Prevalence, awareness and treatment of hypercholesterolaemia in 32 populations: results from the WHO MONICA Project

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Background Several studies have been conducted to estimate the population prevalence of hypertension, or its diagnosis and treatment. There is no multinationally comparable information on the prevalence of hypercholesterolaemia, or its diagnosis and treatment, since individual studies are often not directly comparable.

Methods Data from the WHO MONICA Project's final risk factor surveys were used. Data were collected using standardized methods between 1989 and 1997 for the 35–64 year age range in 32 populations, in 19 countries on 3 continents.

Results The prevalence of hypercholesterolaemia (total cholesterol ⩾6.5 mmol/l or taking lipid-lowering drugs) varied across populations from 3% to 53% in men, and from 4% to 40% in women. Awareness of hypercholesterolaemia varied from 1% to 33% in men, and from 0% to 31% in women. In most populations, over 50% of men and women on lipid-lowering drugs had a cholesterol level <6.5 mmol/l.

Conclusions There is wide variation in the prevalence, awareness, and treatment of hypercholesterolaemia between populations. For the planning and implementation of primary prevention programmes and for the development of health care systems, monitoring of changes, both within and between populations, is essential. To obtain reliable information on these changes, well-standardized methods must be applied.

Keywords Prevalence, awareness, treatment, cholesterol, population study, standardization

Several population studies have shown that people are quite well aware of their blood pressure levels and possible hypertension in many countries. The same does not apply to cholesterol levels and awareness of hypercholesterolaemia, although there has been significant improvement in many countries over the last decade.

The prevalence of hypercholesterolaemia varies considerably between countries,[1–9] as well as within countries, and between different areas and population groups.[8,10–12]

In the US, in the late 1980s about 60% of the population over 18 years of age had had their cholesterol measured.[11,13] By the end of the 1990s, the proportion of the population over 20 years of age whose cholesterol had been measured increased to 70%.[14,15] In Sweden, 69% of the population aged 40–49 years had had its cholesterol measured by the end of the 1980s.[16]

Several studies have reported that around half of those with hypercholesterolaemia are aware of their elevated cholesterol levels. The proportion varies from one-third to two-thirds across populations.[3,6,12,17,18]

In Italy and France about half of those aware of their hypercholesterolaemia were using lipid-lowering drugs.[3,17] In other countries, the prevalence of drug treatment for hypercholesterolaemia among those aware of their condition was substantially lower.[4,6,17,18]

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However important each individual study may be in assessing specific populations, their value for international comparison is limited. Individual studies often differ in terms of study methods: age groups under consideration and data collection methods can vary, as can the indicator definitions used.

Until now, there have been no large-scale multinational comparisons of prevalence, awareness, and treatment of hypercholesterolaemia. The WHO MONICA Project[19] provides unique multinational data, which were collected employing standardized methods. This paper will use these data from 32 populations, in 19 countries on 3 continents to compare the prevalence, awareness, and treatment of hypercholesterolaemia and the frequency of total cholesterol measurement at an international level.

Methods

Study populations

The WHO MONICA Project[20] was carried out in geographically defined populations. Each centre carried out at least two population surveys, one at the beginning and another at the end of the 10-year study period. Most centres also conducted an optional middle survey.

The questionnaire items on awareness and treatment of hypercholesterolaemia were introduced into the MONICA protocol in 1991.[21] By that time, all centres had already conducted their initial surveys and some had started their middle surveys. That is why the data for awareness and treatment of hypercholesterolaemia are not available for all MONICA surveys and why we are only using data from the final surveys in this paper.

A total of 32 populations, representing 19 countries, included questions about awareness and treatment of hypercholesterolaemia and measurement of total cholesterol in their final surveys. These were conducted between 1989 and 1997, but predominantly between 1992 and 1995. The response rate was at least 70% in most populations, with a range of 41–90% (Table 1)

This paper presents data for men and women separately for the 35–64 year age group.

Table 1 Populations, survey periods, and response rates in age group 35–64 years

	Response rate				
Country	**Population**	**Abbreviation**	**Survey period**	**Questionnaire items**	**Total cholesterol measurement[a]**
Australia	Newcastle	AUS–NEW	Jun94–Dec94	63	62
	Perth	AUS–PER	May94–Nov94	74	69
Belgium	Charleroi	BEL–CHA	Jul90–Feb93	61	32
	Ghent	BEL–GHE	Apr90–Apr92	71	50
Canada	Halifax County	CAN–HAL	May95–Nov95	57	46
China	Beijing	CHN–BEI	Sep93–Oct93	70	70
Czech Republic	Czech Republic	CZE–CZE	Mar92–Dec92	77	76
Denmark	Glostrup	DEN–GLO	Feb91–Mar92	74	74
France	Lille	FRA–LIL	Jun95–Nov96	73	72
	Strasbourg	FRA–STR	Mar95–Apr97	41	39
	Toulouse	FRA–TOU	Dec94–Jul96	59	59
Germany	Bremen	GER–BRE	May91–Jun91	68	65
	East Germany	GER–EGE	Sep93–Dec94	58	64
Iceland	Iceland	ICE–ICE	Jun93–Apr94	80	79
Italy	Area Brianza	ITA–BRI	Sep93–Nov94	73	73
	Friuli	ITA–FRI	Mar94–Oct94	77	77
Lithuania	Kaunas	LTU–KAU	Feb92–May93	57	56
Poland	Tarnobrzeg Voivodship	POL–TAR	Jun92–Jul93	75	75
	Warsaw	POL–WAR	Jan93–Dec93	77	76
Russia	Moscow Control	RUS–MOC	Mar92–Mar95	66	65
	Moscow Intervention	RUS–MOI	Jan92–Mar95	76	72
	Novosibirsk Control	RUS–NOC	Jan95–Jun95	70	68
	Novosibirsk Intervention	RUS–NOI	May94–Feb95	73	71
Spain	Catalonia	SPA–CAT	Jun94–May96	74	71
Sweden	Gothenburg	SWE–GOT	Sep94–Feb96	72	66
	Northern Sweden	SWE–NSW	Jan94–Apr94	80	80
Switzerland	Ticino	SWI–TIC	Oct92–May93	76	73
	Vaud/Fribourg	SWI–VAF	Nov92–Jun93	57	56
UK	Belfast	UNK–BEL	Oct91–Dec92	48	46
	Glasgow	UNK–GLA	Feb95–Oct95	58	54
USA	Stanford	USA–STA	Jun89–Jun90	60	57
Yugoslavia	Novi Sad	YUG–NOS	Sep94–Feb95	90	75

