Know, Feel, Do?

Health behaviour change in Scotland, 1996 to 2007

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Contents

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Summary

The Health Education Population Survey (HEPS) ran annually from 1996 to 2007, interviewing a representative sample of the Scottish population aged 16–74. We use its 12-year span of consistent, comparable data to assess overall progress in health knowledge, motivation and behaviour. It is not possible to assess the contribution of specific interventions or other activities to these trends.

We analysed three major health topics: smoking, physical activity and healthy eating. We used multiple logistic regression analysis to examine time trends in:

- health behaviour (with HEPS validated against time trends from other national surveys)
- health-related knowledge
- health motivation
- summary scores combining the three topics for behaviour, for knowledge and for motivation.

The combined summary scores show clear improvements in health behaviour, knowledge and motivation in Scotland between 1996 and 2007. The greatest increase was in knowledge, followed by motivation, with more modest change in behaviour. Motivation scores across the period were generally higher than those for knowledge, and both were generally higher than those for behaviour.

The proportion of adult smokers declined between 1996 and 2007. Although the proportion of smokers with no intention to cut down or stop was unchanged over the period, the results suggest that, for those who did attempt such a change, there was an increasing likelihood over time that they would be successful. These positive changes were not concurrent with increased knowledge among smokers that reducing or stopping could improve their health.

There was a modest increase over time in the proportion of adults meeting the physical activity recommendation. This was supported by enhanced motivation to become more active among inactive adults, with fewer reporting no interest at all in increasing their activity levels. Knowledge of the physical activity recommendation improved over time, but remained very low at only 11%.

The HEPS shows an increase in the proportion of adults meeting the 5-a-day recommendation for fruit and vegetable consumption, though this was not consistently supported by published results from other routine national surveys. This increase was concurrent with improved knowledge of the recommendation, enhanced motivation to eat more healthily among those with low fruit and vegetable intake, and a concomitant decrease in those not taking any action to eat more healthily. Improvement in healthy eating knowledge over the period was more common than improvements in motivation and behaviour.

The health improvement community can take heart from the improvements shown. Change is happening, though in this analysis we cannot ascribe it to any particular cause. However, the moderate pace of change, the inconsistencies between knowledge, motivation and behaviour, and the variable nature of change by topic underline the continuing challenge.

Progress appears uneven with little evidence of a widespread shift in behaviour towards healthier living.

We conclude that there was welcome modest improvement in health behaviour, knowledge and motivation in Scotland between 1996 and 2007.

1   Introduction

The Health Education Population Survey (HEPS) was established to monitor progress in the process of achieving change in health behaviours through a health communications approach. Health communications are 'the development and diffusion of messages to specific audiences in order to influence their knowledge, attitudes and beliefs in favour of healthy behavioral choice'.[1]

Health communication activities have been a strong and consistent element in health improvement in Scotland since at least the early 1990s.[2] This is reflected in policy documents issued by governments of different political complexions both prior to and following devolution.[3] This approach to behaviour change recognises that knowledge and motivation are not the only influences on behaviour, but does see them as important influences:

- **knowledge** – people know about major health issues and about the means to achieve good health[2]
- **motivation** – people are motivated to effect changes in behaviour that promote good health.[2]

The HEPS ran annually from 1996 to 2007, with a gap in the second half of 1999 and in 2000, interviewing a representative sample of the Scottish population aged 16–74.[2,4] This provides an opportunity – with a 12-year span of consistent, comparable data – to assess the level of improvement in health behaviour, knowledge and motivation over a period when health communications were an important part of the health improvement toolbox. (From 2008 similar data are collected through the Knowledge, Attitudes and Motivation module of the Scottish Health Survey.)

Aim

To assess the direction and magnitude of change in adult health behaviour, knowledge and motivation in Scotland, from 1996 to 2007.

Objectives

- To identify time trends in behaviour in the HEPS and to validate these against other health behaviour trend series.
- To identify time trends in knowledge and motivation in the HEPS.
- To investigate the extent to which changes in knowledge, motivation and behaviour are concurrent.
- To draw conclusions to help inform future health improvement activities in Scotland.

This report provides a high-level assessment of change over the period. It is **not** an evaluation of health communications. Health communications are only one element in the mix that drives changes in knowledge and motivation. They, in turn, are only part of the mix that drives changes in behaviour (Figure 1.1). This report does not seek to disentangle these influences, even if that was possible with available data (which it is not). It simply looks at what changes have happened over a period when health communications were a major part of the approach being taken to health improvement. Any concurrence or lack of concurrence between change in knowledge, motivation and behaviour cannot be assumed to be evidence of a causal link, or lack of a causal link. Life is simply too complex to be understood through a retrospective, uncontrolled, observational study. Nonetheless, examining the direction and magnitude of change in these components of health behaviour change allows an overall assessment of progress in health improvement in the period 1996 to 2007.

Figure 1.1   **A schematic behaviour change model**
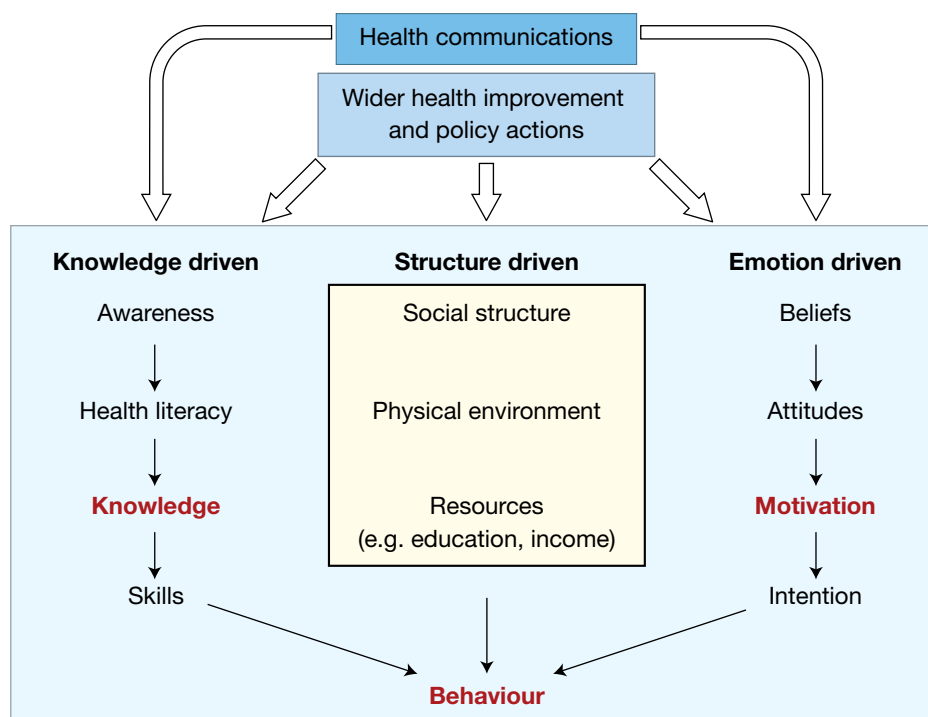
2   Approach

Study design

This study focused on three main health topics: smoking, physical activity and healthy eating. We used multiple logistic regression analysis to examine time trends in:

- health behaviours, using data from the HEPS and to validate these against health behaviour time trends from other routine national surveys
- health-related knowledge and health motivations
- combinations of behaviours, knowledge and motivations using specially constructed health knowledge, health motivation and health behaviour scores.

Data sources

Annual cross-sectional data from the entire HEPS series were used. The HEPS monitored health-related behaviours, knowledge, attitudes and motivations among adults in Scotland. The survey was first conducted in 1996 and ran until 2007. Fieldwork was undertaken in two waves each year, usually in March and September, although the 2006 and 2007 spring waves were brought forward to January to evaluate the smoking ban. The achieved sample size was approximately 1,800 each year, with a minimum response rate of 70% attained in all years except 2006 when it dropped slightly to 68%. The survey was suspended for three waves during 1999 and 2000, so the 1999 data were from a sample size half of that usually obtained, with no estimates for the year 2000.

The Scottish Health Survey (SHeS) was used to validate the HEPS time trends in physical activity behaviour. The Scottish Household Survey (SHoS) was used to validate the HEPS time trend in smoking behaviour. Trends in fruit and vegetable consumption were validated using the Consumer Attitudes to Food Standards survey and the Expenditure and Food Survey. Further detail on these surveys is provided in Appendix A.

Study population

Data were included for all adults aged 16–74 from the HEPS (1996 to 1999, 2001 to 2007) and SHoS (1999 to 2006) available at the time of analysis. Only data from adults aged 16–64 were analysed from the SHeS (1995, 1998 and 2003) to ensure comparability over time, because this was the age range of the target population in the original 1995 SHeS. Recently published results from the SHeS and SHoS, as well as published results from the healthy eating validation surveys, are discussed within the text of the results section of this report. However, because the raw data were not available at the time of analysis to allow logistic regression analyses to be performed across the entire series, they are not presented in the figures.

Indicators

Indicators of health-related behaviour, knowledge and motivation were selected for analysis on the basis that they were included in most, if not all, of the HEPS series. A summary description of the relevant indicators is included within the results section of each health topic. A fuller description is provided in Table A2 of Appendix A.

Health scores

We constructed summary health behaviour, health knowledge and health motivation scores for each respondent (Table 2.1). Scores ranged from a minimum of 0 to a maximum of 3.

Note that adults who had successfully changed their behaviour in the year prior to interview to such an extent that they now adopted the healthy behaviour could not be included in most analyses of motivation. They were therefore excluded from all motivation *Maintained* results. When included in the analysis for smoking – the only behaviour for which they could be included – the point estimates for *Maintained* were higher (by an average of 3 percentage points each year) but the time trend was not affected.

Statistical analysis

Multivariate analyses (multiple binomial logistic regression and multiple ordinal logistic regression) were used to examine time trends in health-related behaviours, knowledge and motivations (including health scores), adjusting for the effects of sex, age, socio-economic status and area-level deprivation.

Only respondents with available data for all explanatory variables were included in the models. The effect that this had on sample size is shown in Appendix A (Table A2). Analysis of the distributions of outcome variables between those with and those without missing data revealed very similar results, except for the healthy eating *Behaviour (HEPS)* and *Knowledge (5-a-day)* variables. It is likely that the odds ratios presented for these variables (see page 14) are slightly exaggerated.

Results are described as statistically significant where $P < 0.05$. Any use of the term 'significant' throughout the report refers to statistical significance and does not necessarily imply practical significance or importance. A more detailed description of our statistical analysis approach is provided in Appendix A.

Because regression analysis gives information about trends and effects in relative terms only, we have presented the corresponding weighted survey estimates in order to give a sense of absolute levels of health-related behaviours, knowledge, motivations and health scores.

Table 2.1 **Summary of health scores**

Health behaviour

Smoking	Non-smoker = 1
Physical activity	Meeting physical activity recommendation = 1
Healthy eating	Meeting healthy eating recommendation = 1

Health knowledge

Smoking	Non-smoker = 1
	Knowledge that cutting down or stopping smoking could make own life healthier = 1
Physical activity	Knowledge of physical activity recommendation = 1
Healthy eating	Knowledge of healthy eating recommendation = 1

Health motivation

Smoking	Non-smoker = 1
	Smoker who cut down smoking in the past year and maintained that change = 1
	Smoker who tried to cut down or stop smoking in the past year but did not maintain that change = 0.5
Physical activity	Meeting physical activity recommendation = 1
	Not meeting physical activity recommendation but increased physical activity levels in the past year and maintained that change = 1
	Not meeting physical activity recommendation but tried to increase activity levels in the past year but did not maintain that change = 0.5
Healthy eating	Meeting healthy eating recommendation = 1
	Not meeting healthy eating recommendation but ate more healthily in the past year and maintained that change = 1
	Not meeting healthy eating recommendation but tried to eat more healthily in the past year but did not maintain that change = 0.5

3   Results

3.1   Introduction

Results for the time-trend analyses in health-related behaviours, knowledge and motivations are first presented for individual health topics: smoking, physical activity and healthy eating. Time trends for health scores are then provided. A standardised approach has been used to describe the results throughout (see below).

