

**Title: Improving lipid profiles and increasing use of lipid-lowering therapy in England: results from a national cross-sectional survey – 2006**

Short title: Improving lipid profiles in England

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## **Abstract**

### **Summary**

Objective To evaluate blood lipid levels in the adult English population in 2006 and to report change in the use and efficacy of lipid-lowering treatment since 2003 after which time the general practitioner contract introduced a 'pay-per-performance' approach.

Design Cross Sectional surveys

Participants Nationally representative sample of 14142 non-institutionalised adults (>16 years) living in England, partaking in the Health Survey for England 2006.

Measurements Mean levels of total, HDL, non-HDL and total: HDL cholesterol ratio, prevalence of hypercholesterolaemia, use of lipid lowering agents and lipid levels and control rates among those on treatment.

Results Age-standardised mean cholesterol levels fell from 5.49mmol/l in men and 5.56mmol/l in women in 2003 to 5.26mmol/l and 5.37mmol/l respectively in 2006. In 2006, 59% of adults had a total cholesterol  $\geq 5.0$ mmol/l and 11% reported lipid-lowering treatment, of whom 66% had a total cholesterol  $< 5.0$ mmol/l and 22% were  $< 4.0$ mmol/l. The majority of those with established coronary heart disease, stroke or diabetes but fewer than one quarter of those with hypertension or  $\geq 20\%$  estimated 10 year cardiovascular risk and no established CVD took lipid-lowering drugs. Lipid lowering treatment rates increased five-fold and control rates among the treated (to  $< 5.0$ mmol/l) more than doubled between 1998 and 2006. About one third of those with established CVD or diabetes had cholesterol levels of  $< 4.0$ mmol/l.

### **Conclusions**

Previously reported improvements in treatment and control rates between 1998 and 2003 continued between 2003 and 2006, with the biggest increases among those with established CVD and diabetes.

**247 words**

## Introduction

Dyslipidaemia has long been established as a major risk factor for coronary heart disease (CHD).<sup>1</sup> Since their successful introduction (some misplaced concerns notwithstanding)<sup>2</sup>, statins have shown clear benefits in the primary and secondary prevention of CHD and stroke in trials carried out in many regions of the world.<sup>3</sup>

Temporal patterns in CHD and stroke mortality vary around the world, depending on various factors including degree of development. However in the UK, CHD mortality rates have fallen consistently since about 1980 partly reflecting falls in plasma cholesterol levels until the mid-1990s.<sup>4,5,6</sup> Since then, improving lipid levels<sup>7,8</sup> have accompanied beneficial lifestyle changes and increasing statin use.<sup>9</sup>

Over the last 17 years, with increasing evidence of the benefits of statins, the thresholds and targets for treating dyslipidaemia recommended in the UK have become increasingly aggressive.<sup>10-12</sup> In 2004, the Quality and Outcomes Framework (QOF) introduced into the new General Medical Services Contract of General Practitioners in parts of the UK, included cholesterol treatment targets as part of this “pay-for-performance” system.<sup>13</sup>

Few nationally representative survey data are available to monitor blood lipid levels anywhere in the world. However, the Health Survey for England (HSE), an annual health examination survey of the general population, intermittently focuses on cardiovascular disease and related risk factors and permits such evaluation of lipid levels. We have used HSE 2006 data to describe mean lipid levels by age and sex in this nationally representative sample of the adult population in England; to examine whether there has been further improvement in treatment and control rates of dyslipidaemia; and the extent to which these changes are targeted towards those at highest cardiovascular risk.

## **Methods**

### ***Participants and data***

Data for this study come from the HSE in 2006, 2003<sup>8</sup> and 1998.<sup>7</sup> The HSE is a series of large cross-sectional surveys of nationally representative samples of the free-living general population in England. A new sample is selected each year. Details of the survey methods have been published elsewhere.<sup>7,8,14</sup> Briefly, a random sample of postcode sectors was selected from the Postcode Address File, stratified by proportion of non-manual head of household, and a sample of addresses randomly selected from each postcode sector. All adults (aged  $\geq 16$  years) at each selected household were eligible. Data were collected at two home visits: an interviewer administered a questionnaire on socio-demographic variables, lifestyle, general health, medication, and self-reported morbidity. Secondly, a nurse asked further questions, including current prescribed medication and, for cardiovascular drugs, their purpose, and collected anthropometric and blood pressure measurements and a non-fasting blood sample. Response rates and sample sizes for the three surveys are shown in Table 1.

