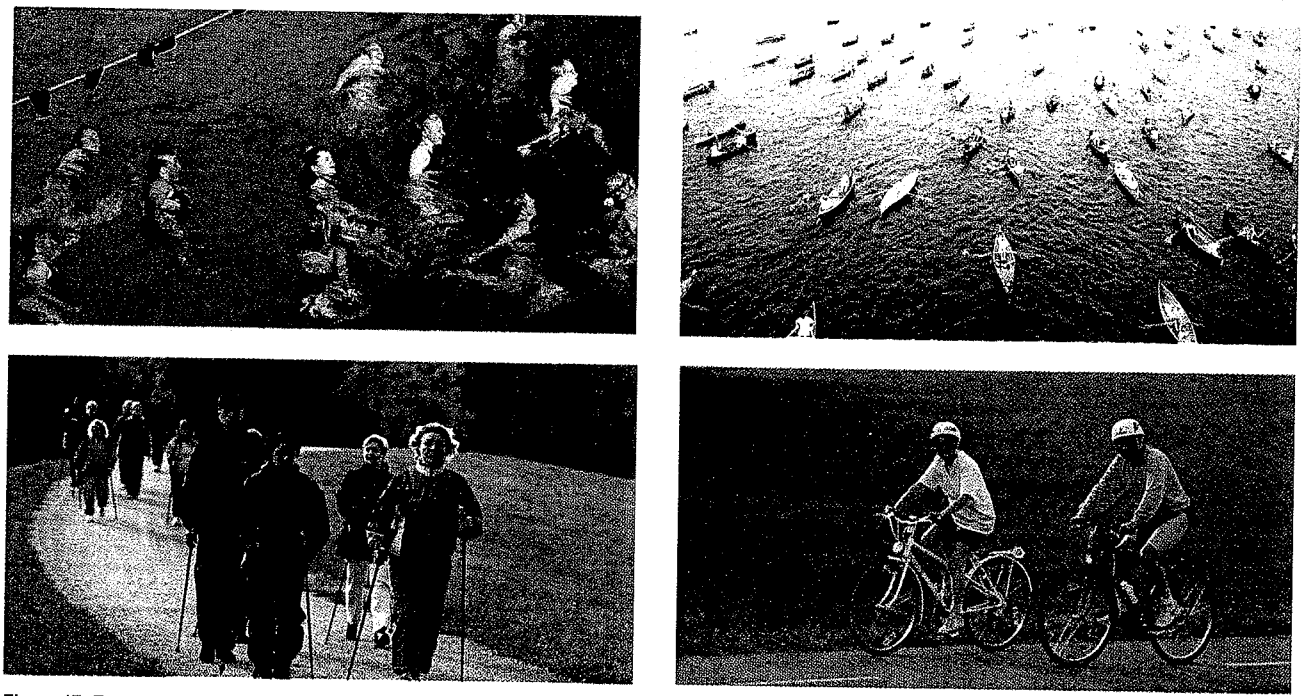

Figure 17 Examples of recreational activities (practised in Finland)

Table 12. Prevalence of physical activity for leisure, work and transport among the total population, males and females in national physical activity surveys