Behaviour (HEPS):	OR = 0.98 (0.97 to 0.99), $P < 0.001$	Base: all adults (aged 16–74)
Behaviour (SHoS):	OR = 0.97 (0.97 to 0.98), $P < 0.001$	Base: all adults (aged 16–74)
Knowledge (health):	OR = 0.99 (0.97 to 1.00), $P = 0.09$	Base: adult smokers (aged 16–74)

Behaviour (HEPS): currently smokes cigarettes, pipes or cigars
Behaviour (SHoS): currently smokes cigarettes
Knowledge (health): knowledge that cutting down or stopping smoking could improve their health

1. A graph showing the weighted survey estimates. Line graphs are used for behaviour and knowledge indicators. Stacked-column graphs are used for motivation indicators and health scores.
2. The direction of the arrows indicates whether or not a statistically significant change occurred over time (based on logistic regression analysis).
    ⇑, significant increase; ⇓, significant decrease; ⇔, no significant change.
    In stacked-column graphs a solid black arrow indicates a significant trend in the direction of the arrow.
3. Results from logistic regression analysis showing the odds ratio (OR) for the *Time (survey year)* variable are presented below the graph [OR (95% confidence interval), *P*-value].
4. The base populations are described for each indicator.
5. Definitions of the indicators presented in the graph (health topics only).
6. A written description of the results.

3.2 Smoking

Behaviour (Figure 3.2.1)

The proportion of adult smokers in Scotland decreased significantly over time. This is supported by data from both the HEPS and SHoS. The weighted estimates from the HEPS suggest that smoking prevalence decreased among those aged 16–74 from 40% in 1996 to 30% in 2007, an average decrease of 0.9 percentage points per year. Results from the SHoS indicate a similar downward trend, with prevalence of cigarette smoking decreasing steadily from 32% in 1999 to 27% in 2006, a decrease of 0.7 percentage points per year. Recently published estimates from the SHoS, although not included in the analyses for this report, suggest that smoking prevalence continued to fall among adults in Scotland in 2008.[5]

Figure 3.2.1 **Smoking behaviour and knowledge in Scotland, 1996 to 2007**

Behaviour (HEPS):	OR = 0.98 (0.97 to 0.99), *P* < 0.001
Behaviour (SHoS):	OR = 0.97 (0.97 to 0.98), *P* < 0.001
Knowledge (health):	OR = 0.99 (0.97 to 1.00), *P* = 0.09

Base: all adults (aged 16–74)
Base: all adults (aged 16–74)
Base: adult smokers (aged 16–74)

> **Behaviour (HEPS):** currently smokes cigarettes, pipes or cigars
> **Behaviour (SHoS):** currently smokes cigarettes
> **Knowledge (health):** knowledge that cutting down or stopping smoking could improve their health

Knowledge (Figure 3.2.1)

The proportion of adult smokers who felt that cutting down or stopping smoking could improve their health did not change over the 12-year HEPS series, remaining consistent at around 70%.

Motivation (Figure 3.2.2)

Between 1996 and 2007, smokers became significantly more motivated to cut down or stop, although changes within individual categories varied. The proportion of smokers who cut down smoking in the year prior to interview and managed to maintain that change increased (1996 = 11%; 2007 = 27%), while the proportion who tried but did not maintain a change decreased (1996 = 35%; 2007 = 29%). There was little change in the proportion of smokers preparing to cut down or stop smoking in the six months after interview (1996 = 13%; 2007 = 14%), while the proportion of contemplators decreased (1996 = 16%; 2007 = 7%). The proportion of smokers not contemplating cutting down or stopping did not change over the HEPS series, fluctuating at around 20% over the 12-year period.

Figure 3.2.2 **Motivation of adult smokers in Scotland to cut down or stop, 1996 to 2007**
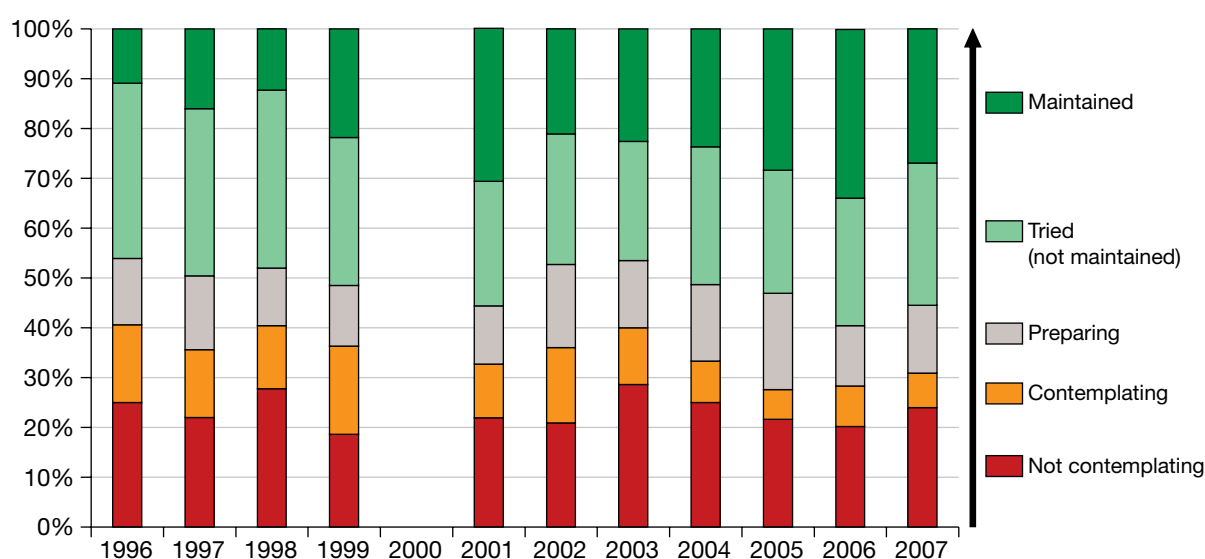
Motivation (overall): OR = 1.03 (1.02 to 1.04), $P < 0.001$ Base: adult smokers (aged 16–74)*

> **Maintained:** cut down smoking in the past year and maintained change
> **Tried (not maintained):** tried to cut down or stop smoking in the past year but did not maintain change
> **Preparing:** intends to cut down or stop smoking in the next 6 months
> **Contemplating:** would like to cut down or stop smoking in the next 6 months
> **Not contemplating:** no intention of cutting down or stopping smoking in the next 6 months

* Excludes individuals who changed their 'unhealthy' behaviour in the year prior to interview to such an extent that they now adopt the 'healthy' behaviour (not smoking). See Appendix A for further details.

Summary

The proportion of adult smokers in Scotland declined between 1996 and 2007. Although the proportion of smokers with no intention to cut down or stop was unchanged over the 12-year HEPS period, the results suggest that for those who did attempt such a change there was an increasing likelihood over time that they would be successful. These positive changes do not appear to be a consequence of increased knowledge among smokers that cutting down or stopping could improve their health.

3.3 Physical activity

Behaviour (Figure 3.3.1)

The proportion of adults in Scotland meeting the physical activity recommendation increased significantly over time. The weighted estimates from the HEPS suggest that compliance increased among those aged 16–74 from 37% in 1996 to 42% in 2007, an average annual increase of 0.5 percentage points. Results from the SHeS indicate a similar upward trend in those aged 16–64, from 38% in 1995 to 42% in 2003, also an average increment of 0.5 percentage points per year. Recently published results from the 2008 SHeS show this trend continuing.[6]

Figure 3.3.1 **Physical activity behaviour and knowledge in Scotland, 1995 to 2007**
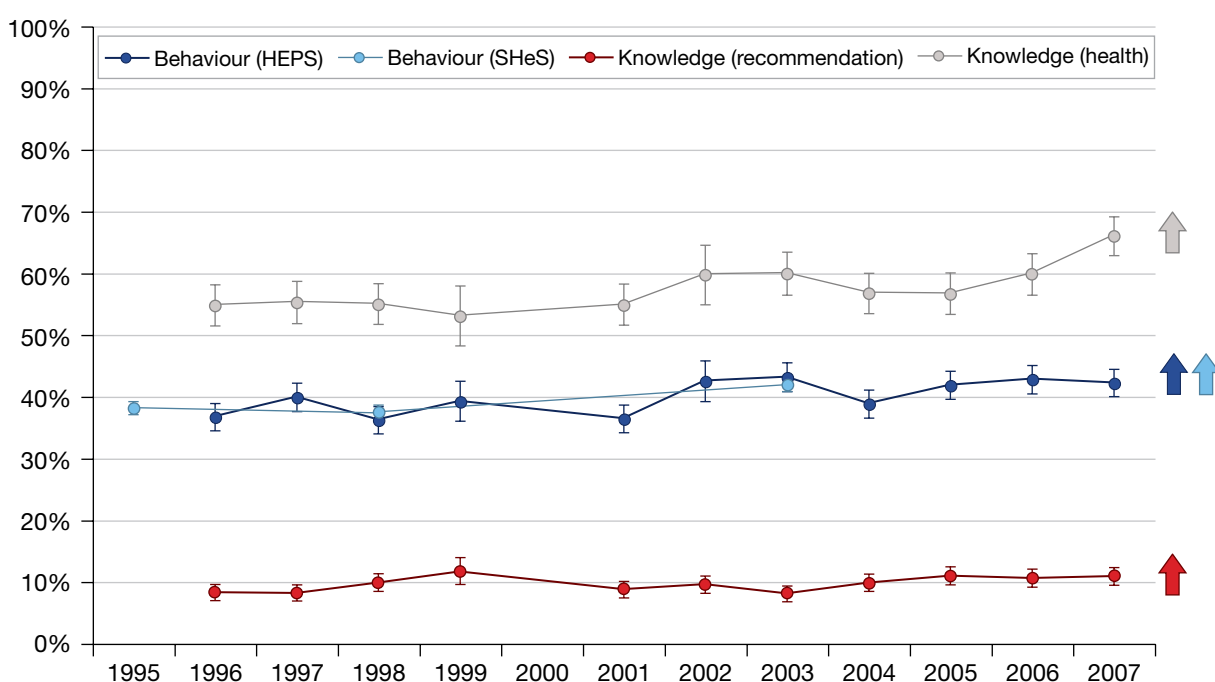
Behaviour (HEPS):	OR=1.01 (1.01 to 1.02), P=0.001	Base: all adults (aged 16–74)
Behaviour (SHeS):	OR=1.03 (1.02 to 1.04), P<0.001	Base: all adults (aged 16–64)
Knowledge (recommendation):	OR=1.03 (1.01 to 1.04), P<0.001	Base: all adults (aged 16–74)
Knowledge (health):	OR=1.03 (1.02 to 1.04), P<0.001	Base: inactive adults (aged 16–74), i.e. not meeting physical activity recommendation

Behaviour (HEPS): meets physical activity recommendation
Behaviour (SHeS): meets physical activity recommendation
Knowledge (recommendation): knowledge of physical activity recommendation
Knowledge (health): knowledge that increasing physical activity could improve their health

Knowledge (Figure 3.3.1)

The proportion of adults with accurate knowledge of the physical activity recommendation significantly increased over time, but remained very low (1996=8%; 2007=11%). Knowledge of the separate duration and frequency components of the recommendation was consistently higher across the HEPS series (both 33% in 2007; Appendix B).