In 1998, 2003 and 2006, the survey included a module on cardiovascular disease. In 2006, only a sub-sample of participants aged 65 and over were asked the CVD questions. We classified participants as having CHD if they reported having doctor-diagnosed angina or heart attack. Stroke and diabetes were also each defined as self-report of a doctor's diagnosis. The participant's occupation was used to determine social class, categorised into manual or non-manual using the Registrar-General's classification.

We defined hypertension as measured systolic blood pressure  $\geq 140$  mmHg or diastolic  $\geq 90$  mmHg (mean of the last two of three seated readings) or taking drugs

specifically for hypertension.<sup>15</sup> Cardiovascular risk was estimated using the Framingham predictive equations.<sup>16</sup>

The Biochemistry Department at the Royal Victoria Hospital, Newcastle analysed the blood samples for total and HDL-cholesterol in all three years, using the same DAX Cholesterol Oxidase assay method on an Olympus 640 analyser calibrated to Centre for Disease Control guidelines. A direct method (no precipitation) was used for HDL-cholesterol.

Ethical approval was obtained prior to each survey from the Multi-centre Research Ethics Committees (MREC) in London. Each participant gave verbal consent to be interviewed, visited by a nurse, and have blood pressure and anthropometric measurements taken, and written consent for blood sampling.

### ***Statistical Analyses***

Comparisons across time used directly age-standardised data, to the estimated sex-specific mid-year 2003 population of England. Data from 2003 and 2006 were weighted for non-response to make the sample representative of the general population; when analysing blood sample data, weights were further corrected for non-response to the blood samples to reduce bias and produce results that remained nationally representative. Non-response weights have not been produced for the 1998 data because this was not government policy until 2003 due to good response rates in earlier surveys. Data for 2003 and 2006 were analysed both with and without weighting and very similar results were obtained, so comparisons across the years are valid.

Mean total cholesterol and the proportion of participants exceeding various treatment thresholds overall and in different sub-groups were calculated. For 2006,

analyses based on disease or risk status included only participants asked the CVD module; in these analyses (apart from Table 1), a separate weight was used that adjusted for the deficit in older participants to maintain the results as nationally representative. Other analyses were based on all those with valid cholesterol measurements.

All analyses were done in SPSSv15 and Stata v9.2, adjusting for the complex survey design.

## Results

In 2006, 14,142 people aged  $\geq 16$  years were interviewed at home (61% of eligible adults), of whom 10,489 had a nurse visit. Of these, 7,471 provided a blood sample from which lipid levels could be measured, 6,610 of whom had also been asked the CVD module (Table 1).

Those asked the CVD module and providing a blood sample in 2006 were predominantly non-manual (61%) and female (54%) with a mean age of 47.2 years. Only a small proportion of respondents were from ethnic minorities, or had self-reported CHD, stroke or diabetes (Table 1).

In 2006, total cholesterol was higher among women than men below age 25 and from age 55 onwards but HDL-cholesterol was higher among women at all ages (Figure 1a). Total cholesterol rose among men until age 55 and fell thereafter whereas among women total cholesterol rose until age 65. HDL-cholesterols were relatively stable in both sexes with increasing age with a tendency to be highest at age 45-64 in both sexes. Non HDL-cholesterol (total minus HDL) was higher among men than women until age 55 (Figure 1a), whereas total:HDL-cholesterol ratios were higher among men at all ages (Figure 1b).

After the age of 44, women had a higher proportion of participants with mean total cholesterol levels at or above 6.5mmol/L and 5.0mmol/L - levels previously used as arbitrary cut points for normality<sup>10,11</sup>, but in all age groups a smaller proportion of women had total:HDL-cholesterol ratios  $\geq 5$  or  $\geq 6$  (Table 2).