[a] Blood sample taken

Data collection and quality control

In the WHO MONICA Project, data were collected using standardized methods and questions.[21] Blood samples were taken by venepuncture and assayed in local laboratories with central standardization and external quality control. The details of the standardization of lipid measurements are given in the MONICA Manual.[22]

The data quality was assessed and reported in the retrospective quality assessment reports. Some populations modified the MONICA protocol to accommodate local needs and to lend continuity with earlier surveys. All these differences, data quality and availability, are reported in detail in the quality assessment reports,[23,24] but briefly: for the total cholesterol measurement, four populations (Perth, Australia, Kaunas, Lithuania, and Ticino and Vaud/Fribourg, Switzerland) had major problems in the external quality control. In four populations (Charleroi and Ghent, Belgium, Glostrup, Denmark, and Auckland, New Zealand) 4–6% lower total cholesterol values can be expected, because of venepuncture in the supine position, instead sitting as in all other populations. In Perth and Newcastle, Australia, Strasbourg and Toulouse, France, Tarnobrzeg Voivodship and Warsaw, Poland, and Stanford, USA, we can expect 3–4.5% lower total cholesterol values because EDTA-plasma was used for cholesterol determination instead of serum.[23]

For the questionnaire items, the data availability was at least 90% for those who were surveyed in most of the populations.[24]

Definitions

The following definitions of indicators are used in this paper:

Hypercholesterolaemia
Total cholesterol ⩾6.5 mmol/l or using lipid-lowering drugs. (Several other definitions were also considered using alternative cut-points [5.0 mmol/l and 6.2 mmol/l] and whether or not an individual was on lipid-lowering medication.)

Awareness of hypercholesterolaemia
A doctor or other health care worker had told that the subject had elevated total cholesterol.

On drug treatment
During the past 2 weeks had taken medicine prescribed by a doctor to lower blood cholesterol.

On dietary treatment
Were on the special diet prescribed by a doctor or other health care worker to lower blood cholesterol.

On drug and dietary treatment
During the past 2 weeks having taken prescribed medicine and on a diet to lower blood cholesterol.

Controlled hypercholesterolaemia
Used lipid-lowering drugs and had total cholesterol <6.5 mmol/l.

Statistical methods

Reported prevalences were age standardized according to the World standard population weights.[25] Correlations between different indicators were calculated from population prevalences.

Results

Prevalence of hypercholesterolaemia

The prevalence of hypercholesterolaemia depends on the population mean total cholesterol (Table 2), distribution curve of total cholesterol in the population and the chosen definition (Figure 1).

The difference in the prevalence of hypercholesterolaemia within populations was on average 48 percentage points when comparing the prevalence defined as total cholesterol ⩾6.5 mmol/l or using lipid-lowering drugs, with the prevalence defined as total cholesterol ⩾5.0 mmol/l. In men, in Toulouse, France the variation was up to 60 percentage points (Figure 1).

The prevalence of hypercholesterolaemia (total cholesterol ⩾6.5 mmol/l) in men was on average 27%, being lowest in Beijing, China (2%), and highest in Ticino, Switzerland (51%). The prevalence was below 10% in Beijing, China and in Novosibirsk Control, Russia, over 10% but less than 30% in 18 populations and over 30% in 12 populations (Figure 1).

In women, the prevalence of hypercholesterolaemia was on average 25%, again being lowest in Beijing, China (3%), and highest in Novi Sad, Yugoslavia (40%). The prevalence was below 10% only in Beijing, China, over 10% but not more than 30% in 21 populations and over 30% in 10 populations (Figure 1).

When taking lipid-lower drug treatment into account in the definition of hypercholesterolaemia (⩾6.5 mmol/l), the prevalence increased on average by 1% in both men and women (Figure 1).

There was no clear geographical pattern to the prevalence of hypercholesterolaemia in men or women.

Frequency of total cholesterol measurement

On average, 30% of men had had their cholesterol measured in the past year. There were big differences in the frequency of cholesterol measurement during the past year between populations. In Moscow Control, Russia, only 2% of men had had their cholesterol measured in the past year, while in Bremen, Germany, the frequency was 57%. The frequency was on average 37% in men with hypercholesterolaemia (Figure 2).