There was also a significant increase over time in the proportion of inactive adults (i.e. those not meeting the physical activity recommendation) who felt that they could improve their health by doing more physical activity (1996=55%; 2007=66%).

Motivation (Figure 3.3.2)

Between 1996 and 2007, inactive adults in Scotland became more motivated to increase their activity levels. The proportion of inactive adults who increased their activity levels in the year prior to interview and managed to maintain that change increased (1996=13%; 2007=25%), while the proportion who tried but did not maintain a change was stable at around 17%. There was a slight increase in the proportion of inactive adults preparing to increase activity levels in the six months after interview (1996=14%; 2007=16%), while the proportion of contemplators remained fairly stable across the HEPS series at around 6%. The proportion of inactive adults who were not contemplating a change in their physical activity levels decreased over time (1996=47%; 2007=38%).

Figure 3.3.2   **Motivation of inactive adults in Scotland to increase physical activity levels, 1996 to 2007**
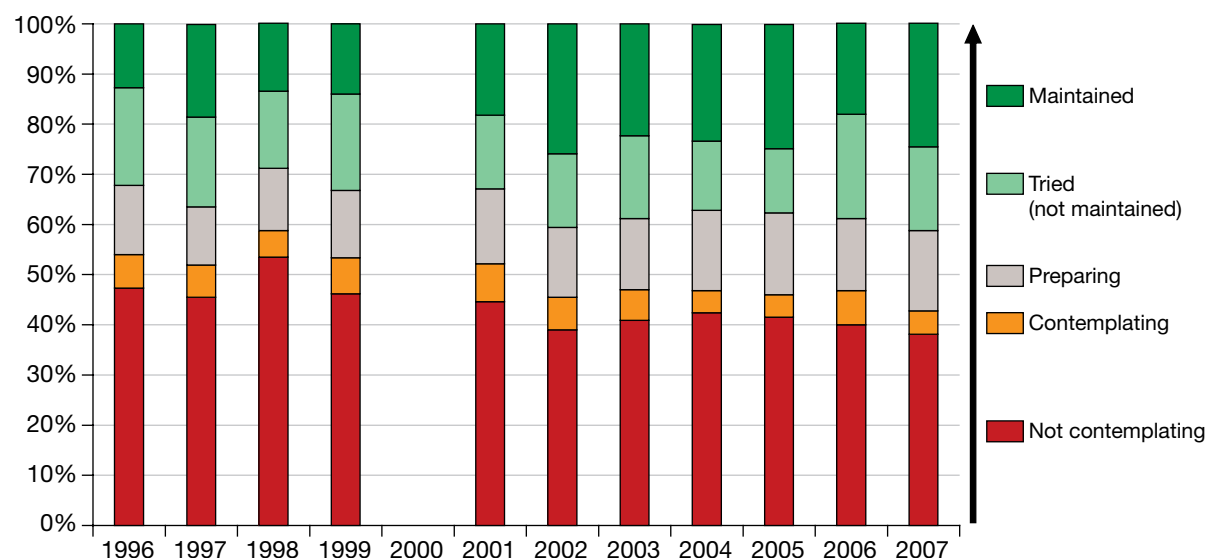
Motivation (overall):   OR=1.03 (1.02 to 1.04), P<0.001   Base: inactive adults (aged 16–74), i.e. not meeting physical activity recommendation*

Maintained: increased activity levels in the past year and maintained change
Tried (not maintained): tried to increase activity levels in the past year but did not maintain change
Preparing: intends to increase activity levels in the next 6 months
Contemplating: would like to increase activity levels in the next 6 months
Not contemplating: no intention of increasing activity levels in the next 6 months

* Excludes individuals who changed their 'unhealthy' behaviour in the year prior to interview to such an extent that they now adopt the 'healthy' behaviour (meeting the physical activity recommendation). See Appendix A for further details.

Summary

There was a modest increase over time in the proportion of adults in Scotland meeting the physical activity recommendation. This was supported by enhanced motivation among inactive adults to become more active, with fewer reporting no interest at all in increasing their activity levels. Knowledge of the physical activity recommendation also improved over time, despite remaining very low at only 11%.

3.4 Healthy eating

Behaviour (Figure 3.4.1)

The proportion of adults in Scotland eating at least five portions of fruit and vegetables a day increased significantly over the HEPS series. The weighted estimates suggest a steady increase from 18% in 1996 to 34% in 2007, an average annual increase of 1.5 percentage points. A similar upward trend has been reported in the self-report Consumer Attitudes to Food Standards survey, carried out by the Food Standards Agency. However, recent results from the SHeS, which has a larger sample size, indicate that there was no change in the proportion of adults aged 16 and over meeting the recommendation for daily fruit and vegetable consumption between 2003 and 2008.[6] Similarly, results from Household Budget Surveys – the most robust for assessing food consumption – show that there was no improvement in Scotland over the period 1996 to 2003/04.[7]

Figure 3.4.1   **Healthy eating behaviour and knowledge in Scotland, 1996 to 2007**
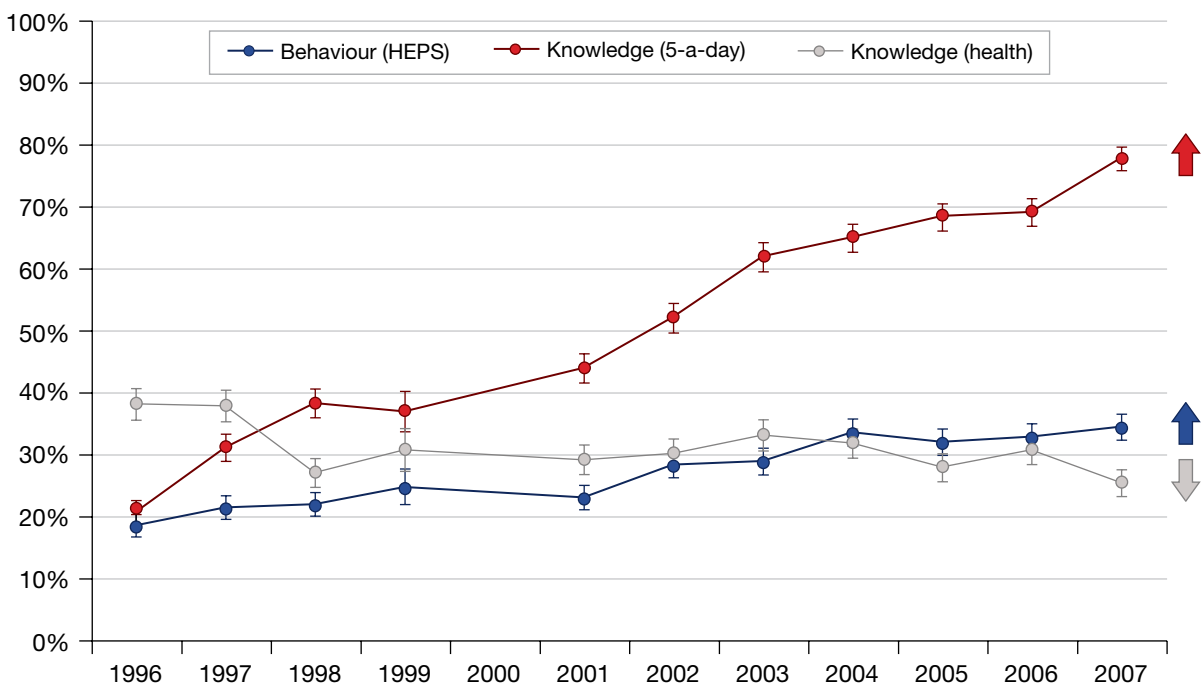
Behaviour (HEPS):*	OR = 1.07 (1.06 to 1.08), *P* < 0.001	Base: all adults (aged 16–74)
Knowledge (5-a-day):*	OR = 1.24 (1.23 to 1.25), *P* < 0.001	Base: all adults (aged 16–74)
Knowledge (health):	OR = 0.97 (0.96 to 0.98), *P* < 0.001	Base: all adults (aged 16–74)

Behaviour (HEPS): meets 5-a-day fruit and vegetable consumption recommendation
Knowledge (5-a-day): knowledge of recommended daily fruit and vegetable consumption
Knowledge (health): knowledge that healthier eating could improve their health

* The presented odds ratio may be slightly exaggerated because of differences between those with and those without data for all explanatory variables. See Approach for further details.

Knowledge (Figure 3.4.1)

The proportion of adults with knowledge of the recommended daily consumption of fruit and vegetables significantly increased over time from 21% in 1996 to 78% in 2007, an average annual increase of 5 percentage points. A very similar trend in knowledge of the 5-a-day message was recently reported in the Consumer Attitudes to Food Standards survey, reporting an average increment of 4 percentage points between 2000 (41%) and 2007 (76%).[8]

In contrast, the proportion of adults who felt that eating more healthily could improve their health decreased significantly over the 12-year period (1996 = 38%; 2007 = 25%).

Motivation (Figure 3.4.2)

Between 1996 and 2007, adults in Scotland not meeting daily fruit and vegetable consumption recommendations became significantly more motivated to eat more healthily, despite diverse changes within individual categories. The proportion who ate more healthily

Figure 3.4.2   **Motivation of adults in Scotland to eat more healthily, 1996 to 2007**
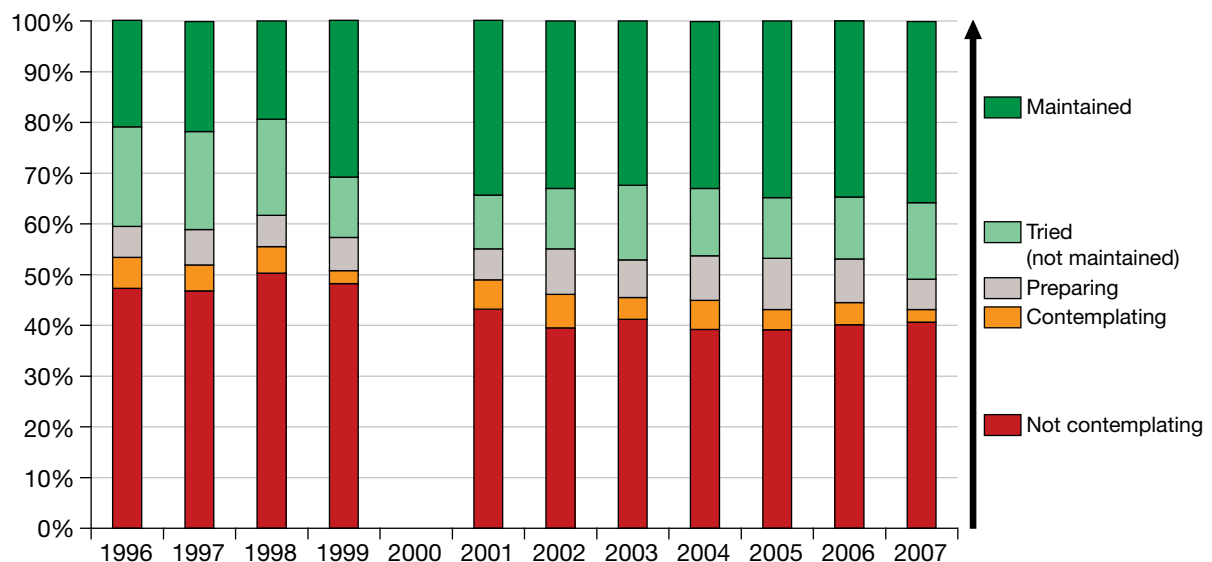
Motivation (overall):   OR = 1.04 (1.03 to 1.05), *P* < 0.001   Base: adults (aged 16–74) not meeting 5-a-day fruit and vegetable consumption recommendation*

Maintained: ate more healthily in the past year and maintained change
Tried (not maintained): tried to eat more healthily in the past year but did not maintain change
Preparing: intends to eat more healthily in the next 6 months
Contemplating: would like to eat more healthily in the next 6 months
Not contemplating: no intention of eating more healthily in the next 6 months

* Excludes individuals who changed their 'unhealthy' behaviour in the year prior to interview to such an extent that they now adopt the 'healthy' behaviour (meeting daily fruit and vegetable consumption recommendation). See Appendix A for further details.

in the year prior to interview and managed to maintain that change increased (1996=21%; 2007=36%), while the proportion who tried but did not maintain a change fell (1996=20%; 2007=15%). There was a trend for an overall increase in the proportion preparing to eat more healthily in the six months after interview, even though the weighted estimates at the farthest time points were not different (1996=6%; 2007=6%). The proportion of contemplators decreased across the HEPS series (1996=6%; 2007=3%), and there was also a reduction in the proportion of adults not eating five or more portions of fruit and vegetables a day who were not contemplating eating more healthily (1996=47%; 2007=41%).