In all age groups, except those aged  $\geq 75$ , a greater proportion of men than women were on lipid-lowering treatment, rates being highest among men in the age range 65-74 and among women from age 75 onwards (Table 2). Overall, 11% of

participants (12% of men and 10% of women) were on treatment; two-thirds of those on treatment (71% of men and 61% of women) had total cholesterol levels <5.0mmol/L and 22% (27% of men and 16% of women) <4.0mmol/L. Rates of those reaching both targets were higher among men than women at all ages above 45.

Table 3 shows treatment and control rates (defined separately as total cholesterol <5.0mmol/L and <4.0mmol/l) among those aged 16-80 in whom treatment was indicated (i.e. total cholesterol  $\geq$ 5.0mmol/l or on treatment), by disease or risk status. High rates of treatment are apparent in those with either cardiovascular disease (CHD or stroke) or diabetes, but among hypertensive participants and those with high ( $\geq$ 20%) 10 year cardiovascular risk without established cardiovascular disease or diabetes <25% were treated. Men were marginally more commonly treated than women except among those with high estimated cardiovascular disease risk. Control rates to either target were more frequently reached among men than women except for those with self-reported hypertension and those at high estimated cardiovascular disease risk, using the 5.0mmol/L target. Over two-thirds of those on treatment with cardiovascular disease or diabetes were controlled to <5.0mmol/L but only about half of those with hypertension or high estimated cardiovascular disease risk were controlled. About one in five women but two in five men with cardiovascular disease and on treatment reached the current target of <4.0mmol/L whereas about one-third of men and women with diabetes reached this target. No important differences in lipid levels, treatment and control rates were apparent between socio-economic strata (non-manual and manual) with or without diabetes or hypertension (data not shown).

### *Temporal Trends*

The number of participants interviewed and studied in 2006 were smaller than in the two previous years (1998 and 2003) when cardiovascular disease was also the survey focus. In 2006 among both men and women mean serum total cholesterol levels overall (5.26mmol/l and 5.37mmol/l respectively) were lower than in 2003 (5.49 and 5.56mmol/l) and 1998 (5.39 and 5.53mmol/l respectively, Table 4, as was the case among those with CHD, stroke, diabetes, hypertension or high 10year cardiovascular disease risk.

In all subgroups evaluated, the use of lipid-lowering drugs increased systematically across the three years, being highest among those with CHD. Overall, treatment rates increased four- to five-fold compared with 1998 (Table 4) and control rates (to <5.0mmol/L) among men on treatment rose from 31% in 1998 to 65% in 2003 and to 71% in 2006 (Figure 2). The equivalent figures for women were 20%, 45% and 61% respectively. Similarly, patterns of treatment and control improved among men and women since 1998 and 2003 when earlier treatment thresholds of >6.5mmol/L were considered for comparison (Figure 2).

## Discussion

These extensive and most recent data from nationally representative samples of the English population show that in 2006 mean lipid levels were suboptimal for the majority of the population but significant improvements in total cholesterol levels are apparent compared with 2003 and 1998, overall and amongst various high-risk subgroups of the population. The improved profiles among the untreated population presumably reflect some improving dietary and lifestyle factors.<sup>9</sup> Reassuringly, although social class is often inversely related with health promotion advice on preventive care we found no sign of differential adverse lipid levels by socio-economic status.

Between 1998 and 2006, the use of lipid-lowering in the population overall has risen around five-fold, with dramatic increases in the absolute prevalence of the use of lipid-lowering agents among those with established cardiovascular disease or diabetes. Nevertheless, even among those high risk groups, greater use of lipid-lowering agents is warranted: among others for whom statin use is indicated<sup>18</sup> (hypertensive participants and those with a 10 year cardiovascular risk of  $\geq 20\%$  uncomplicated by established cardiovascular disease or diabetes<sup>12</sup>) fewer than one-fifth were taking lipid-lowering therapy.

Among those on lipid-lowering therapy, control rates (to total cholesterol  $< 5.0\text{mmol/L}$ ) rose significantly between 1998 and 2003<sup>7</sup> and again between 2003 and 2006.