In women, the frequency of cholesterol measurement during the past year was similar to that in men (on average 30%) but there was a little wider variation between populations. The lowest frequency was in Moscow Control, Russia (2%), and the highest in Toulouse, France, and Bremen, Germany (59%). The frequency of cholesterol measurement among women with hypercholesterolaemia remained about the same as in the entire population, running on average at 38% (Figure 2).

Some geographical patterns in the frequency of cholesterol measurements emerged. The highest frequency was observed in France, Belgium, Germany, Italy, and Spain in both men and women, while the lowest were seen in Russia and Lithuania.

Awareness of hypercholesterolaemia

On average 19% of men in all populations were aware of their hypercholesterolaemia. There was large variation between populations: from 1% in Kaunas, Lithuania to 33% in Strasbourg, France, and in Bremen, Germany. The prevalence of awareness, on average 36%, was much higher among men with hypercholesterolaemia, varying from 3% in Kaunas, Lithuania, to 62% in Catalonia, Spain (Figure 3).

Table 2 Correlation coefficients between different age-standardized prevalences for men (top triangle) and women (bottom triangle) in age group 35–64

	Cholesterol measured during the past year in population	Cholesterol measured during the past year among people with hypercholesterolaemia	Awareness in population	Awareness among people with hypercholesterolaemia	Drug treatment only	Dietary treatment only	Combined drug and dietary treatment	Controlled hypercholesterolaemia	Hypercholesterolaemia[a]	Mean total cholesterol (mmol/l)
Cholesterol measured during the past year in population	**	0.95	0.91	0.82	0.30	−0.08	0.12	0.04	0.39	0.34
Cholesterol measured during the past year among people with hypercholesterolaemia	0.96	**	0.84	0.75	0.27	−0.18	0.12	−0.03	0.26	0.30
Awareness in population	0.92	0.88	**	0.92	0.33	−0.12	0.08	0.08	0.49	0.39
Awareness among people with hypercholesterolaemia	0.84	0.88	0.88	**	0.57	−0.06	0.22	0.28	0.19	−0.02
Drug treatment only	0.16	0.26	0.16	0.44	**	−0.20	0.25	0.49	−0.09	−0.43
Dietary treatment only	0.06	0.01	0.09	−0.01	−0.36	**	0.12	−0.06	−0.07	−0.12
Combined drug and dietary treatment	−0.14	−0.05	−0.17	−0.13	−0.02	−0.11	**	0.30	−0.25	−0.44
Controlled hypercholesterolaemia	−0.24	−0.09	−0.19	−0.06	0.12	0.06	0.30	**	−0.18	−0.45
Hypercholesterolaemia[a]	0.13	0.02	0.14	−0.14	−0.47	0.36	−0.26	−0.07	**	0.91
Mean total cholesterol (mmol/l)	0.07	−0.02	0.08	−0.24	−0.66	0.41	−0.22	−0.07	0.82	**

[a] Total cholesterol ⩾ 6.5 mmol/l or using lipid-lowering drugs.