Summary

Although not consistently supported by published results from other routine national surveys, the HEPS suggests that there was an increase over time in the proportion of adults in Scotland meeting the 5-a-day recommendation for fruit and vegetable consumption. This is supported by improved knowledge of the recommendation, enhanced motivation of those who do not eat enough fruit and vegetables to eat more healthily and a concomitant decrease in those not taking any action to eat more healthily. Improvement in healthy eating knowledge over the HEPS series was, however, much more likely than improvements in motivation and behaviour.

3.5 Health scores

Health behaviour (Figure 3.5.1)

Health behaviour scores of adults in Scotland have significantly improved over time. There was a decrease in the proportion of adults adopting all three unhealthy behaviours – smoking, low physical activity and low fruit and vegetable consumption (i.e. health behaviour score of 0) – from 23% in 1996 to 14% in 2007. The proportion of adults adopting only one healthy behaviour also decreased (1996 = 45%; 2007 = 37%), while there were increases in the proportion adopting two (1996 = 26%; 2007 = 36%) or three (1996 = 6%; 2007 = 12%).

Figure 3.5.1 **Health behaviour scores of adults in Scotland, 1996 to 2007**

A higher score indicates better behaviour.
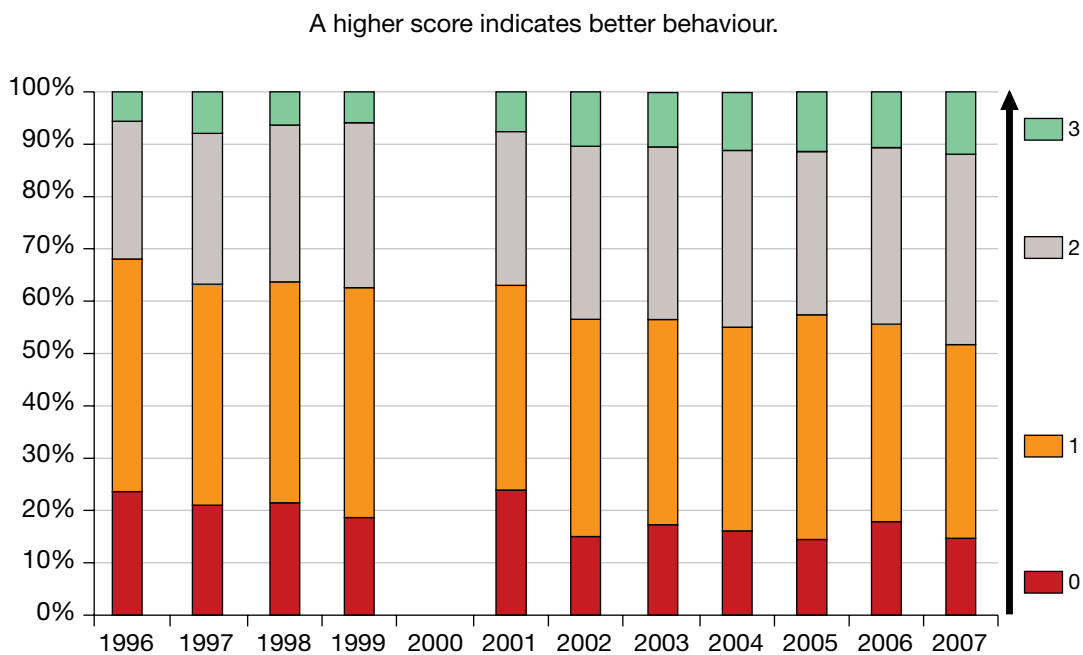
Health behaviour scores over time: OR = 1.04 (1.04 to 1.05), *P* < 0.001   Base: all adults (aged 16–74)

Health knowledge (Figure 3.5.2)

The proportion of adults in Scotland with knowledge of the recommendations for physical activity, healthy eating and the health benefits of not smoking significantly increased over time. Decreases in the proportion of adults with scores of 0 (1996 = 9%; 2007 = 3%) or 1 (1996 = 66%; 2007 = 22%) were matched by increases in those with health knowledge scores of 2 (1996 = 25%; 2007 = 67%) or 3 (1996 = 1%; 2007 = 8%).

Figure 3.5.2   **Health knowledge scores of adults in Scotland, 1996 to 2007**

A higher score indicates better knowledge.
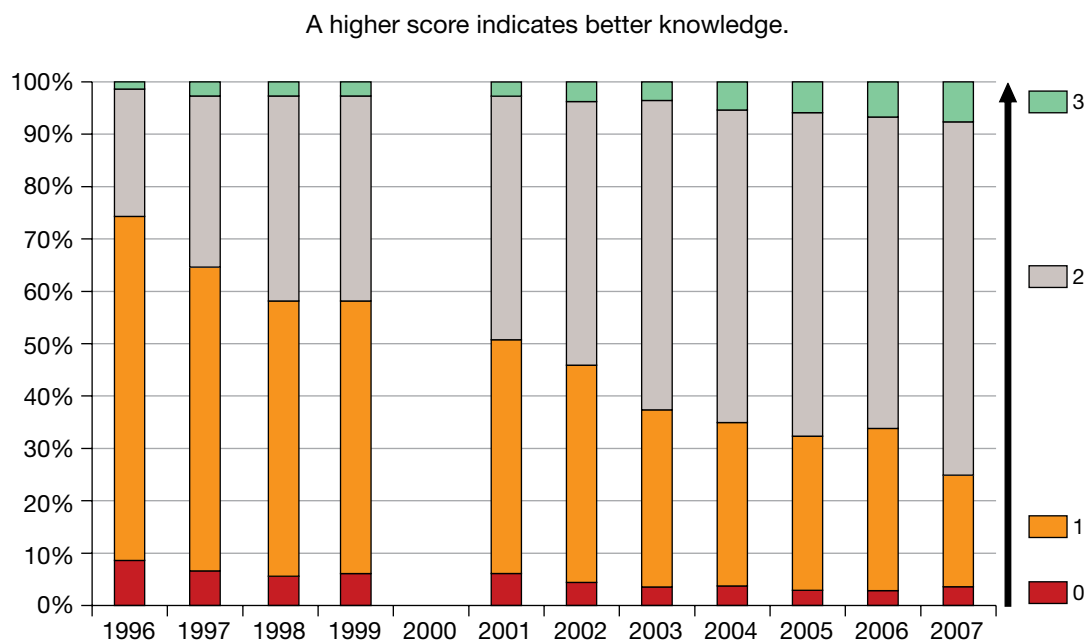
Health knowledge scores over time: OR = 1.18 (1.16 to 1.19), $P < 0.001$ Base: all adults (aged 16–74)

Health motivation (Figure 3.5.3)

Between 1996 and 2007, adults in Scotland became significantly more motivated to adopt healthy behaviours. There were decreases in the proportion with health motivation scores of 0 (1996 = 15%; 2007 = 6%) or 1 (1996 = 36%; 2007 = 22%), while there were increases in health motivation scores of 2 (1996 = 35%; 2007 = 43%) and 3 (1996 = 15%; 2007 = 29%).

Figure 3.5.3   **Health motivation scores of adults in Scotland, 1996 to 2007***

A higher score indicates better motivation.
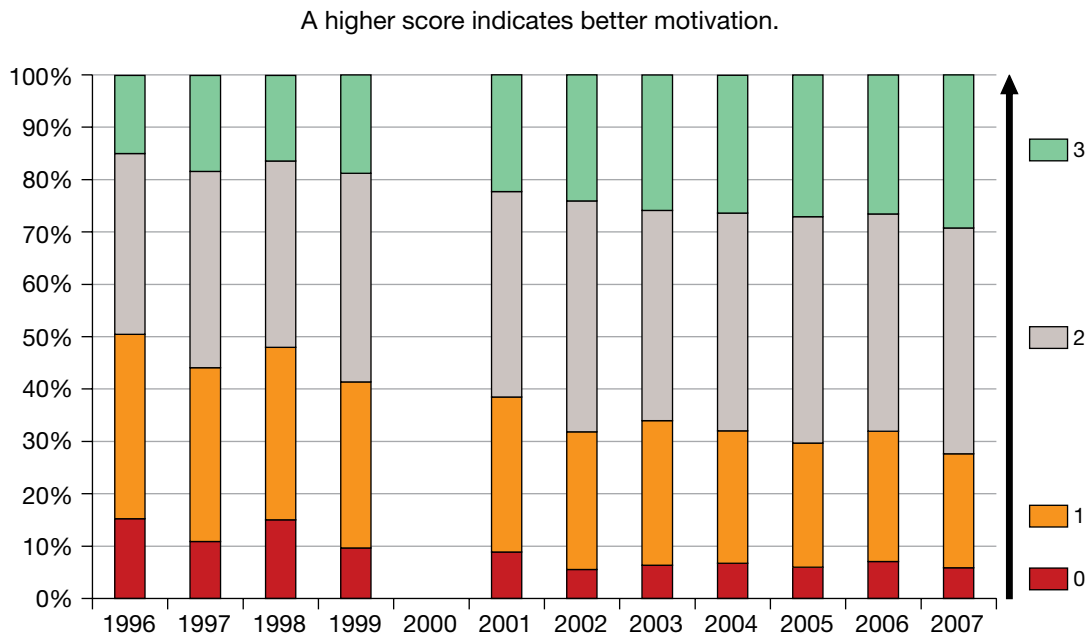
Health motivation scores over time: OR = 1.06 (1.05 to 1.07), $P < 0.001$ Base: all adults (aged 16–74)

* Half scores for health motivation are presented and discussed within integer scores (i.e. 0 includes 0.5, 1 includes 1.5 and 2 includes 2.5).

Summary

Between 1996 and 2007, there were improvements in health-related knowledge, health motivation and health behaviour. The greatest increase was in knowledge, followed by motivation, with more modest change in behaviour. Motivation scores across the period were generally higher than those for knowledge, and both were generally higher than those for behaviour.

4 Discussion and conclusions

In this report we have looked at trends in three health behaviours with a direct and strong impact upon the quality and quantity of healthy life.[9,10] Overall, there is evidence of statistically significant improvements in all of the health behaviours included in the analysis: smoking, physical activity and healthy eating (Table 4.1). The picture is also generally positive for both knowledge and motivation. Those working to improve health in Scotland can take some heart from this, even if the analysis cannot prove a direct causal relationship between specific health improvement activities and any of these changes.