Type of activity, country, survey name (reference), year of survey	Lowest activity				Moderate activity				Highest activity			
	Definition of activity level	Prevalence (%)[a] T	M	F	Definition of activity level	Prevalence (%) T	M	F	Definition of activity level	Prevalence (%) T	M	F
Leisure activity												
Australia												
National Physical Activity Survey (Armstrong *et al.*, 2000), 1999	Sedentary No physical activity during previous week	14.6	14.6	14.7	Insufficiently active > sedentary and < sufficiently active	40.2	38.3	41.9	Sufficiently active ≥ 150 min/week and ≥ 5 sessions/week in walking, moderate, or vigorous activity	45.2	47.1	43.4
Canada												
Nationa Population Health Survey (Health Canada, 1999), 1996–97	Inactive < 1.5 kcal/kg/day	56.7	53.8	59.5	Moderately active 1.5–2.9 kcal/kg/day	22.7	22.3	23.0	Active ≥ 3.0 kcal/kg/day	20.6	23.9	17.5
England												
National Health Survey for England (Prior, 1999), 1998	Group 1 ≤ 3 occasions/4 weeks of moderate or vigorous activity for ≥ 30 min	38.0	35.0	41.0	Group 2 4–19 occasions/4 weeks of moderate or vigorous activity for ≥ 30 min	31.0	28.0	34.0	Group 3 ≥ 20 occasions/4 weeks of moderate or vigorous activity for ≥ 30 min	31.0	37.0	25.0
European Union[b]												
Pan-European Union Survey (Vaz de Almeida *et al.*, 1999), 1997	Leisure time No time spent in 18 leisure time activities	31.0	NR[c]	NR	Leisure time > 0–3.5 h/week spent in 18 leisure time activities	10.0	NR	NR	Leisure time > 3.5 h/week spent in 18 leisure time activities	59.0	NR	NR
Finland												
National Health Behaviour Monitoring System (Helakorpi *et al.*, 1999), 1999	Leisure time ≤ a few times a year of physical activity to produce light sweating or cannot exercise	10.7	12.1	9.4	Leisure time 1 time/week or 2–3 times/month of physical activity to produce light sweating	26.6	25.0	28.0	Leisure time ≥ 2 times/week and ≥ 30 min/occasion of physical activity to produce light sweating	62.8	62.9	62.6
Ireland												
Happy Heart National Survey (Irish Heart Foundation, 1994), 1992	Sedentary Sedentary at leisure	39.0	36.1	42.0	Moderate Moderate (walking, etc., ≥ 4 h/week)	48.3	47.2	49.4	Active/very active Active (running, etc > 3 h/week) and very active (regular training, competitive sports)	12.7	16.7	8.6
New Zealand												
Life in New Zealand Survey (Hopkins *et al.*, 1991; Russell & Wilson, 1991), 1990	Low Not in moderate or high group	31.0	37.0	25.0	Moderate Not in high group but had ≥ 21 h/week of medium/low-intensity activity	41.0	31.0	51.0	High ≥ 2 occasions/week in high-intensity activity for total of ≥ 1 h/week	28.0	32.0	24.0

Table 12 (contd)

Type of activity, country, survey name (reference), year of survey	Lowest activity				Moderate activity				Highest activity			
	Definition of activity level	Prevalence (%)[a] T	M	F	Definition of activity level	Prevalence (%) T	M	F	Definition of activity level	Prevalence (%) T	M	F
United States												
National Health Interview Survey (USDHHS, 1996), 1991	No leisure-time activity	24.3	21.4	26.9	100%– (prevalence of lowest plus highest activity levels)	52.2	52.2	52.4	Regular, sustained ≥ 5 times/week and ≥ 30 min/occasion	23.5	26.6	20.7
Work activity												
England												
National Health Survey for England (Prior, 1999), 1998	Mainly sitting or standing Not in any of the 3 groups (e.g., mainly walking about, climbing, or lifting and/or carrying heavy loads)	36.0	32.0	40.0	Climbing 100% – (prevalence of lowest plus highest activity)	19.0	19.0	19.0	Carrying leavy loads Lifting and/or carrying heavy loads	45.0	49.0	41.0
European Union												
Pan-European Union Survey (European Commission, 1999), 1997	Sitting ≥ 6 h/day	19.0	20.0	18.0	Sitting < 2–6 h/day	75.0	74.0	76.0	Sitting 0 h/day	6.5	6.0	7.0
Finland												
National Health Behaviour Monitoring System (Helakorpi *et al.*, 1999), 1999	Work activities Job mainly sitting	50.9	48.9	52.6	Work activities NR	NR	NR	NR	Work activities Work involves quite a lot of walking, much walking and lifting, or is very physically demanding	49.1	51.1	47.5
Ireland												
Happy Heart National Survey (Irish Heart Foundation, 1994), 1992	Sedentary Sedentary during usual working day	27.0	25.2	32.1	Moderate Moderately active, walking quite a lot	41.4	35.4	58.8	Active/very active Active/very active during a usual working day	31.6	39.4	9.1
Transport												
Finland												
National Health Behaviour Monitoring System (Helakorpi *et al.*, 1999), 1999	Transport Travel to work by car or by bus	46.0	55.8	37.5	Transport < 15 min/day of walking or cycling to work	15.0	14.0	15.9	Transport ≥ 15 min/day of walking or cycling to work	39.0	30.0	46.5