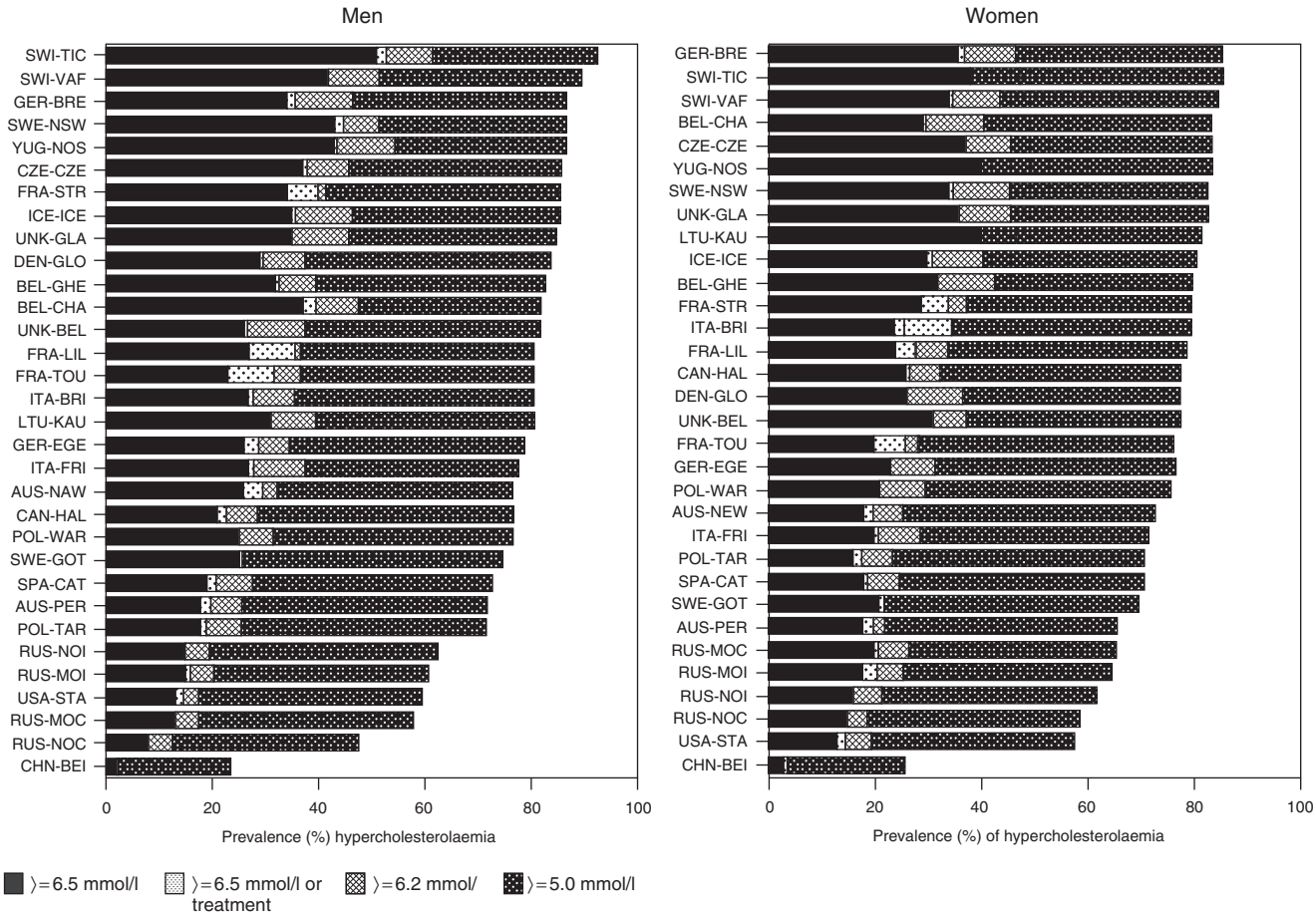

Figure 1 The age-standardized prevalence of hypercholesterolaemia for men and women in age group 35–64

On average 17% of females in all populations were aware of their hypercholesterolaemia, varying from 0% in Novosibirsk Intervention, Russia to 31% in Bremen, Germany. The prevalence of awareness was substantially higher in most populations among women with hypercholesterolaemia. The lowest prevalence was seen in Novosibirsk Intervention in Russia (0%) and the highest in Toulouse, France (65%) (Figure 3).

The highest awareness among people with hypercholesterolaemia was in populations in Spain, France, Belgium, Germany, Italy, and North America and, in men, also in Australia. The awareness was lowest in Lithuania and Russia.

Treatment of hypercholesterolaemia

In men with hypercholesterolaemia, from 0% to 100% were using either lipid-lowering drugs or were on special diets to lower their blood cholesterol, or both. On average, 45% of men with hypercholesterolaemia were using some kind of treatment. The prevalence of drug treatment alone was on average 8%, being lowest in Russia, Lithuania, USA, and Denmark (0%) and highest in Beijing, China (41%), and France (20–28%). The prevalence of dietary treatment alone was on average 23%, being lowest in Novosibirsk Control, Russia (0%) and highest in Warsaw, Poland (46%), and Iceland (42%). The prevalence of combined drug and dietary treatment was on average 14%, varying from 0% in Moscow and Novosibirsk Controls, Russia, and in Kaunas, Lithuania, to 48% in Novosibirsk Intervention, Russia (Table 3).

In women with hypercholesterolaemia, on average 44% were using some kind of treatment to lower their blood cholesterol, ranging from 0% in Novosibirsk Intervention to 91% in Moscow Intervention, Russia. The prevalence of drug treatment alone was on average 6%, varying from 0% in Russia, Lithuania, Iceland, and Ghent, Belgium to 37% in China. The prevalence of dietary treatment alone, on average 24%, was lowest in China and Novosibirsk Intervention in Russia (0%) and the highest in Lithuania (72%). The prevalence of combined drug and dietary treatment on average was 14%, varying from 0% in Novosibirsk Intervention to 79% in Moscow Intervention, Russia (Table 3).

There was no clear geographical pattern to the prevalence of drug or dietary treatment, singly or in combination, in men or women.

Controlled hypercholesterolaemia

The proportion of those with total cholesterol below the desired level (<6.5 mmol/l) among lipid-lowering drug users was on average 61% in men, varying from 18% in Vaud/Fribourg, Switzerland to 100% in Beijing, China and Moscow Control,