Table 4.1 **Summary of change**

Indicator	Smoking	Physical activity	Healthy eating
Behaviour			
HEPS	⬇	⬆	⬆
Other national surveys	⬇	⬆	⬌
Knowledge			
Recommendations	n/a	⬆	⬆
Health-related	⬌	⬆	⬇
Motivation	⬆	⬆	⬆

⬆ ⬇ = improvement over time   ⬇ ⬆ = deterioration over time   ⬌ = stable over time

The greatest increase between 1996 and 2007 was in knowledge, followed by motivation, with more modest changes in behaviour. Across the period as a whole, scores for motivation were generally higher than those for knowledge and both were generally higher than for behaviour. This is consistent with a wider literature that shows no simple causal relationship between knowledge, motivation and behaviour.[11–13]

The moderate pace of change, the inconsistencies between behaviour, knowledge and motivation, and the variable nature of change by topic underline the continuing challenge. Progress appears uneven, with little evidence of a widespread shift in behaviour towards healthier living. There are many possible explanations for this which it is beyond the scope of this report to discuss.

The HEPS annual samples are too small to assess trends in inequalities. We explored the cross-sectional pattern of inequalities, using the combined data for the full period, looking at differences related to gender, age, social class and place of residence. Our results, summarised in Appendix D, are consistent with the patterns reported in most health analyses.[6,14]

The core finding of the present study is therefore that there was a welcome modest improvement in health knowledge, motivation and behaviour related to smoking, physical activity and diet in Scotland between 1996 and 2007. However, there are many health-related behaviours for which such a robust analytical approach is not possible because the data are sparse, not consistent over time, or deficient in other ways. It is important that there is continuing long-term investment in consistent data series – on health status, behaviours, knowledge, motivations, and the wider 'determinants' of health – and in the analytical resources to interpret them. Such investment is essential to understanding better how to improve the health of the Scottish population.

Appendix A: Technical approach

Introduction

This appendix supplements the approach in the main body of this report by providing further information on:

- data sources
- statistical analysis
- analysis issues and caveats.

Data sources

Health Education Population Survey (HEPS) The HEPS monitored health-related knowledge, attitudes, motivations and behaviours among adults in Scotland. Respondents were selected using a multi-stage clustered random sampling design with the Postal Address File as the primary sampling frame. The universe was first defined as the Scottish mainland. Postal sectors were extracted and all addresses were stratified by Carstairs index within health region. The survey was first conducted in 1996 and ran until 2007. Fieldwork was undertaken in two waves each year, usually in March and September, although the 2006 and 2007 spring waves were brought forward to January to evaluate the smoking ban. The survey was suspended for three waves during 1999 and 2000, so the 1999 data were from a sample size half of that usually obtained, with no estimates for the year 2000. The achieved sample size was approximately 1,800 each year, with a minimum response rate of 70% attained in all years except 2006 when it dropped slightly to 68%. A 'rolling' sampling procedure allowed results to be combined from consecutive waves. Further information about the HEPS and previous reports are available from the Health Scotland website.

Scottish Household Survey (SHoS) The SHoS was used to validate the HEPS time trend in smoking behaviour because it is the official source of smoking trends data in Scotland. The SHoS is a continuous cross-sectional survey based on a sample of the general adult population in private residences in Scotland. It is designed to provide reliable and up-to-date information on the composition, characteristics and behaviour of Scottish households, at both national and sub-national levels. The highest income householder, or his/her partner/spouse, is interviewed about himself/herself and other members of the household. In addition, a randomly selected adult member of the same household aged 16 and over (who may, by chance, be the same person) is interviewed on other topics. In this way, results from the survey are representative of both Scottish households and adult individuals. The achieved sample size over each two-year survey sweep between 1999 and 2006 was approximately 31,000 for householder interviews and 29,000 for random adult interviews. Response rates were approximately 70%. Further information on the survey and the survey reports are available from the SHoS website.

Scottish Health Survey (SHeS) The SHeS was used to validate the HEPS time trend in physical activity. The SHeS monitors the health of the general population living in private households throughout Scotland and is the stated source for monitoring trends in physical activity behaviour. The survey was first conducted in 1995 and then repeated in 1998 and 2003. Following review and redevelopment, it is now running continuously from 2008 to 2011. Age of the target population has been extended over the series: aged 16–64 in 1995, aged 2–74 in 1998 and individuals of all ages from 2008. Achieved sample size was approximately 8,000 adults in the 1995, 1998 and 2003 surveys. The 1995 and 1998 surveys sampled one adult per household, but in 2003 the design was altered to include all adults per household. Thus, in 1995 and 1998 there was no difference between household and individual response (81% and 76%, respectively). In 2003, individual response declined to 60% and further to 54% in 2008. Further information about the survey and previous reports are available from the SHeS website.

Consumer Attitudes to Food Standards (Scotland) The Consumer Attitudes to Food Standards (Scotland) survey was used to validate the HEPS time trend in healthy eating behaviour. This annual survey, commissioned by the Food Standards Agency, ran from 2000 to 2007 and aimed to further understanding of consumer attitudes, knowledge, claimed behaviour and awareness with regards to food. A representative sample of adults in Scotland aged 16 and over was interviewed, with an achieved annual sample size of approximately 700, except in 2007 when it declined to 517. It was not possible for response rates to be calculated for this survey (which will soon be replaced by the Food Issues Survey) because of sampling methodology. The newly designed survey – which will be more methodologically robust and use stratified random sampling (as employed by most government social surveys) – is expected to have a response rate of 55–60% (Food Standards Agency, personal communication, October 2009). Further information about the Consumer Attitudes to Food Standards survey and previous reports are available from the Food Standards Agency website.

Expenditure and Food Survey (EFS; formerly National Food Survey and now known as the Living Costs and Food module of the Integrated Household Survey) The EFS is an annual household budget survey designed to collect information about household food and expenditure. The EFS is likely to produce more accurate statistics on household food purchases than self-report surveys such as the SHeS and Consumer Attitudes to Food Standards owing to various design improvements, including the use of till receipts and individual two-week diaries for each household member aged 7 years and over. However, information is not collected in such a way as to directly determine the intake of individuals. The EFS includes around 600 households per year in mainland Scotland, with an achieved sample size of approximately 1,300 people. The household response rate is approximately 55%. Further information about the survey is available from the National Statistics website. In addition, specific information relating to data from households in Scotland between 1996 and 2004 is available from the Food Standards Agency website.

Statistical analysis

Logistic regression

Multiple binary logistic regression modelling was used throughout this report to examine the association of *Time (survey year)* with selected health-related behaviour and knowledge indicators (i.e. outcome variables), after adjusting for other explanatory variables (age, sex, socio-economic status and area-level deprivation). The results of these analyses, presented throughout the results section of this report, show the odds ratios for the *Time (survey year)* explanatory variable, which is significantly associated with the outcome variable if $P < 0.05$. A significant odds ratio greater than 1 indicates that, as time increased by a unit of one (i.e. one year), the odds of a specific health-related behaviour or knowledge outcome occurring increased. Conversely, a significant odds ratio less than 1 indicates that, as time increased by one year, the odds of the outcome occurring decreased. For example, the odds ratio of *Time (survey year)* for the smoking *Behaviour (HEPS)* outcome variable was 0.98 ($P < 0.001$; see page 9). In other words, smoking prevalence decreased significantly, with the odds of being a smoker decreasing by a factor of 0.98 each year between 1996 and 2007 or, more generally, adults in Scotland were less likely to smoke over time.

Multiple ordinal logistic regression modelling was used for health-related motivation indicators and health scores because these outcome variables are ordered, not binary [motivation categories were given arbitrary scores (not contemplating = 0, contemplating = 1, preparing = 2, tried = 3, maintained = 4)]. Models were adjusted for other explanatory variables (age, sex, socio-economic status and area-level deprivation). The results of these analyses, presented throughout the results section of this report, show the odds ratio for the *Time (survey year)* explanatory variable. A significant odds ratio greater than 1 indicates that, as time increased by a unit of one (i.e. one year), the odds of being one category higher up on the ordinal scale also increased. Conversely, a significant odds ratio less than 1 indicates that as time increased by one year, the odds of being one category higher up decreased. For example, the odds ratio of *Time (survey year)* for the *Health motivation score* outcome variable was 1.06 ($P < 0.001$; see page 19). In other words, for every one-year increase in survey year, the odds of being one score higher in terms of health motivation increased significantly by a factor of 1.06 or, more generally, health motivation scores increased over time.

The results of the final logistic regression models for each outcome variable are shown in Appendix C. In addition to *Time (survey year)*, these also show the odds ratios for the other explanatory variables (sex, age, socio-economic status and area-level deprivation). For categorical explanatory variables, odds ratios are expressed relative to a reference category, which has a given value of 1.

Outcome variables

Descriptions of the indicators used as outcome variables in this study are provided in Table A2 on page 31.

Explanatory variables

Time (survey year) was the main explanatory variable of interest and was entered as a continuous variable in all regression models. This was based on the assumption that any trends in the log-odds of outcome variables over the HEPS period were linear.

Sex was entered as a categorical explanatory variable (male/female) in all regression models.

Age was entered as a categorical explanatory variable in all regression models fitted to HEPS data with respondents being classified into one of six age bands: 16–24, 25–34, 35–44, 45–54, 55–64, 65–74. For regression models fitted to data from the SHeS and SHoS, age was entered as a continuous variable.

Socio-economic status (SES) was entered as a categorical explanatory variable in all regression models fitted to data from the HEPS and SHeS. Different individual-based markers of SES were used depending on the data source (Table A1). The smoking behaviour model fitted to the SHoS data [*Behaviour (SHoS)*] did not adjust for SES because there were a large number of missing responses to SES-related items.

Table A1 **Data sources**

Data source	Individual-level marker of SES	Description
HEPS	Social grade	Social grade is determined by the occupation of the chief income earner in each household, which we categorised into four grades: AB (professional, managerial and technical), C1 (skilled non-manual), C2 (skilled manual) and DE (partly skilled, unskilled, casual workers and those dependent on the state)
SHeS*	Social class	The Registrar General's Social Class categorises respondents into six classes: I (professional), II (managerial and technical/intermediate), IIIN (skilled non-manual), IIIM (skilled manual), IV (partly skilled manual) and V (unskilled manual)

* Social class of respondents was not recorded in the 2003 SHeS and was therefore derived from the National Statistics socio-economic classification (NS-SEC) using continuation tables available from the Office for National Statistics.

Area-level deprivation was entered as a categorical explanatory variable in all regression models. The smoking behaviour model fitted to the SHoS data [*Behaviour (SHoS)*] adjusted for area-level deprivation using the Scottish Index of Multiple Deprivation (SIMD).[i] For models fitted to the HEPS and SHeS data, the Carstairs index was used because the SIMD was not obtainable over the entire time series of these surveys.

The following subgroups were specified as the reference group for the categorical explanatory variables:

- sex: male
- age: 16–24 age band
- socio-economic status: HEPS = social grade AB
                                              SHeS = social class I
- deprivation: the least deprived quintile (quintile 1).

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i   For more information on the SIMD, see www.scotland.gov.uk/topics/statistics/simd

Approach

Regression models were fitted to the data using a two-step modelling strategy. First, all explanatory variables were entered into the model using a single-step approach (the 'enter' method). Retaining these main effects, all possible pairwise interaction terms (excluding the interaction between deprivation and socio-economic status) were added to the model. A backward stepwise selection procedure was then used to ensure models included all significant interactions, with the exception of significant interactions with time. The exit criterion for the backward step procedure was set at $P < 0.05$. Results are described as statistically significant where $P < 0.05$.

Analysis involved two stages. First, for health topics where a more robust routine national data source than the HEPS was available, we used the two-step logistic regression modelling strategy described above to assess time trends in behaviour. If a significant interaction between time and sex was observed, indicating different time trends for men and women, analysis for that health topic was stratified by sex. Second, we applied the same regression techniques to the HEPS data to assess time trends in health-related behaviours, knowledge, motivations and health scores.