It is not possible to evaluate exactly the extent to which the “pay-for-performance” approach instigated in 2004 as part of the new General Medical Services Contract<sup>12</sup> for general practitioners has contributed to the increasing treatment and control rates (points were awarded for effective lipid-lowering among

those with established cardiovascular disease or diabetes but not for other patients). However, the much lower absolute treatment rates among those for whom “pay-for-performance” did not apply (e.g. those with a total: HDL-cholesterol ratio of  $\geq 6$ ,<sup>12</sup> hypertensives,<sup>18</sup> and those with an estimated 10year cardiovascular disease risk  $\geq 20\%$ ) suggest that the GP contract has influenced prescribing practice. The HSE database does not yet permit more detailed evaluation of the type and doses of lipid-lowering agents used, but other data suggest that in 2006 over 90% of lipid-lowering prescriptions were for statins, of which simvastatin was the commonest agent used and the commonest prescribed dose was 40mg.<sup>19</sup> Clearly, more effective lipid-lowering could be achieved and thereby control rates improved by the use of more potent statins in some of those treated but not reaching current targets.

In 2008 the latest NICE guidelines<sup>20</sup> effectively recommend that for those with established cardiovascular disease, total and LDL cholesterol should be lowered with statins to  $<4.0\text{mmol/L}$  and  $<2.0\text{mmol/L}$  respectively. Furthermore for those aged 30 years and above with a 10year cardiovascular risk of  $\geq 20\%$ , simvastatin at 40mg should be prescribed irrespective of lipid levels. If these two recommendations are adhered to, there is likely to be a dramatic increase in the overall use of and/or dose of statins because as of 2006 only 38% and 20% of treated men and women respectively with established cardiovascular disease had their total cholesterol controlled to  $<4.0\text{mmol/L}$  and fewer than one in five adults with 10year cardiovascular disease risk of  $\geq 20\%$  (up to one in five of the adult population in 2006) were treated with lipid-lowering therapy.

Limitations of these analyses include concerns associated with the relatively low response rate for the blood sample, which is lower than experienced in previous years but compatible with falling response rates around the world.<sup>21,22</sup> To minimise

the potential bias derived from this low response, data were weighted for non-response at each stage: to the interview using socio-demographic data and to the nurse visit and the blood samples using additional data available from all those interviewed. The data presented are therefore reasonably representative of the non-institutionalised adult population of England.

Lipids were measured on only one occasion and hence data are susceptible to regression to the mean, thereby generating some misclassification among lipid level strata. Furthermore, non-fasting blood samples were collected, which produces some inaccuracy in the measurement of HDL-cholesterol levels<sup>23</sup> and precludes the evaluation of serum triglyceride levels. Disease status was determined by self-reported doctor-diagnosis and hence prone to some misclassification, while survey-defined hypertension status may include a proportion of spurious cases because blood pressures were measured only at one visit in contradiction with currently recommended optimal practice.<sup>18</sup> To compensate for this error, both survey-defined and self-reported hypertension data are presented in Table 3 to allow a comparison of the different potential sources of error. Overall results between the two hypertension strata did not differ importantly. The data may also be criticised for being over three years old but more contemporary nationally-representative data are not available. Nevertheless it is likely that the changes apparent between 2003 and 2006 will have increased in the years since 2006, although no new local guidelines relating to lipid-lowering were produced until the end of 2008.<sup>20</sup> Total cholesterol levels among the whole population were higher in 2003 than in 1998, both including and excluding those taking lipid-lowering drugs. Small but significant beneficial changes were apparent from 2003 to 2006 among those not treated with lipid-lowering therapy. However, levels in 2006 were only marginally lower than in 1998

(though significantly so in women). We are unable to explain the higher levels seen in 2003, which could be a chance finding, even with the sample sizes of these surveys.