[a] T, = total, M = male, F = female. Total prevalence represents a simple, unweighted average of male and female prevalences for England (for all types of activity) and the European Union (for work activity only).

[b] The 15 countries included in the European Union survey were Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom

[c] NR, not reported

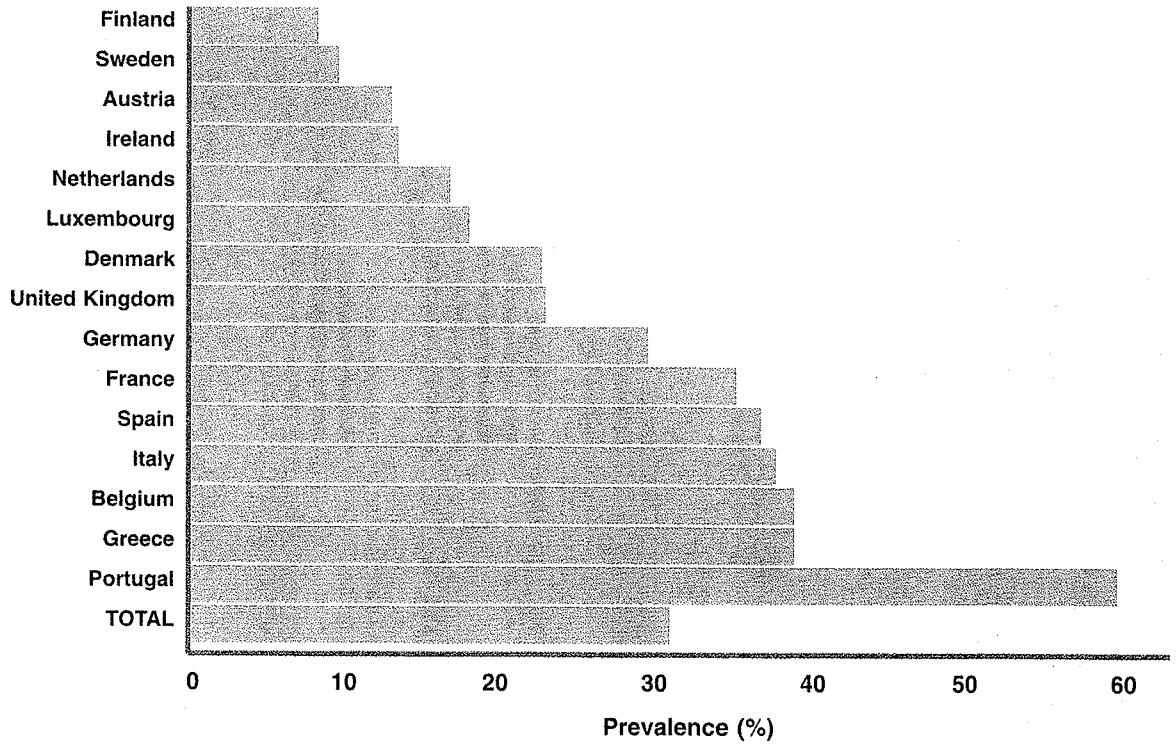

Figure 18 Prevalence of reporting no recreational physical activity participation for 15 member countries of the European Union, sorted from low to high
European Commission, 1999