All analyses were performed using SPSS version 17.0.

Analysis issues and caveats

Weighting

To obtain accurate estimates of prevalence, survey data are weighted to correct for under- or over-representation of certain socio-demographic groups in the samples. We used the unweighted data in our logistic regression models because our aim was to test for associations between specific variables. Up- or down-weighting groups may have artificially inflated or deflated strands of evidence within the model, possibly giving rise to spurious associations.

Confidence intervals

All proportions presented in this report have a degree of uncertainty associated with them. Confidence intervals (95%) – the range within which the 'true' proportion of the whole population is likely to fall within 95 times out of 100 – are provided for odds ratios and presented in all line graphs as error bars. However, they are not presented in stacked-column graphs or reported within the Results section, as this was deemed to be too cumbersome. The confidence intervals of all weighted estimates in this report are available in the accompanying data file.

Variation in base sizes for analysis

The sample bases used for analysis, both within and between health topics, fluctuate throughout this report as a result of missing information and survey design. If an individual was missing a response to an outcome variable (or missing a response to a variable used to derive an outcome variable), this individual was not included in logistic regression analysis or the weighted survey estimates. If an individual was missing data for an explanatory

variable, this individual was not included in logistic regression analysis. Table A2 gives bases for the outcome variables used in our logistic regression analyses. The unweighted bases used for the weighted survey estimates presented throughout this report are also shown.

Interactions

Significant interactions with the *Time (survey year)* explanatory variable were omitted from all final logistic regression models using HEPS data. Although we recognise that time trends in health-related knowledge, motivations, behaviours and health scores may be different among sub-groups of other explanatory variables, our intention was to examine the overall effect of time on these outcomes. If significant interactions with *Time (survey year)* had been left in our final regression models, the overall effect of time would have been confounded. Also, if a significant interaction was observed, the sample size was too small to perform separate models on sub-groups without compromising the robustness of the analysis. The full results of the logistic regression analyses provided in Appendix C indicate the models from which significant interactions with the *Time (survey year)* variable were omitted.

The inclusion criterion for interactions within regression models was set at $P < 0.05$. To assess the effect of increased sensitivity on the modelled time trends, a selection of final models, which contained significant interactions, was selected and re-run with the inclusion criterion set at $P < 0.01$. The effect on the odds ratio of the time variable was minimal, resulting in discrepancies only at the level of the third decimal point.

1999 data

The HEPS was suspended for three waves during 1999 to 2000, so the 1999 data were from a sample size half of that usually obtained. Although the graphs throughout this report present the 1999 weighted survey estimates, because of imprecision of estimates the data were not included in any logistic regression models.

Base population for *Knowledge (health)* indicators

The base population for the *Knowledge (health)* indicators differed across health topics. For smoking and physical activity, the base population was respondents adopting the unhealthy behaviour, namely smokers and those not meeting the physical activity recommendations. For healthy eating, all respondents were included in the base population because the question used as a measure for this indicator was not specific to fruit and vegetable consumption but to healthier eating in general.

Numerator for *Maintained* indicators

By including only adults currently adopting the 'unhealthy' behaviour in the numerator for the *Maintained* indicators, those who had successfully changed their behaviour in the year prior to interview to such an extent that they now adopted the healthy behaviour were not included in analyses of motivation. This is despite the fact that they had maintained a healthy behaviour change. It was not possible to include such adults in the analysis for physical activity or healthy eating because of survey limitations. When included in the analysis for smoking, although the point estimates for *Maintained* were higher (by an average of 3 percentage points each year), the time trend was not affected.

Table A2 **Descriptions and base population sizes of indicators (i.e. outcome variables) used in this report**

Indicator	Description	Logistic regression	Unweighted
Smoking			
Knowledge (health)	Respondents who felt that they could make their own life healthier if they cut down or stopped smoking	5,166	5,478
Behaviour (HEPS)	Respondents who reported that they smoked cigarettes, cigars or pipes at all nowadays, even if only occasionally	17,662	18,786
Behaviour (SHoS)	Respondents who reported that they smoked cigarettes at all nowadays	99,578	99,909
Maintained	Smokers who have cut down smoking in the past year and maintained change	1,395	1,464
Tried (not maintained)	Smokers who tried to cut down or stop smoking in the past year but did not manage to maintain that change	1,804	1,929
Preparing	Smokers who are intending to cut down or stop smoking in the next 6 months	804	853
Contemplating	Smokers who would like to cut down or stop smoking	712	754
Not contemplating	Smokers who have no intention of cutting down or stopping smoking	1,527	1,631
Physical activity			
Knowledge (day)	Respondents who knew how much time per day of moderate physical activity is recommended to help them to stay healthy. Responses in the range of 30–59 minutes were classified as correct	16,958	18,020
Knowledge (week)	Respondents who knew how many times a week of moderate physical activity is recommended to help them to stay healthy. Owing to changes in the physical activity health education messages over the HEPS series, responses in the range of 7–10 times a week (1996–2003) and in the range of 5–7 times a week (2004–2007) were classified as correct	16,985	18,052
Knowledge (recommendation)	Respondents who knew both how much time per day and how many times a week of moderate physical activity is recommended to help them stay healthy	16,666	17,703
Knowledge (health)	Respondents not meeting physical activity recommendations who felt that they could make their own life healthier if they increased activity levels	7,905	8,187
Behaviour (HEPS)	Respondents who achieved at least five sessions of moderate intensity activity and/or at least three sessions of vigorous intensity activity per week	16,735	17,840
Behaviour (SHeS)	As above for Behaviour (HEPS)	20,226	21,701
Maintained	Respondents not meeting the current physical activity recommendations who increased activity levels in the past year and maintained change	1,990	2,099
Tried (not maintained)	Respondents not meeting the current physical activity recommendations who tried to increase activity levels in the past year but did not maintain change	1,595	1,702
Preparing	Respondents not meeting the current physical activity recommendations who intend to increase activity levels in the next 6 months	1,441	1,524
Contemplating	Respondents not meeting the current physical activity recommendations who would like to increase activity levels	599	643
Not contemplating	Respondents not meeting the physical activity recommendations who have no intention of increasing activity levels	4,933	5,288

Table A2 **(continued)**

Indicator	Description	Logistic regression	Unweighted
Healthy eating			
Knowledge (5-a-day)	Respondents who knew daily recommendations for fruit and vegetable consumption (five or more portions per day)	16,686	17,736
Knowledge (health)	Respondents who felt that they could make their own life healthier if they ate more healthily	9,490	10,100
Behaviour (HEPS)	Respondents meeting daily recommendations for fruit and vegetable consumption (five or more portions per day)	17,613	18,716
Maintained	Respondents not meeting daily recommendations for fruit and vegetable consumption who ate more healthily in the past year and maintained change	3,695	3,907
Tried (not maintained)	Respondents not meeting daily recommendations for fruit and vegetable consumption who tried to eat more healthily in the past year but did not maintain change	1,737	1,847
Preparing	Respondents not meeting daily recommendations for fruit and vegetable consumption who intend to eat more healthily in the next 6 months	852	909
Contemplating	Respondents not meeting daily recommendations for fruit and vegetable consumption who would like to eat more healthily	504	537
Not contemplating	Respondents not meeting daily recommendations for fruit and vegetable consumption who have no intention of eating more healthily	5,721	6,149
Health behaviour (see Approach for more detail)			
Score = 0	Respondents with a health behaviour score of 0	3164	3374
Score = 1	Respondents with a health behaviour score of 1	6815	7278
Score = 2	Respondents with a health behaviour score of 2	5126	5478
Score = 3	Respondents with a health behaviour score of 3	1571	1641
Health knowledge (see Approach for more detail)			
Score = 0	Respondents with a health knowledge score of 0	650	705
Score = 1	Respondents with a health knowledge score of 1	6023	6482
Score = 2	Respondents with a health knowledge score of 2	7693	8083
Score = 3	Respondents with a health knowledge score of 3	767	800
Health motivation (see Approach for more detail)			
Score = 0 (or 0.5)	Respondents with a health motivation score of 0 or 0.5	1544	1673
Score = 1 (or 1.5)	Respondents with a health motivation score of 1 or 1.5	4824	5155
Score = 2 (or 2.5)	Respondents with a health motivation score of 2 or 2.5	6548	6977
Score = 3	Respondents with a health motivation score of 3	3760	3966

Appendix B: Knowledge of the physical activity recommendation

Accurate knowledge of the physical activity recommendation requires knowledge of **both** frequency and duration components, as presented on page 11 of the Results section. However, information on knowledge of the separate components over time is also useful, and is therefore presented below (Figure B1).

Figure B1 **Knowledge of physical activity recommendation in Scotland, 1996 to 2007**
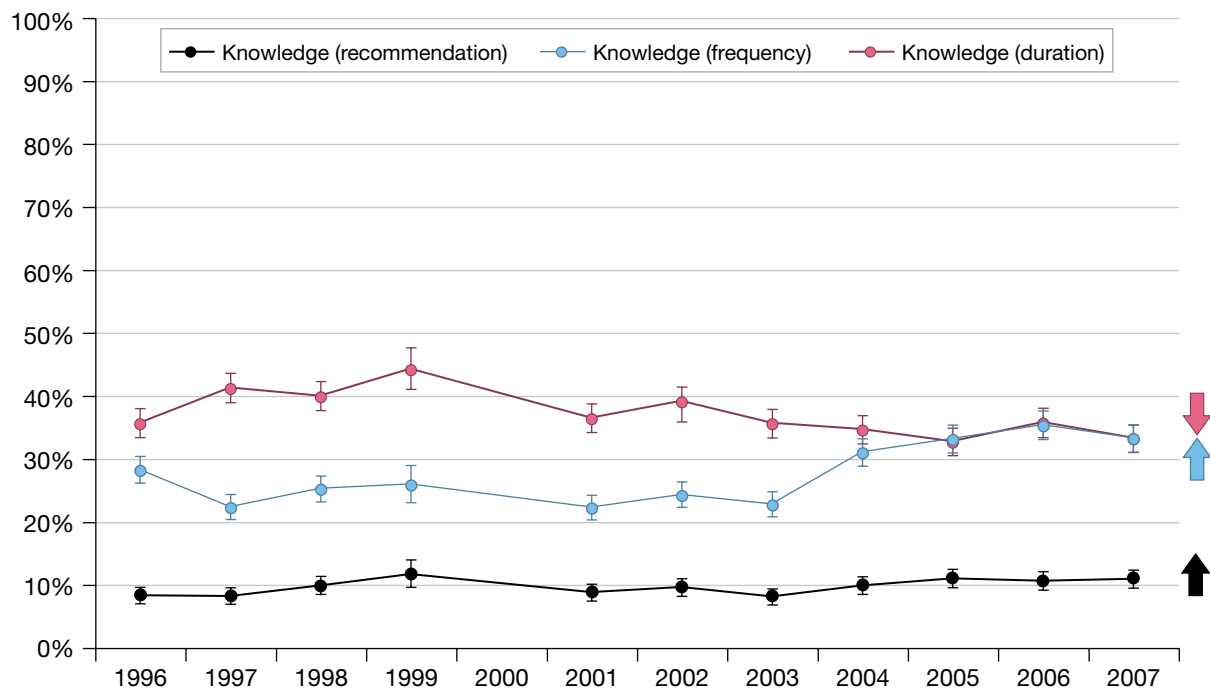
Knowledge (duration):	OR = 0.98 (0.97 to 0.99), P < 0.001	Base: all adults (aged 16–74)
Knowledge (frequency):	OR = 1.04 (1.03 to 1.05), P < 0.001	Base: all adults (aged 16–74)
Knowledge (recommendation):	OR = 1.03 (1.01 to 1.04), P < 0.001	Base: all adults (aged 16–74)

Knowledge (duration): knowledge of recommended daily duration of moderate activity
Knowledge (frequency): knowledge of recommended weekly frequency of moderate activity
Knowledge (recommendation): knowledge of both daily and weekly moderate activity recommendations

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There was a significant decrease in the proportion of adults accurately identifying the duration component of the physical activity recommendation across the HEPS series (36% to 33%), while knowledge of the weekly frequency component significantly increased (28% to 33%). The proportion of adults able to identify the complete physical activity recommendation (i.e. frequency and duration) also increased significantly, but remained very low (8% to 11%).