The main strength of this study is the use of consistent protocols for sampling, recruitment, obtaining information, and measuring cholesterol in all three studies. Falling CHD case fatality rates over the period of the surveys would tend to result in increased survival among those with higher mean cholesterol levels, suggesting that our findings represent real changes in cholesterol reduction and are not artefactual. This is one of the strengths of the use of repeated cross-sectional surveys on new individuals rather than a cohort study.

### **Conclusions:**

In 2006, lipid levels among a large population-based representative sample of the English adult population were largely suboptimal but were better than in 1998 and 2003. These improvements reflect higher usage of lipid-lowering therapy, being 11% of the population surveyed in 2006. By 2006, lipid-lowering treatment rates had risen to about three-quarters of adults with established vascular disease and those with diabetes, but these rates should ideally rise to over 90%. However, among those with a 10year cardiovascular risk of  $\geq 20\%$ , fewer than one in five adults were receiving lipid-lowering therapy. Adequate control of total cholesterol ( $< 5.0\text{mmol/L}$ ) among those on lipid-lowering treatment was apparent among over three-quarters of men and over two-thirds of women with established cardiovascular disease or diabetes but only about half of treated hypertensives and those at  $\geq 20\%$  10 year risk were controlled to this level.

Nevertheless, the current trends in improving lipid profiles and increasing statin use are likely to continue in UK in light of recent more assertive guidance.<sup>20</sup>



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## **Ethics approval**

Ethical approval was obtained prior to each survey from the Multi-centre Research Ethics Committees (MREC) in London: HSE 2006 ref 05/MRE02/73; HSE 2003 ref MREC/02/2/72; HSE 1998 ref MREC(1)97/48. Each participant gave verbal consent to be interviewed, visited by a nurse, and have blood pressure and anthropometric measurements taken, and written consent for blood sampling.

## References

- <sup>1</sup> Kannel WB, Dawber TR, Friedman GD, Glennon WE, McNamara PM. Risk factors in coronary heart disease. An evaluation of several serum lipids as predictors of coronary heart disease; the Framingham study. *Ann Intern Med.* 1964;61:888-99.
- <sup>2</sup> Oliver MF. Might treatment of hypercholesterolaemia increase non-cardiac mortality? *Lancet.* 1991;**337**:1529-31.
- <sup>3</sup> Cholesterol Treatment Trialists' Collaborators. Efficacy and safety of cholesterol-lowering treatment: prospective meta-analysis of data from 90,056 participants in 14 randomised trials of statins. *Lancet.* 2005; **366**:1267-78.
- <sup>4</sup> Unal B, Critchley JA, Capewell S. Explaining the decline in coronary heart disease mortality in England and Wales between 1981 and 2000. *Circulation.* 2004;**109**:1101-7.
- <sup>5</sup> Mann JI, Lewis B, Shepherd J, Winder AF, Fenster S, Rose L, Morgan B. Blood lipid concentrations and other cardiovascular risk factors: distribution, prevalence, and detection in Britain. *BMJ.* 1988;**296**:1702-6.
- <sup>6</sup> Colhoun H, Prescott-Clarke P (eds). Health Survey for England 1994. London: DH, 1995.
- <sup>7</sup> Primatesta P, Poulter NR. Lipid concentrations and the use of lipid lowering drugs: evidence from a national cross sectional survey. *BMJ.* 2000;**321**:1322-5.

- <sup>8</sup> Primatesta P, Poulter N. Levels of dyslipidaemia and improvement in its management in England: results from the Health Survey for England 2003. *Clin Endocrin.* 2006;**64**:292-8.
- <sup>9</sup> Allender S, Peto V, Scarborough P, Kaur A, Rayner M. Coronary heart disease statistics. BHF: London, 2008
- <sup>10</sup> Betteridge DJ, Dodson PM, Durrington PN, Hughes EA, Laker MF, Nicholls DP, Rees JA, Seymour CA, Thompson GR, Winder AF. Management of hyperlipidaemia: guidelines of the British Hyperlipidaemia Association. *Postgrad Med J* 1993; **69**: 359-369.
- <sup>11</sup> Wood D, Durrington P, Poulter N, McInnes G, Rees A, Wray R for the British Cardiac Society, British Hyperlipidaemia Association, British Hypertension Society, and British Diabetic Association. Joint British recommendations on prevention of coronary heart disease in clinical practice. *Heart* 1998;**80**:S1-S29.
- <sup>12</sup> Wood D, Poulter NR, Williams B, Wray R, Kirby M, Patel V, Durrington P, Reckless J, Davis M, Sivers F, Potter J. JBS2: Joint British Societies' Guidelines on Prevention of Cardiovascular Disease in Clinical Practice. *Heart* 2005;**91**:Supp V:1-52.
- <sup>13</sup> Department of Health. *Delivering investment in general practice: Implementing the new GMS contract*. London: Department of Health, 2003.
- <sup>14</sup> Craig R, Mindell J (eds). *The Health Survey for England 2006*. London: Information Centre, 2008.