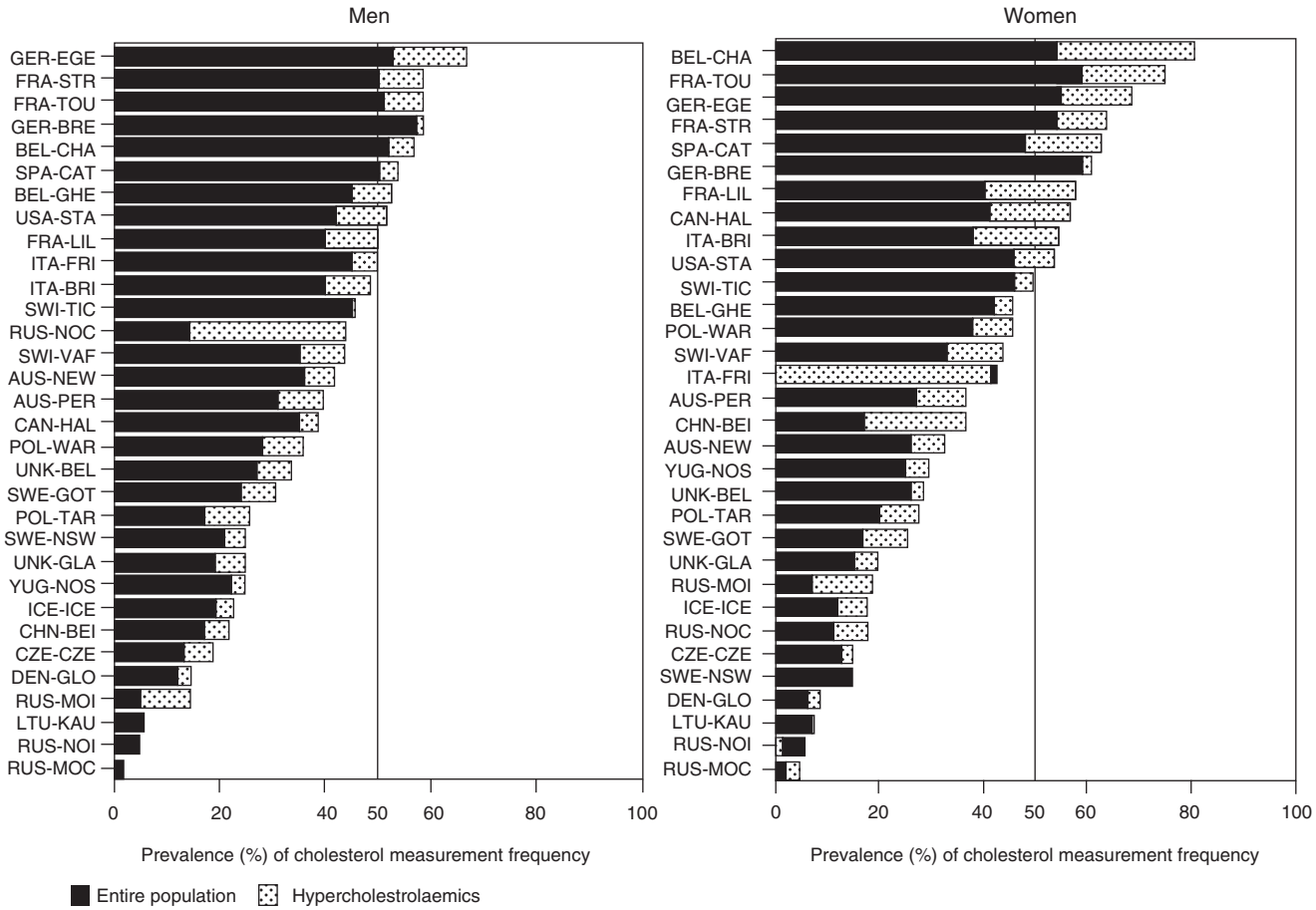

Figure 2 The age-standardized prevalence of cholesterol measurement for men and women in age group 35–64

Russia. In both Beijing and Moscow Control the number of people using lipid-lowering drugs was very low, seven in Beijing and only one in Moscow Control. In most populations (17 out of 32), the proportion was at least 50% but less than 100% (Table 3).

In women, the proportion was on average 65% and varied from 0% in Glostrup, Denmark, to 100% in Moscow and Novosibirsk Controls, Russia. In Glostrup, only two women were using lipid-lowering drugs and neither of them had total cholesterol <6.5 mmol/l. In both Moscow and Novosibirsk Controls, only one woman was using lipid-lowering drugs. The proportion was at least 50% but less than 100% in the majority (19 out of 32) of populations (Table 3).

There was no evident geographical pattern to controlled hypercholesterolaemia in either men or women.

Relationships between prevalences

In men, the prevalence of the awareness of hypercholesterolaemia was high in populations where the prevalence of cholesterol measurement was also high (r = 0.91). The same pattern was seen among hypercholesterolaemics (r = 0.86). At the population level, there was a positive correlation between the frequency of cholesterol measurement and the prevalence of hypercholesterolaemia (r = 0.39) (Table 2).

The prevalence of awareness of hypercholesterolaemia among men with hypercholesterolaemia was positively correlated with the prevalence of drug treatment (r = 0.57). The prevalence of awareness in the population was also positively correlated with the prevalence of hypercholesterolaemia (r = 0.49) (Table 2).

In men, the prevalence of controlled hypercholesterolaemia was positively correlated with the prevalence of drug treatment (r = 0.49). The prevalence of treatment (drugs, diet, or combination of drugs and diet) showed no correlation with the prevalence of hypercholesterolaemia (Table 2).

In women, the prevalence of awareness of hypercholesterolaemia was strongly correlated with the frequency of cholesterol measurement (r = 0.92). An equally strong correlation was observed in women with hypercholesterolaemia (Table 2).

The prevalence of the awareness of hypercholesterolaemia in women with hypercholesterolaemia was positively correlated with the prevalence of drug treatment (r = 0.44) (Table 2).

In women, the prevalence of combined drug and diet treatment was positively correlated with the prevalence of controlled hypercholesterolaemia (r = 0.30). The prevalence of hypercholesterolaemia was negatively correlated with drug treatment (r = −0.47) but positively correlated with the prevalence of dietary treatment (r = 0.36) (Table 2).