Appendix C: Results tables

Smoking

Table C1 **Behaviour (HEPS) model**

Explanatory variable	Exp(B) odds ratio	95% confidence interval		*P*-value
		Lower	Upper	
Time effect (per year)	0.981	0.972	0.990	<0.001
Sex	0.815	0.764	0.870	<0.001
Age				0.01
16–24	1			
25–34	0.942	0.589	1.507	0.80
35–44	0.633	0.406	0.987	0.04
45–54	0.812	0.521	1.266	0.36
55–64	0.737	0.467	1.163	0.19
65–74	0.492	0.302	0.801	0.004
Socio-economic status (SES)				<0.001
AB	1			
C1	1.821	1.237	2.680	<0.001
C2	2.740	1.838	4.085	<0.001
DE	3.995	2.704	5.904	<0.001
Deprivation quintile				0.96
1st (least deprived)	1			
2nd	0.951	0.690	1.312	0.76
3rd	1.008	0.733	1.387	0.96
4th	1.061	0.778	1.447	0.71
5th (most deprived)	1.052	0.773	1.431	0.75
Age/SES interaction				0.04
Age/deprivation interaction				0.004

Note: time/sex interaction significant but removed from final model.

Table C2 **Behaviour (SHoS) model**

Explanatory variable	Exp(B) odds ratio	95% confidence interval		P-value
		Lower	Upper	
Time effect (per year)	0.972	0.966	0.978	<0.001
Sex	0.941	0.915	0.968	<0.001
Age	0.988	0.985	0.990	<0.001
Deprivation quintile				<0.001
1st (least deprived)	1			
2nd	1.569	1.336	1.842	<0.001
3rd	2.293	1.967	2.673	<0.001
4th	2.755	2.372	3.200	<0.001
5th (most deprived)	3.984	3.436	4.618	<0.001
Age/deprivation interaction				0.03

Note: time/deprivation interaction significant but removed from final model.

Table C3 **Knowledge (health) model**

Explanatory variable	Exp(B) odds ratio	95% confidence interval		P-value
		Lower	Upper	
Time effect (per year)	0.985	0.969	1.002	0.09
Sex	0.963	0.852	1.089	0.55
Age				0.006
16–24	1			
25–34	3.149	1.431	6.932	0.004
35–44	2.132	1.030	4.410	0.04
45–54	3.521	1.671	7.418	0.001
55–64	2.938	1.342	6.432	0.007
65–74	1.324	0.547	3.203	0.53
Socio-economic status (SES)				0.02
AB	1			
C1	2.098	1.064	4.137	0.03
C2	2.910	1.448	5.847	0.003
DE	1.898	0.978	3.683	0.06
Deprivation quintile				0.17
1st (least deprived)	1			
2nd	0.825	0.669	1.018	0.07
3rd	0.977	0.792	1.206	0.83
4th	0.868	0.703	1.072	0.19
5th (most deprived)	0.828	0.672	1.020	0.08
Age/SES interaction				0.02

Table C4 **Motivation model**
Not contemplating (0), Contemplating (1), Preparing (2), Tried (3), Maintained (4)

| | Exp(B) odds ratio | 95% confidence interval | | *P*-value |
		Lower	Upper	
Time effect (per year)	1.031	1.018	1.043	<0.001
Sex	1.180	1.079	1.291	<0.001
Age				
16–24	1			
25–34	1.730	0.828	3.616	0.14
35–44	1.060	0.524	2.142	0.87
45–54	1.101	0.549	2.210	0.78
55–64	0.753	0.368	1.541	0.43
65–74	0.302	0.137	0.664	0.003
Socio-economic status (SES)				
AB	1			
C1	1.489	0.815	2.718	0.19
C2	1.630	0.884	3.006	0.11
DE	1.372	0.758	2.484	0.29
Deprivation quintile				
1st (least deprived)	1			
2nd	0.862	0.550	1.349	0.51
3rd	0.923	0.593	1.438	0.72
4th	0.842	0.549	1.292	0.43
5th (most deprived)	0.870	0.571	1.327	0.51
Age/SES interaction*	0.425	0.206	0.876	0.02
Age/deprivation interaction*	2.264	1.195	4.289	0.01

* When using ordinal logistic regression analysis, significance is calculated for each individual level of an interaction term with no 'overall' statistic for the interaction. If at least one level of an interaction was significant, it was kept in the model. The interaction presented in the above table represents the results of the most significant level.

Note: time/sex interaction significant but removed from final model.

Physical activity

Table C5   **Behaviour (HEPS) model**

Explanatory variable	Exp(B) odds ratio	95% confidence interval		P-value
		Lower	Upper	
Time effect (per year)	1.014	1.006	1.023	0.001
Sex	0.422	0.329	0.540	<0.001
Age				<0.001
16–24	1			
25–34	0.828	0.566	1.211	0.33
35–44	0.666	0.466	0.951	0.03
45–54	0.502	0.349	0.723	<0.001
55–64	0.365	0.251	0.530	<0.001
65–74	0.323	0.219	0.476	<0.001
Socio-economic status (SES)				0.04
AB	1			
C1	1.286	0.903	1.831	0.16
C2	1.675	1.152	2.435	0.007
DE	1.243	0.869	1.778	0.23
Deprivation quintile				<0.001
1st (least deprived)	1			
2nd	1.044	0.946	1.154	0.39
3rd	0.972	0.877	1.077	0.59
4th	0.866	0.779	0.962	0.007
5th (most deprived)	0.766	0.687	0.855	<0.001
Sex/age interaction				<0.001
Sex/SES interaction				<0.001
Age/SES interaction				<0.001

Note: time/sex and time/deprivation interactions significant but removed from final model.

Table C6 **Behaviour (SHeS) model**

Explanatory variable	Exp(B) odds ratio	95% confidence interval		*P*-value
		Lower	Upper	
Time effect (per year)	1.031	1.022	1.041	<0.001
Sex	0.543	0.381	0.775	0.001
Age	0.981	0.969	0.993	0.002
Socio-economic status (SES)				<0.001
I	1			
II	1.574	0.880	2.812	0.13
IIIN	1.861	1.041	3.329	0.04
IIIM	3.845	2.168	6.818	<0.001
IV	3.302	1.853	5.885	<0.001
V	8.217	4.191	16.108	<0.001
Deprivation quintile				<0.001
1st (least deprived)	1			
2nd	1.018	0.930	1.114	0.70
3rd	1.031	0.941	1.130	0.51
4th	0.948	0.864	1.041	0.26
5th (most deprived)	0.751	0.681	0.828	<0.001
Sex/age interaction				<0.001
Sex/SES interaction				<0.001
Age/SES interaction				<0.001

Table C7 **Knowledge (day) model**

Explanatory variable	Exp(B) odds ratio	95% confidence interval		*P*-value
		Lower	Upper	
Time effect (per year)	0.978	0.969	0.986	<0.001
Sex	1.145	1.075	1.221	<0.001
Age				<0.001
16–24	1			
25–34	1.123	0.993	1.269	0.06
35–44	1.161	1.031	1.309	0.01
45–54	1.345	1.190	1.521	<0.001
55–64	1.257	1.112	1.420	<0.001
65–74	1.334	1.179	1.509	<0.001
Socio-economic status (SES)				<0.001
AB	1			
C1	0.856	0.778	0.942	0.001
C2	0.705	0.636	0.783	<0.001
DE	0.663	0.601	0.731	<0.001
Deprivation quintile				<0.001
1st (least deprived)	1			
2nd	0.836	0.759	0.920	<0.001
3rd	0.878	0.796	0.968	0.009
4th	0.908	0.821	1.003	0.06
5th (most deprived)	0.802	0.723	0.891	<0.001

Table C8 **Knowledge (week) model**

Explanatory variable	Exp(B) odds ratio	95% confidence interval		*P*-value
		Lower	Upper	
Time effect (per year)	1.041	1.031	1.051	<0.001
Sex	0.947	0.749	1.198	0.65
Age				<0.001
16–24	1			
25–34	0.983	0.574	1.682	0.95
35–44	1.327	0.817	2.156	0.25
45–54	2.240	1.390	3.610	0.001
55–64	2.972	1.841	4.797	<0.001
65–74	4.486	2.778	7.246	<0.001
Socio-economic status (SES)				0.001
AB	1			
C1	1.151	0.723	1.832	0.55
C2	1.416	0.878	2.283	0.15
DE	1.962	1.244	3.096	0.004
Deprivation quintile				0.20
1st (least deprived)	1			
2nd	1.048	0.940	1.169	0.40
3rd	1.139	1.021	1.272	0.02
4th	1.037	0.925	1.163	0.53
5th (most deprived)	1.077	0.958	1.210	0.21
Sex/age interaction				0.01
Age/SES interaction				<0.001

Note: time/sex, time/age and time/deprivation interactions significant but removed from final model.

Table C9 **Knowledge (recommendation) model**

Explanatory variable	Exp(B) odds ratio	95% confidence interval		P-value
		Lower	Upper	
Time effect (per year)	1.027	1.013	1.042	<0.001
Sex	0.940	0.850	1.039	0.23
Age				<0.001
16–24	1			
25–34	1.346	0.616	2.944	0.46
35–44	1.595	0.769	3.310	0.21
45–54	2.083	1.010	4.297	0.05
55–64	3.028	1.474	6.223	0.003
65–74	4.606	2.258	9.395	<0.001
Socio-economic status (SES)				0.44
AB	1			
C1	1.424	0.681	2.979	0.35
C2	1.328	0.613	2.873	0.47
DE	1.728	0.828	3.605	0.15
Deprivation quintile				0.01
1st (least deprived)	1			
2nd	0.820	0.700	0.960	0.01
3rd	1.071	0.919	1.247	0.38
4th	1.007	0.859	1.180	0.94
5th (most deprived)	0.922	0.781	1.089	0.34
Age/SES interaction				0.03

Table C10 **Knowledge (health) model**

Explanatory variable	Exp(B) odds ratio	95% confidence interval		*P*-value
		Lower	Upper	
Time effect (per year)	1.028	1.015	1.041	<0.001
Sex	1.332	0.966	1.836	0.08
Age				<0.001
16–24	1			
25–34	0.660	0.346	1.262	0.21
35–44	0.826	0.448	1.521	0.54
45–54	0.770	0.417	1.423	0.40
55–64	0.325	0.177	0.598	<0.001
65–74	0.340	0.179	0.646	0.001
Socio-economic status (SES)				<0.001
AB	1			
C1	0.663	0.370	1.189	0.17
C2	0.429	0.235	0.783	0.006
DE	0.330	0.185	0.590	<0.001
Deprivation quintile				<0.001
1st (least deprived)	1			
2nd	0.987	0.852	1.144	0.87
3rd	0.808	0.696	0.939	0.005
4th	0.781	0.671	0.908	0.001
5th (most deprived)	0.717	0.613	0.838	<0.001
Age/sex interaction				0.04
Age/SES interaction				0.01

Note: time/age interaction significant but removed from final model.