parentheses) as: small (<5.0%), moderate (5.0–9.9%), large (10.0–14.9%), and very large (≥15.0%) (Caspersen *et al.*, 2000). The differences between sexes for the lowest levels of leisure-time physical activity were small for Australia (0.1%) and Finland (2.7%), but large for New Zealand (12.0%), with all other countries having moderate differences of 5.5–6.0%. For the highest activity levels, the same countries showed similar small and moderate differences between the sexes to those noted for the lowest activity levels, except that the largest sex difference (12.0%) was noted for England, where the definition of highest activity included participation in moderate and vigorous physical activity. Because 'vigorous' was defined in absolute terms in England, e.g., ≥31 kJ (7.5 kcal)/min, it may have been harder for women to reach this intensity than for men, who have a higher average maximal cardiorespiratory capacity at any given age (Caspersen, 1994). Although not tabulated, the sex difference for regular, vigorous physical activity participation was small (3.2%) in the United States, where the definition of "vigorous" was standardized according to age and sex. Otherwise, sex differences were mainly of moderate magnitude (e.g., 5.9–8.0%).

Sex differences for individual EU countries were quite variable. Women usually had lower prevalence of physical activity than men, the differences being small for Austria (–2.5), Denmark (–2.5) and Ireland (–1.0), moderate for Germany (–5.6), Italy (–6.9), Spain (–7.2) and Sweden (–7.2), large for France (–12.6) and Greece (–12.8), and very large for Portugal (–20.5). Men had lower prevalence than women for Belgium (9.4), Finland (1.5), and the United Kingdom (5.0). There was essentially no sex difference for Luxembourg (–0.1) and the Netherlands (0.9).

For Finland, sex differences were small (3.7%) for prolonged time spent sitting on the job, while differences were moderate (8.0%) for lifting and/or carrying heavy loads in England, but very large (30.3%) for active and/or very active work in Ireland (Table 12). For Finland, sex differences were very large (≥15%) for transport to or from work, with men being more likely to use a car or bus, and women more likely to walk or cycle for ≥15 minutes per day.

Most countries showed increases in the lowest levels of physical activity as cross-sectional age increased (Figure 19(*a*)). Canada had a curvilinear increase essentially reaching an asymptotic plateau for the oldest ages,