- <sup>15</sup> Falaschetti E, Chaudhury M, Mindell J, Poulter NR. Continued Improvement in Hypertension Management in England: Results from the Health Survey for England 2006. *Hypertension* 2009; **53**:480-486
- <sup>16</sup> Anderson KM, Odell PM, Wilson PWP, Kannel WB, Cardiovascular disease profiles. *Am Heart J.* 1991;121:293-309
- <sup>17</sup> Tunstall-Pedoe H, Smith WC, Tavendale R. How-often-that-high graphs of serum cholesterol. Findings from the Scottish Heart Health and Scottish MONICA studies. *Lancet.* 1989;1:540-2.
- <sup>18</sup> Williams B, Poulter N, Brown M, Davies M, McInnes G, Potter J, Sever P, Thom S McG. Guidelines for management of hypertension: report of the fourth working party of the British Hypertension Society 2004-BHS IV. *J Human Hypertens* 2004;**18**:139-185.
- <sup>19</sup> NHS Business Services Authority. Prescribing Analysis Charts. <http://www.nhsbsa.nhs.uk/PrescriptionServices/942.aspx> (8 April 2010, information subject to NHSBSA copyright)
- <sup>20</sup> Cooper A, O'Flynn N, on behalf of the Guideline Development Group. Risk assessment and lipid modification for primary and secondary prevention of cardiovascular disease: summary of NICE guidance. *BMJ.* 2008;**336**:1246-1248.
- <sup>21</sup> Galea S, Tracy M. Participation rates in epidemiologic studies. *Annals of Epidemiology.* 2007;**17**:643-53;

- <sup>22</sup> Tolonen H, Helakorpi S, Talala K, Helasoja V, Martelin T, Prattala R. 25-year trends and socio-demographic differences in response rates: Finnish adult health behaviour survey. *Eur J Epidemiol.* 2006;**21**:409-15.
- <sup>23</sup> Craig SR, AMin RV, Russell DW, Paradise NR. Blood cholesterol screening: Influence of fasting state on cholesterol results and management decisions. *J Gen Intern Med.* 2000;**15**:392-9.
- <sup>24</sup> Office for National Statistics. *Mortality data England and Wales 1999 Table DH2.*  
[http://www.statistics.gov.uk/downloads/theme\\_health/DH2\\_26\\_1999/DH2\\_26.pdf](http://www.statistics.gov.uk/downloads/theme_health/DH2_26_1999/DH2_26.pdf) (8 April 2010)

## Figure Legends

Figure 1 Cholesterol levels by age and sex in 2006

a Mean total, non-HDL, and HDL cholesterol

b Total:HDL cholesterol ratio

Figure 2 Changes over time in treatment and control † of different definitions of dyslipidaemia

a Treatment threshold 6.5mmol/l Men

b Treatment threshold 6.5mmol/l Women

c Treatment threshold 5.0mmol/l Men

d Treatment threshold 5.0mmol/l Women

Footnote: Data from 1998 unweighted; data from 2003 and 2006 weighted for blood sample non-response.