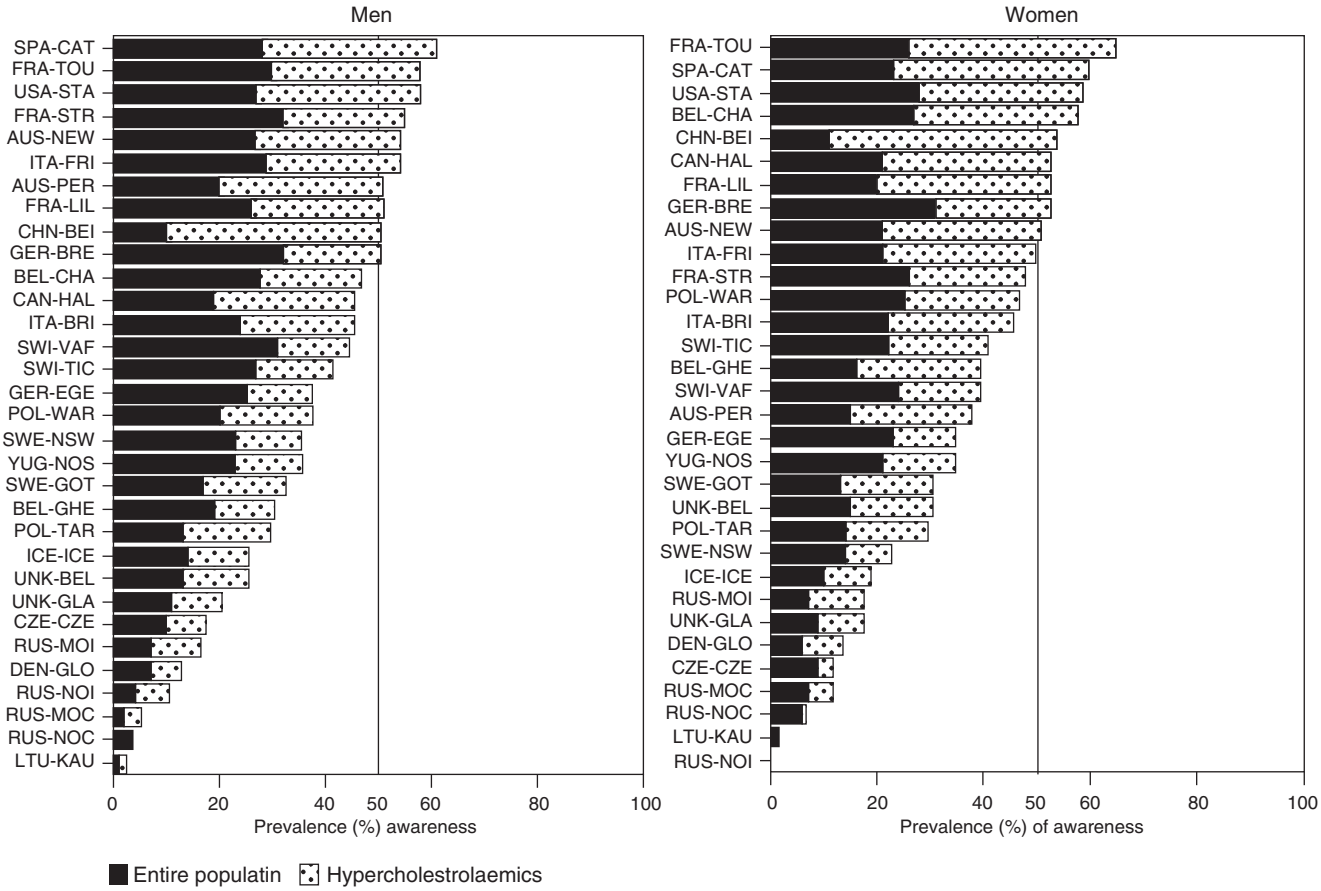

Figure 3 The age-standardized prevalence of awareness of hypercholesterolaemia for men and women in age group 35–64

Discussion

Methodological issues

Information about the prevalence, awareness, and treatment of hypercholesterolaemia, and the proportions of populations, who had had their cholesterol measured during the past year, can be collected through population surveys. Some information on the prevalence of hypercholesterolaemia and its treatment can also be assembled from routine medical records. The use of medical (or pharmacy) records is not possible in multinational studies as the coverage, availability, and data access regulations vary greatly.

Several validation studies of questionnaires collecting health information have been published but in only a few has the validity of awareness of hypercholesterolaemia been assessed.[26–28] The sensitivity for awareness of hypercholesterolaemia, has been reported to be 75–80%[27,28] and the specificity 75–90%.[26–28] Although some studies have reported lower sensitivities[26] and specificities.[27]

The validity of prescription drug use can be assessed by comparing self-reported data with pharmacy or medical records. Several such studies have been conducted but they have rarely included lipid-lowering drugs.[29] Generally, the agreement between self-reported use of prescription drugs and medical or pharmacy records is high, even though there are differences between drug classes.[29–31] The sensitivity for self-reported lipid lowering drugs is said to lie between 85% and 100%.[29,32] Based on this information we can assume that the results from MONICA are fairly reliable and reflect the true situation in the populations.

MONICA asked whether a person had ever been told that he/she had high cholesterol. It may be difficult for respondents to remember what a doctor has told them about their cholesterol levels several years earlier. It has been documented that the degree of recall bias increases with the length of the recall period.[33] From the monitoring standpoint, it would be more interesting to know how many people have been told by their doctor in the past year or 5 years that they have elevated cholesterol. This would also reduce recall bias and give more up-to-date information about awareness of hypercholesterolaemia in the population.