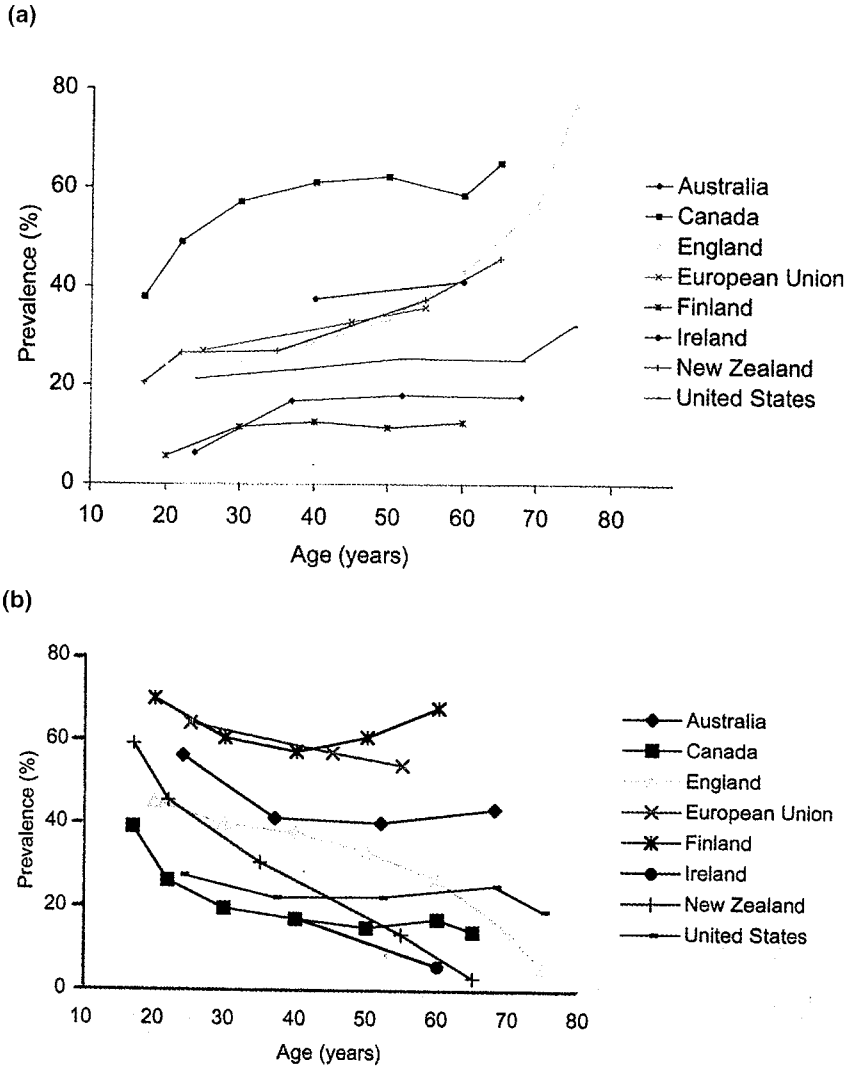

Figure 19 Changes in the (a) lowest and (b) highest levels of physical activity by cross-sectional age, by country
Data from Vaz de Almeida *et al.* (1999)

while Australia, Finland and the United States had plateaus across broad age spans following an initial increase at the youngest ages, or which was followed by an increase in prevalence in the oldest age group. The increases in prevalence were nearly identical for England and New Zealand between the ages of 20 and 60 years. The decreases in prevalence with increasing age for the highest levels of physical activity (Figure 19(*b*)) often corresponded to the increases in the lowest activity levels (Figure 19(*a*)). Australia and the United States had plateaus that corresponded to increases noted for the lowest activity levels, although Finland's plateau for the lowest activity level became a notable U-shaped curve. The other countries showed varying forms of decreasing prevalence with increasing age.

Each country provided data on prevalence of physical activity levels according to levels of socioeconomic status (Table 13) that suggest not only existing health disparities but also areas needing intervention. In terms of level of education, the differences in prevalence for the lowest leisure-time physical activity levels were moderate for Australia (8.6% comparing <12 and ≥12 years of education) and for New Zealand (9.0% comparing primary school with university or technical school education), and very large for the United States (22.9% comparing <12 years with college education or higher). The differences for the highest levels of physical activity were large for Australia (13.7%) and for the United States (10.4%), and very large for New Zealand (23.0%), but almost non-existent for Finland (1.0% comparing <10 years and ≥13 years of education). Three countries used different constructs to assess socioeconomic status. For the lowest and highest activity levels, respectively, Canada reported a large (10.7%) and a moderate (5.9%) difference comparing the lowest and highest quartiles of income adequacy; England reported a small (4.0%) and a moderate (9.5%) difference when comparing social class I with class V; and Ireland reported moderate differences (5.4% and 6.8% when comparing persons engaged in unskilled, semiskilled, and skilled manual professions with those engaged in professional and non-manual professions). Hence, there was a tendency, though not uniform, towards larger differences for the highest leisure-time activity levels compared with the lowest levels, regardless of the construct used to assess socioeconomic status. The converse was seen for socioeconomic contrasts for work activity, where differences were larger for the lowest activity levels compared with the highest activity levels for countries of the EU (15.0% and 6.0%, respectively when comparing primary and tertiary