† <5.0mmol/l

**Table 1. Adult participants (aged 16+) in the three surveys and characteristics of those with valid cholesterol measurements and asked the cardiovascular module questions**

	1998	2003*	2006*
Household response rate	74%	73%	68%
No. interviewed (response rate)	15,908 (69%)	14,836 (66%)	14,142 (61%)
No. with nurse visit (% of those with an interviewer visit)	13,586 (85%)	11,408 (77%)	10,489 (74%)
No. agreeing to a blood sample (% of those with a nurse visit)	10,773 (79%)	8,552 (75%)	8,181 (78%)
No. with Total- & HDL-cholesterol measurements	10,538	8,274	6,610 †
% male	47	46	46
Mean age (SD)	48.2 (17.6)	49.5 (17.3)	47.2 (15.8)
% non-manual	50	58	61
% Asian ethnicity	2	3	5
% Black ethnicity	1	1	2
Prevalence of self-reported CHD (%)	6	5	4

Prevalence of self-reported stroke (%)	2	2	1
Prevalence of self-reported stroke but no CHD (%)	1	2	1
Prevalence of self-reported diabetes (%)	3	4	4
Prevalence of self-reported diabetes (%) but no CHD or Stroke	2	3	3
Prevalence of self-reported hypertension (%)	20	25	24
Prevalence of self-reported hypertension but no CHD, Stroke or Diabetes (%)	15	22	21
Prevalence of survey-defined hypertension (%)	37	33	28
Prevalence of survey-defined hypertension but no CHD, stroke or diabetes (%)	31	1630	24
% 10yr CVD risk $\geq$ 20%	27	22	15
% 10yr CVD risk $\geq$ 20%, but no CHD, stroke or Diabetes	24	21	13
% taking lipid-lowering drugs	2	7	10

Mean Total cholesterol (mmol/l) (SD) [all ]	5.53 (1.16)	5.64 (1.18)	5.43 (1.15)
Mean Total cholesterol (mmol/l) (SD) [excluding those on lipid-lowering drugs]	5.53 (1.16)	5.70 (1.18)	5.51 (1.13)
Mean HDL cholesterol (mmol/l) (SD) [all]	1.43 (0.43)	1.52 (0.39)	1.49 (0.39)
Mean HDL cholesterol (mmol/l) (SD) [excluding those on lipid-lowering drugs]	1.43 (0.43)	1.53 (0.39)	1.50 (0.39)

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\*Results in this table are unweighted and not age-standardised.

† In HSE 2006, only a sub-sample of participants aged 65+ were asked the CVD module. Results in this table are restricted to those with cholesterol levels who were asked the CVD module.

**Table 2. Prevalence and treatment of dyslipidaemia by different definitions and age, 2006**

	Age groups														
	16-44			45-64			65-74			75+			All (16+)		
	All	Men	Women	All	Men	Women	All	Men	Women	All	Men	Women	All	Men	Women
% TC ≥ 6.5mmol/l	9	12	7	26	24	28	23	14	32	19	10	24	17	15	18
% TC ≥ 5.0mmol/l	47	49	45	77	74	81	66	54	76	59	47	67	59	57	61
% TC:HDL ≥ 5	14	22	6	19	26	11	14	18	11	10	14	8	15	22	8
% TC:HDL ≥ 6	4	7	2	6	9	3	4	5	3	2	3	1	5	7	2
% on	1	2	0	12	15	9	33	39	29	32	31	32	11	12	10

treatment

% on

treatment

with TC

<5.0mmol/l

55 48 85 58 62 51 68 75 61 77 90 69 66 71 61

% on

treatment

with TC

<4.0mmol/l

14 3 60 18 22 11 24 32 14 27 40 19 22 27 16

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Data have been weighted for non-response to blood sample. Results include people taking lipid-lowering drugs.