Table C11 **Motivation model**

Not contemplating (0), Contemplating (1), Preparing (2), Tried (3), Maintained (4)

Explanatory variable	Exp(B) odds ratio	95% confidence interval		P-value
		Lower	Upper	
Time effect (per year)	1.034	1.024	1.044	<0.001
Sex	1.373	1.063	1.774	0.01
Age				
16–24	1			
25–34	1.062	0.816	1.382	0.65
35–44	0.822	0.640	1.056	0.12
45–54	0.615	0.478	0.792	<0.001
55–64	0.495	0.387	0.634	<0.001
65–74	0.400	0.312	0.513	<0.001
Socio-economic status (SES)				
AB	1			
C1	0.794	0.710	0.888	<0.001
C2	0.551	0.487	0.623	<0.001
DE	0.398	0.355	0.445	<0.001
Deprivation quintile				
1st (least deprived)	1			
2nd	1.004	0.899	1.122	0.94
3rd	0.886	0.791	0.993	0.03
4th	0.896	0.798	1.006	0.06
5th (most deprived)	0.874	0.776	0.984	0.02
Sex/age interaction*	0.666	0.490	0.905	0.009

* When using ordinal logistic regression analysis, significance is calculated for each individual level of an interaction term with no 'overall' statistic for the interaction. If at least one level of an interaction was significant it was kept in the model. The interaction presented in the above table represents the results of the most significant level.

Note: time/age and time/deprivation interactions significant but removed from final model.

Healthy eating

Table C12 **Behaviour (HEPS) model**

Explanatory variable	Exp(B) odds ratio	95% confidence interval		P-value
		Lower	Upper	
Time effect (per year)	1.073	1.063	1.084	<0.001
Sex	1.941	1.662	2.267	<0.001
Age				<0.001
16–24	1			
25–34	1.231	1.066	1.422	0.01
35–44	1.416	1.233	1.626	<0.001
45–54	1.837	1.597	2.113	<0.001
55–64	1.954	1.701	2.244	<0.001
65–74	1.861	1.618	2.139	<0.001
Socio-economic status (SES)				<0.001
AB	1			
C1	0.748	0.639	0.876	<0.001
C2	0.530	0.447	0.629	<0.001
DE	0.463	0.394	0.545	<0.001
Deprivation quintile				<0.001
1st (least deprived)	1			
2nd	0.993	0.899	1.097	0.89
3rd	0.795	0.717	0.882	<0.001
4th	0.776	0.697	0.864	<0.001
5th (most deprived)	0.631	0.562	0.708	<0.001
Sex/SES interaction				0.05

Table C13 **Knowledge (5-a-day) model**

| Explanatory variable | Exp(B) odds ratio | 95% confidence interval | | *P*-value |
		Lower	Upper	
Time effect (per year)	1.239	1.227	1.252	<0.001
Sex	3.565	2.986	4.257	<0.001
Age				<0.001
16–24	1			
25–34	1.043	0.917	1.187	0.52
35–44	1.056	0.931	1.198	0.40
45–54	0.975	0.855	1.111	0.71
55–64	0.799	0.702	0.909	0.001
65–74	0.613	0.538	0.699	<0.001
Socio-economic status (SES)				<0.001
AB	1			
C1	0.804	0.688	0.939	0.006
C2	0.569	0.483	0.670	<0.001
DE	0.451	0.385	0.528	<0.001
Deprivation quintile				<0.001
1st (least deprived)	1			
2nd	0.832	0.749	0.925	0.001
3rd	0.720	0.646	0.801	<0.001
4th	0.688	0.616	0.768	<0.001
5th (most deprived)	0.562	0.502	0.630	<0.001
Sex/SES interaction				<0.001

Note: time/age, time/SES and time/deprivation significant but removed from final model.

Table C14 **Knowledge (health) model**

Explanatory variable	Exp(B) odds ratio	95% confidence interval		P-value
		Lower	Upper	
Time effect (per year)	0.970	0.960	0.980	<0.001
Sex	0.851	0.710	1.019	0.08
Age				<0.001
16–24	1			
25–34	0.855	0.754	0.970	0.02
35–44	0.705	0.622	0.798	<0.001
45–54	0.528	0.461	0.605	<0.001
55–64	0.449	0.389	0.517	<0.001
65–74	0.383	0.326	0.452	<0.001
Socio-economic status (SES)				<0.001
AB	1			
C1	1.032	0.872	1.221	0.72
C2	0.824	0.689	0.985	0.03
DE	0.760	0.637	0.907	0.002
Deprivation quintile				0.02
1st (least deprived)	1			
2nd	1.115	0.991	1.253	0.07
3rd	1.227	1.089	1.382	0.001
4th	1.128	0.998	1.275	0.05
5th (most deprived)	1.132	0.997	1.285	0.06
Sex/SES interaction				0.03

Table C15 **Motivation model**
Not contemplating (0), Contemplating (1), Preparing (2), Tried (3), Maintained (4)

Explanatory variable	Exp(B) odds ratio	95% confidence interval		P-value
		Lower	Upper	
Time effect (per year)	1.044	1.035	1.054	<0.001
Sex	1.355	1.268	1.448	<0.001
Age				
16–24	1			
25–34	1.203	0.893	1.621	0.22
35–44	1.199	0.908	1.582	0.20
45–54	0.842	0.630	1.124	0.24
55–64	0.766	0.573	1.024	0.07
65–74	0.359	0.266	0.485	<0.001
Socio-economic status (SES)				
AB	1			
C1	1.017	0.910	1.136	0.76
C2	0.841	0.749	0.944	0.003
DE	0.788	0.706	0.879	<0.001
Deprivation quintile				
1st (least deprived)	1			
2nd	1.431	1.047	1.955	0.02
3rd	0.986	0.722	1.347	0.93
4th	1.217	0.901	1.643	0.20
5th (most deprived)	1.256	0.933	1.691	0.13
Age/deprivation interaction*	0.601	0.409	0.883	0.01

* When using ordinal logistic regression analysis, significance is calculated for each individual level of an interaction term with no 'overall' statistic for the interaction. If at least one level of an interaction was significant, it was kept in the model. The interaction presented in the above table represents the results of the most significant level.

Health scores

Table C16   **Health behaviour scores model** (0, 1, 2, 3)

Explanatory variable	Exp(B) odds ratio	95% confidence interval		*P*-value
		Lower	Upper	
Time effect (per year)	1.045	1.037	1.053	<0.001
Sex	0.690	0.581	0.820	<0.001
Age				
16–24	1			
25–34	1.007	0.682	1.486	0.97
35–44	1.016	0.708	1.458	0.93
45–54	0.964	0.668	1.391	0.84
55–64	0.954	0.659	1.382	0.81
65–74	0.820	0.563	1.195	0.30
Socio-economic status (SES)				
AB	1			
C1	0.868	0.637	1.182	0.37
C2	0.707	0.511	0.978	0.04
DE	0.508	0.370	0.698	<0.001
Deprivation quintile				
1st (least deprived)	1			
2nd	0.862	0.649	1.146	0.31
3rd	0.873	0.656	1.161	0.35
4th	0.780	0.590	1.030	0.08
5th (most deprived)	0.801	0.408	0.835	0.003
Age/sex interaction*	1.571	1.268	1.946	<0.001
Age/deprivation interaction*	0.584	0.408	0.835	0.003
Age/SES interaction*	0.596	0.411	0.865	0.006

* When using ordinal logistic regression analysis, significance is calculated for each individual level of an interaction term with no 'overall' statistic for the interaction. If at least one level of an interaction was significant, it was kept in the model. The interaction presented in the above table represents the results of the most significant level.

Note: time/sex interaction significant but removed from final model.

Table C17 **Health knowledge scores model** (0, 1, 2, 3)

Explanatory variable	Exp(B) odds ratio	95% confidence interval		*P*-value
		Lower	Upper	
Time effect (per year)	1.175	1.164	1.186	<0.001
Sex	2.201	1.828	2.650	<0.001
Age				
16–24	1			
25–34	1.327	0.874	2.015	0.18
35–44	1.725	1.169	2.546	0.006
45–54	1.201	0.808	1.785	0.37
55–64	1.498	0.999	2.246	0.05
65–74	1.667	1.103	2.518	0.02
Socio-economic status (SES)				
AB	1			
C1	0.896	0.645	1.244	0.51
C2	0.704	0.498	0.996	0.05
DE	0.565	0.402	0.793	0.001
Deprivation quintile				
1st (least deprived)	1			
2nd	0.725	0.533	0.987	0.04
3rd	0.686	0.504	0.934	0.02
4th	0.681	0.503	0.922	0.01
5th (most deprived)	0.731	0.541	0.988	0.04
Age/sex interaction *	0.718	0.559	0.923	0.01

* When using ordinal logistic regression analysis, significance is calculated for each individual level of an interaction term with no 'overall' statistic for the interaction. If at least one level of an interaction was significant, it was kept in the model. The interaction presented in the above table represents the results of the most significant level.

Note: time/age, time/deprivation and time/SES interactions significant but removed from final model.

Table C18 **Health motivation scores model** (0, 0.5, 1, 1.5, 2, 2.5, 3)

Explanatory variable	Exp(B) odds ratio	95% confidence interval		P-value
		Lower	Upper	
Time effect (per year)	1.062	1.054	1.069	<0.001
Sex	1.058	0.896	1.250	0.50
Age				
16–24	1			
25–34	1.696	1.159	2.481	0.007
35–44	1.447	1.018	2.057	0.04
45–54	1.106	0.774	1.581	0.58
55–64	1.068	0.745	1.530	0.72
65–74	0.711	0.494	1.024	0.07
Socio-economic status (SES)				
AB	1			
C1	1.026	0.760	1.386	0.87
C2	0.853	0.622	1.170	0.32
DE	0.578	0.424	0.787	0.001
Deprivation quintile				
1st (least deprived)	1			
2nd	1.172	0.889	1.545	0.26
3rd	0.908	0.688	1.197	0.49
4th	0.944	0.721	1.237	0.68
5th (most deprived)	0.994	0.759	1.303	0.97
Age/sex interaction*	1.424	1.150	1.764	0.001
Age/deprivation interaction*	0.528	0.373	0.749	<0.001
Age/SES interaction*	0.513	0.350	0.751	0.001

* When using ordinal logistic regression analysis, significance is calculated for each individual level of an interaction term with no 'overall' statistic for the interaction. If at least one level of an interaction was significant, it was kept in the model. The interaction presented in the above table represents the results of the most significant level.

Note: time/sex and time/SES interactions significant but removed from final model.

Appendix D: Summary of inequalities

Women, compared with men, appeared to be:

- less likely to have a high (favourable) health behaviour score
- less likely to smoke
- less likely to be active
- more likely to eat healthily
- more likely to know 5-a-day recommendation
- more likely to have a high health knowledge score
- more motivated to quit smoking
- more motivated to increase physical activity
- more motivated to eat healthier.

Older people, compared with younger people, appeared to be:

- less likely to smoke
- less likely to be active
- more likely to eat healthily
- more likely to know physical activity recommendation
- less likely to know 5-a-day recommendation
- less likely to know that more physical activity and healthy eating could improve health
- less likely to be motivated to stop smoking, do more physical activity or eat more healthily.

People of lower social class, compared with people of higher social class, appeared to be:

- less likely to have a high health behaviour score
- more likely to smoke
- more likely to be active
- less likely to eat healthily
- less likely to know 5-a-day recommendation
- less likely to have a high health knowledge score
- less likely to be motivated to increase physical activity
- less likely to have a high health motivation score.

People living in more, compared with less, deprived areas appeared to be:

- less likely to have a high health behaviour score
- more likely to smoke
- less likely to eat healthily
- less likely to be active.

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All web links were verified as working on 22 June 2010.

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