The formulation of questions used to obtain medical treatment information may affect the findings. When medical treatment is studied using specific questions like 'Are you currently taking medication prescribed by a doctor to lower your blood cholesterol level?', the prevalence is usually lower than if the question simply asks for all medications to be listed.[34] In all MONICA populations, the question about cholesterol-lowering

Table 3 Mean total cholesterol (mmol/l), prevalence of hypercholesterolaemia, different treatments among people with hypercholesterolaemia, and controlled hypercholesterolaemia. Age group 35–64, age-standardized

	Men								**Women**							
		Hypercholesterolaemia[a]								Hypercholesterolaemia[a]						
				Treatment[b]								Treatment[b]				
Population	Mean total cholesterol (mmol/l)	%	*n*	Drugs	Diet + Drugs	Diet	None	Controlled	Mean total cholesterol (mmol/l)	%	*n*	Drugs	Diet + Drugs	Diet	None	Controlled
AUS–NEW	5.76	30	184	22	7	9	63	66	5.58	20	171	9	7	14	71	51
AUS–PER	5.57	20	121	19	8	1	72	90	5.45	20	129	24	5	4	67	83
BEL–CHA	6.18	40	96	14	8	26	52	93	6.1	30	74	1	6	23	70	95
BEL–GHE	6.03	33	121	3	19	39	39	54	5.96	32	101	0	12	31	58	71
CAN–HAL	5.64	23	48	7	29	15	49	82	5.77	27	64	1	9	48	42	72
CHN–BEI	4.52	3	16	41	21	39	0	100	4.49	4	28	37	8	0	55	88
CZE–CZE	6.17	38	334	6	15	30	49	53	6.14	37	355	1	5	35	60	75
DEN–GLO	5.96	30	187	0	10	32	58	42	5.82	26	175	2	13	27	58	0
FRA–LIL	5.4	36	211	20	42	13	25	67	5.82	28	182	11	29	18	42	67
FRA–STR	6.03	40	214	20	19	15	46	63	5.91	34	193	17	23	16	44	35
FRA–TOU	5.82	32	201	28	31	9	32	77	5.65	26	168	22	22	17	39	84
GER–BRE	6.15	36	262	2	7	36	56	55	6.16	37	287	0	6	30	64	39
GER–EGE	6.05	29	120	9	25	14	52	60	5.85	23	122	3	18	15	64	31
ICE–ICE	6.16	36	255	3	8	42	47	46	6.03	31	239	0	13	29	58	84
ITA–BRI	5.93	28	186	4	14	32	49	27	5.89	26	184	1	12	34	53	57
ITA–FRI	5.87	28	192	3	3	21	73	38	5.66	21	152	5	10	13	71	49
LTU–KAU	5.96	31	178	0[c]	0[c]	29	71	0	6.19	40	249	0	14	72	14	100
POL–TAR	5.58	19	100	2	31	32	35	87	5.51	18	117	11	24	38	27	90
POL–WAR	5.75	25	123	5	4	46	46	42	5.65	21	118	3	9	41	47	54
RUS–MOC	5.26	13	71	6	0	9	85	100	5.55	21	110	0	20	7	74	100
RUS–MOI	5.38	16	84	3	22	6	69	79	5.51	21	175	0	79	12	9	88
RUS–NOC	5.01	8	45	0[c]	0[c]	0	100	0	5.34	15	79	0	39	12	49	100
RUS–NOI	5.38	15	87	0	48	38	15	48	5.4	16	102	0	0	0	100	0
SPA–CAT	5.61	21	290	3	19	18	60	49	5.53	19	243	2	11	25	62	70
SWE–GOT	5.57	26	158	8	11	39	42	28	5.44	22	164	13	10	19	58	74
SWE–NSW	6.28	45	258	4	5	31	60	94	6.12	35	212	1	2	33	64	75
SWI–TIC	6.54	53	369	13	7	6	74	40	5.19	38	297	6	4	13	76	22
SWI–VAF	6.31	42	231	4	7	5	84	18	6.06	35	189	4	11	11	74	69
UNK–BEL	5.9	27	229	1	8	36	54	57	5.91	31	254	1	3	45	51	33
UNK–GLA	6.05	35	227	4	1	4	90	57	6.08	36	252	1	5	8	86	68
USA–STA	5.4	15	57	0	28	39	33	67	5.31	15	70	10	20	48	23	36
YUG–NOS	6.37	44	200	5	6	20	69	50	6.19	40	218	1	4	26	69	64

Note the year of the survey in Table 1.

[a] Total cholesterol ⩾6.5 mmol/l and/or using lipid-lowering drugs.

[b] Among people with hypercholesterolaemia.

[c] No one using lipid-lowering drugs.

drugs was specifically asked, so this should not have biased the comparisons between populations but may have caused some underestimation of the reported treatment prevalences.

Limitations of the study

Even though the MONICA Project may provide the largest available standardized multinational dataset on which the prevalence, awareness, and treatment of hypercholesterolaemia can be studied, there are some limitations to the use of the data.

The data were collected in early and mid 1990s. Over the last decade, treatment practices for hypercholesterolaemia have changed markedly, especially since the introduction of statins. Current prevention guidelines recommend starting patients on cholesterol-lowering drugs at total cholesterol levels as low as 5.0 mmol/l if they are considered to be at high multifactorial risk of developing coronary heart disease (CHD).[35]

We have employed cut-points in order to categorize the data for presentation in this paper. We recognize that this may be misleading as the risk associated with total cholesterol tends to be continuous, and, as we have seen, the cut-points recommended are constantly being reduced.