**Table 3. Treatment and control rates by disease and cardiovascular disease risk status 2006 (age 16-80)**

	Disease or CVD risk category									
	CHD or stroke*		Diabetes* †		Hypertension‡				≥ 20% 10year CVD risk‡	
	Men	Wome n	Men	Wome n	Self-reported doctor- diagnosed*		Survey-defined§		Men	Wome n
					Men	Women	Men	Women		
N	172	95	117	86	558	651	635	573	402	116
% eligible for treatment (TC ≥ 5.0mmol/l or on treatment)	87	98	78	86	79	84	81	88	87	95
% of eligible being treated	87	72	79	76	25	19	19	18	17	19

% on treatment with TC <5.0mmol/l	84	70	81	67	52	53	54	50	49	50
% on treatment with TC <4.0mmol/l	38	20	34	33	12	10	13	9	2	0

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\* Self-reported doctor-diagnosed disease

† No CHD or stroke

‡ No CHD, stroke or diabetes

§ SBP ≥ 140mmHg or DBP ≥ 90mmHg or taking drugs to reduce blood pressure

Data have been weighted for non-response to blood sample, adjusted for the sub-sample included in the cardiovascular module.

**Table 4. Trends in mean cholesterol and use of lipid-lowering drugs in England, by disease group and sex, aged 16+**

	Men			Women		
	1998	2003*	2006*	1998	2003*	2006*
<b>Mean cholesterol (mmol/l) (SE)</b>						
With CHD <sup>†</sup>	5.54 (0.06)	4.79 (0.06)	4.45 (0.08)	6.23 (0.08)	5.47 (0.08)	5.06 (0.09)
With stroke <sup>† ‡</sup>	5.59 (0.14)	5.28 (0.16)	4.52 (0.21)	5.92 (0.13)	5.57 (0.15)	4.95 (0.13)
With diabetes <sup>† §</sup>	5.45 (0.10)	5.07 (0.10)	4.55 (0.09)	5.95 (0.13)	5.48 (0.11)	4.78 (0.11)
With hypertension <sup>†   </sup>	5.74 (0.04)	5.84 (0.04)	5.50 (0.04)	6.14 (0.04)	6.06 (0.04)	5.80 (0.04)
With survey-defined hypertension <sup>   #</sup>	5.69 (0.03)	5.91 (0.04)	5.61 (0.04)	6.17 (0.03)	6.24 (0.04)	5.92 (0.05)
10yr CVD risk $\geq 20\%$ <sup>  </sup>	5.96 (0.03)	6.09 (0.04)	5.71 (0.05)	6.62 (0.05)	6.70 (0.05)	6.28 (0.07)
Low CVD risk (10yr risk $\leq 20\%$ ) <sup>  </sup>	5.49 (0.02)	5.43 (0.02)	5.57 (0.03)	5.51 (0.02)	5.45 (0.02)	5.56 (0.02)
All	5.39 (0.02)	5.49 (0.02)	5.26 (0.02)	5.53 (0.02)	5.56 (0.02)	5.37 (0.02)
All, excluding those on lipid-lowering drugs	5.40 (0.02)	5.57 (0.02)	5.36 (0.02)	5.53 (0.02)	5.63 (0.02)	5.44 (0.02)
<b>% on lipid-lowering drug(s)**</b>						

With CHD <sup>†</sup>	22	63	75	17	51	63
With stroke <sup>† ‡</sup>	6	33	47	11	26	58
With diabetes <sup>† §</sup>	7	25	62	6	28	59
With hypertension <sup>†   </sup>	2	9	19	3	7	16
With survey-defined hypertension <sup>   #</sup>	2	6	16	2	6	17
10yr CVD risk $\geq$ 20% <sup>  </sup>	2	5	15	2	5	17
Low CVD risk (10yr risk $\leq$ 20%) <sup>  </sup>	1	2	5	1	2	5
All	2	7	12	2	5	9

\* Results for 2003 and 2006 are weighted for non-response to blood sample, adjusted for the sub-sample asked the cardiovascular module, and SE adjusted for complex survey design. Results are age-standardised to the 2003 mid-year population. Except where specified, results include people taking lipid-lowering drugs.

<sup>†</sup> Self-reported doctor-diagnosed disease

<sup>‡</sup> No CHD

<sup>§</sup> No CHD or stroke

<sup>||</sup> No CHD, stroke or diabetes

# SBP  $\geq$  140mmHg or DBP  $\geq$  90mmHg or taking drugs to reduce blood

\*\* Irrespective of total cholesterol level, so results for 2006 differ from those presented (for those aged 16-80) in Table 2