Table 13. Prevalence of physical activity for leisure, work and transport for the lowest and highest socioeconomic groups in national physical activity surveys

Type of activity, country, survey name (reference), year of survey	Definition of socioeconomic status		Physical activity level[a]					
			Lowest (%)		Moderate (%)		Highest (%)	
			Socioeconomic status		Socioeconomic status		Socioeconomic status	
	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest
Leisure activity								
Australia								
National Physical Activity Survey (Armstrong *et al.*, 2000), 1999	Education < 12 years	Education > High school	19.5	10.9	41.9	36.8	38.6	52.3
Canada								
National Population Health Survey (Health Canada, 1999), 1996–97	Income adequacy[b] Lowest quartile	Income adequacy Highest quartile	59.5	48.8	20.8	25.6	19.7	25.6
England								
National Health Survey for England (Prior, 1999), 1998	Social class of head of household[c] Class V	Social class of head of household Class I	34.0	38.0	40.5	26.5	25.5	35.0
European Union								
Pan-European Union Survey (Vaz de Almeida *et al.*, 1999), 1997	Education Primary level	Education Tertiary level	41.0	23.0	11.0	10.0	48.0	68.0
Finland								
National Health Behaviour Monitoring System (Helakorpi *et al.*, 1999), 1999	Education < 10 years	Education ≥ 13 years	NR[d]	NR	NR	NR	64.0	63.0
Ireland								
Happy Heart National Survey (Irish Heart Foundation, 1994), 1992	Profession Unskilled, semi-skilled, and skilled manual professions	Profession Higher professional, lower professional, other non-manual professions	41.6	36.2	49.1	47.7	9.4	16.2

Table 13. (contd)

Type of activity, country, survey name (reference), year of survey	Definition of socioeconomic status		Physical activity level[a]					
			Lowest (%)		Moderate (%)		Highest (%)	
			Socioeconomic status		Socioeconomic status		Socioeconomic status	
	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest
New Zealand								
Life in New Zealand Survey (Hopkins *et al.*, 1991; Russell & Wilson, 1991), 1990	Education Primary school	Education University, technical school	46.0	37.0	49.0	35.0	5.0	28.0
United States								
National Health Interview Survey (USDHHS, 1996) 1991	Education < 12 years	Education College (≥ 16 years)	37.1	14.2	44.8	57.3	18.1	28.5
Work activity								
European Union								
Pan-European Union Survey (European Commission, 1999) 1997	Education Primary level	Education Tertiary level	13.0	28.0	78.0	69.0	9.0	3.0
Ireland								
Happy Heart National Survey (Irish Heart Foundation, 1994), 1992	Profession Unskilled, semi-skilled, and skilled manual professions	Profession Higher professional, lower professional, other non-manual professions	15.9	35.3	48.6	47.5	35.6	22.4
Transport								
Finland								
National Health Behaviour Monitoring System (Helakorpi *et al.*, 1999), 1999	Education < 10 years	Education ≥ 13 years	NR	NR	NR	NR	45.0	37.0

[a] Prevalence represents a simple, unweighted average of male and female prevalences for England (for all types of activities) and New Zealand (for all types of activity).
[b] Income adequacy is based on household income and number of persons living in the household.
[c] Social class of head of household is defined as Class I and II = professional and intermediate occupations, Class III = manual skilled occupations, Class IV and V = partly-skilled and unskilled occupations.
[d] NR, = not reported