In comparing results from cross-sectional studies, it would be better to have all surveys in the different populations conducted simultaneously. In the MONICA Project, most surveys were conducted within a few years, but some were separated by up to eight years.

In few populations, the low overall response rate or low data availability of some items may have biased the results. If it is assumed that survey respondents and non-respondents are similar, then there would be no bias, even in those populations with low response rates. Unfortunately, there is evidence that non-respondents usually manifest unhealthier lifestyles and health profiles.[36–38]

In some MONICA populations, the phrase 'prescribed by a doctor' was omitted from the question(s) on the drug treatment of hypercholesterolaemia. This may have caused slight overestimation of treatment prevalence as respondents may have reported the use of medications other than specific lipid-lowering drugs, such as herbal substances.

Prevalence of hypercholesterolaemia

In general, populations with low mean total cholesterol levels have lower prevalences of hypercholesterolaemia than populations with high mean total cholesterol levels. However, the population mean total cholesterol levels are not the sole determinants of the prevalence of hypercholesterolaemia. Additionally, the shape of the total cholesterol distribution has a significant effect on the prevalence of hypercholesterolaemia, and the treatment practice for hypercholesterolaemia, which may vary between populations. The diverse treatment practices do not explain the differences between population prevalences in our study, since adding those using lipid-lowering drugs only increased the prevalence of hypercholesterolaemia by 1%.

Depending on the definition of hypercholesterolaemia used, the prevalence varied substantially within populations. This emphasizes the importance of a uniform definition of hypercholesterolaemia when the results from more than one study are compared.

The wide variations in the prevalences of hypercholesterolaemia between populations cannot be explained by poor data quality since the populations with quality problems did not cluster at either end of the distribution.

Awareness of hypercholesterolaemia and measurement of total cholesterol

The awareness of hypercholesterolaemia correlated strongly with the prevalence of total cholesterol measurement in the population, which seems self-evident. Some believe that everyone should have their total cholesterol measured every 5 years. To fulfil this goal would require huge financial investment and is unrealistic. In every day practice, it would be equally as important to identify those at high multifactorial risk of cardiovascular disease and to treat them.

Increasing the frequency of cholesterol screenings will not in itself reduce the prevalence of hypercholesterolaemia, as our results indicate. In those populations with the highest prevalence of hypercholesterolaemia, the prevalence of cholesterol measurement during the past year was also amongst the highest.

Treatment of hypercholesterolaemia

The prevalence of the medical treatment of hypercholesterolaemia is very low in most populations, even among those aware of their hypercholesterolaemia. Increasing the frequency of drug treatment of hypercholesterolaemia will require much effort to even approach the level of treatment for hypertension.[39]

The prevalence of drug treatment is strongly correlated with the frequency of screening, which would support the need of screenings to detect hypercholesterolaemia in the population.

Comparison with prevention recommendations

The European Guidelines on Cardiovascular Disease Prevention in Clinical Practice in 1994,[40] 1998,[41] and 2003[35] have set out primary and secondary prevention targets and practical guidelines. Since the CHD is a multifactorial disease, total cholesterol should not be considered in isolation when treating the patient. In general, the goal for total cholesterol levels is <5.0 mmol/l.[35] In our study, only Beijing, China, had more than 50% of its populations with total cholesterol <5.0 mmol/l.

When the data for this study were collected, the level of total cholesterol at which the risk of CHD rapidly increased was considered to be 6.5 mmol/l.[40] Applying this cut-point in all our study populations, the prevalence of drug treatment among people with hypercholesterolaemia (total cholesterol ≥ 6.5 mmol/l or using lipid-lowering drugs) would have appeared extremely low. In those on treatment, the cholesterol level was <6.5 mmol/l in the majority of populations, i.e. more than 50% of those treated were controlled.

Conclusions

There is wide variation between populations in the prevalence, awareness and treatment of hypercholesterolaemia. There is also a clear relationship between screening frequency for cholesterol and the awareness and treatment of hypercholesterolaemia across populations.

Even though the frequency of cholesterol measurement is strongly correlated with the awareness and treatment of hypercholesterolaemia at the population level, it is more

important to focus existing financial resources on primary prevention in those at high risk, and on secondary prevention, than on screening entire populations.

Information on the prevalence of hypercholesterolaemia, its treatment in people with hypercholesterolaemia and their awareness is also important in the planning and implementation of primary prevention programmes and the development of health care systems.

In order to monitor changes within and between populations, standardization of methods is essential. As this kind of information can only be collected through population surveys, special attention must be paid to the standardization of total cholesterol measurement and the questions assessing awareness and treatment of hypercholesterolaemia.

The WHO MONICA Project is an example of a well-standardized study in which results between populations and over time are comparable. Since MONICA was conducted, the survey methodology has advanced: see, for example, the new standardized methods recommended by the European Health Risk Monitoring Project (http://www.ktl.fi/ehrm/).[42]

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KEY MESSAGES

- No multinational comparisons of the prevalence of hypercholesterolaemia, or its diagnosis are available.
- Prevalence, awareness, and treatment of hypercholesterolaemia vary considerably between populations.
- There is a clear relationship between screening frequency for cholesterol and the awareness and treatment for hypercholesterolaemia.

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