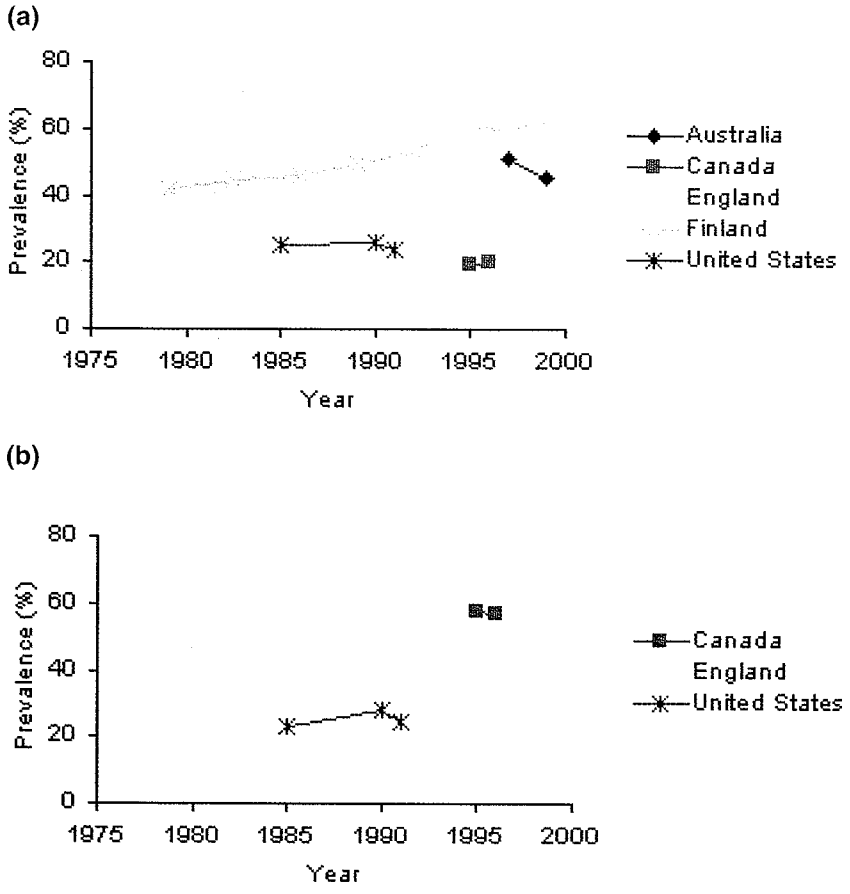

Figure 20 Trends in (a) lowest and (b) highest levels of physical activity by country

educational levels) and for Ireland (19.4% and 13.2%, respectively). For transport to and from work, there was a moderate difference (8.0%) in Finland. From these data, it is clear that socioeconomic status usually has a moderate to very large association with prevalence of physical activity.

Trends in physical activity prevalence

Physical activity trends are described by the absolute size of the average annual rate of change in prevalence (in parentheses) as: small (<0.5%/yr), moderate (0.5–2.9%/yr), large (3.0–4.9%/yr) and very large (≥5.0%/yr) (Caspersen *et al.*, 2000). Trends in the lowest levels of physical activity are inconsistent (Figure 20(*a*)), with a moderate decrease for Canada (–0.5%/yr from 1995 to 1996), a moderate increase for England (+1.4%/yr) from 1994 to 1998), and a small decrease for the United States (–0.2%/yr) from 1985 to 1990). A decrease for the United States from 1990 to 1991 reflected a survey change (Pereira *et al.*, 1997; US Department of Health and Human Services, 1996), so that further trend determination is not possible.

Trends in the highest levels of physical activity (Figure 20(*b*)) were also inconsistent, showing small decreases for Canada (–0.2%/yr) from 1995 to 1996), for England (+0.4%/yr from 1994 to 1998) and for the United States (+0.2%/yr) from 1985 to 1990). Although not shown in Figure 20, there was a small decrease in regular, vigorous physical activity in the United States (–0.1%/yr) over the same time period. Conversely, there was a quite large decrease for Australia (–2.9%/yr) from 1997 to 1999) which would be truly alarming for this country if continued over an extended period.

Children and adolescents

Childhood is generally the most physically active time during life, although in westernized countries, both cross-sectional and longitudinal studies have shown levels of physical activity to decline dramatically during adolescence and early adulthood (Anderssen *et al.*, 1996; van Mechelen *et al.*, 2000; Telama & Young, 2000). However, there have been few surveys of nationally representative samples of children and adolescents which can be compared (Caspersen *et al.*, 2000). This may arise in part from the difficulty in reliably and validly measuring physical activity in children and adolescents ranging in age from 4 to 17 years (Kohl *et al.*, 2000), while physical activity assessment for children aged 3–5 years is even more problematic.

Concluding comments

Data from these national surveys reveal that many countries have high prevalence of the lowest physical activity levels in their adult populations, suggesting that many adults are at risk for chronic diseases. This is reinforced by the often low prevalence of the highest physical activity levels – levels that would be likely to confer health benefits. However, existing surveys have not normally been designed to determine physical activity levels to address population-based cancer risks.

The differences in physical activity prevalence by sex and age, and for contrasting levels of socioeconomic

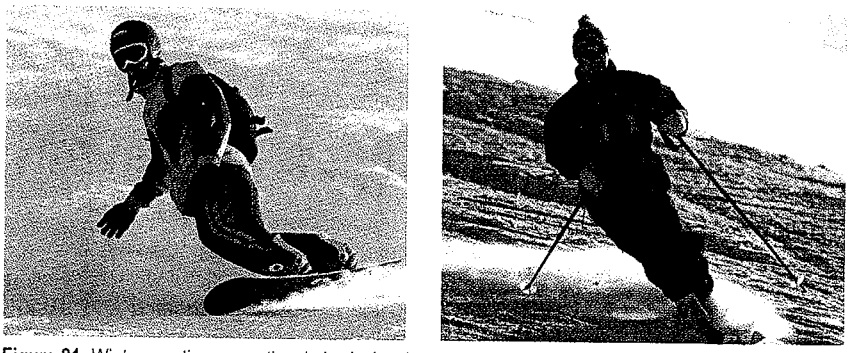

Figure 21 Winter sporting recreational physical activity

indices, reveal that disparities prevail for physical activity participation between population groups in these countries. Such differences suggest foci for in tervention efforts. The few available trend data are, however, inconsistent from country to country and mostly relate to short time frames (with the exception of Finland), highlighting the need for longer-term, immutable surveillance systems that use questionnaires having high reliability and validity (Caspersen *et al.*, 1994).

In conclusion, national population prevalence data, primarily on participation in leisure-time physical activity, exist for only a small number of industrialized nations. Earlier comparisons of population surveys from various countries concluded that the extent of participation by adults in leisure-time physical activities of the moderate and vigorous type is not at a satisfactory level (Stephens & Caspersen, 1994).

- Over half the adult populations of industrialized countries are insufficiently active in their leisure time to yield health benefits.
- One quarter to one third of adults may be classified as totally inactive in their leisure time.
- Less than 15% of adults participate in regular, vigorous activity.
- There is a clear social-class gradient for leisure time physical activity in most industrialized populations; those who are socially and economically disadvantaged are less active.

More recent data on trends in leisure-time physical activity participation show these patterns to have been relatively stable over the past two decades. There are several examples of significant regional (Bauman *et al.*, 1999; US Department of Health and Human Services, 1996), seasonal (Uitenbroek, 1993) and latitudinal (Centers for Disease Control, 1997) variations in participation in leisure-time physical activity. However, leisure-time activity is just one component of overall energy expenditure – other aspects of physical activity need to be better understood.

For the vast majority of countries worldwide, population data on physical activity participation are unavailable. This is the case for most of the world's developing nations. In these countries, economic transition involves large numbers of people moving from traditionally active rural lifestyles to cities and other urban environments. In such settings, they are likely to be much less physically active. It is plausible that such changes in physical activity are occurring and affecting an increasing proportion of the world's population, but to what extent they are taking place cannot be quantified, in the absence of population surveillance systems. Even in many developed countries, relevant data are unavailable, and where available, often address only leisure-time physical activity.