Government of **Western Australia**
Department of **Health**

Evaluating raked weighting methods: WA Health and Wellbeing Surveillance System

Epidemiology Directorate

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Contents

1 Introduction

The Health and Wellbeing Surveillance System (HWSS) is a continuous data collection system developed to monitor the health and wellbeing of Western Australians. The HWSS began in 2002 and is run on a continual basis, where thousands of people throughout Western Australia (WA) are interviewed each year. The HWSS is managed by the Epidemiology Directorate at the Department of Health WA, with data collected by a contracted research organisation. The survey is primarily conducted as a Computer Assisted Telephone Interview (CATI), with an online completion option introduced in 2021.

Respondents are asked questions on a range of health and wellbeing topics, including chronic health conditions, lifestyle behaviours, biomedical risk factors, health service utilisation, mental health, social characteristics, and demographics. Information from the survey is used to monitor the health status of Western Australians, inform health education programs, evaluate interventions and programs, inform health research, support health policy development, identify and monitor emerging trends and support health service planning and development.

Surveys such as the HWSS are designed to provide information at a population level, for example to inform what proportion of the population have a particular characteristic. Most surveys will only collect information from a sample of the target population. These raw data are then weighted to represent the population from which it was drawn, with each person given a weight which can be thought of as the number of people they represent. Since 2002, the HWSS has used both design and post stratification weighting to account for each respondents' chance of selection, as well as their age, sex, and geographic location. This weighting process was designed to ensure that prevalence estimates generated using HWSS data are representative of the WA population.

A major strength of the HWSS is the ability to detect trends in population health over time. By collecting data continually and reporting on prevalence estimates each year, the HWSS can detect trends in topics of public health concern such as smoking and high-risk alcohol consumption based on the 2009 guidelines for long-term harm. For example, the prevalence of current smokers reduced from 22% to 10% and high risk for long-term harm from alcohol consumption reduced from 36% to 27% between 2002 and 2019[1].

1.1 HWSS sample frame and mode changes

Another strength of the HWSS is the ability of the system to adapt to societal and methodological change. In late 2019, the need for methodological change became clear due to an ageing White Pages sample frame, declining response rates and a disproportionate number of responses from older age groups. It was therefore vital that the HWSS sampling and data collection methods were updated to ensure the quality and accuracy of health information supplied to HWSS users into the future.

In 2020, the HWSS conducted trials of several alternative sample frames including the WA Electoral Roll and third-party databases, as well as trials of online and dual mode data collection modes. These trials were conducted while continuing with usual HWSS data

[1] Epidemiology Directorate, 2020. Health and Wellbeing of Adults in Western Australia 2019. Overview and Trends. Department of Health, Western Australia. https://www.health.wa.gov.au/~/media/Corp/Documents/Reports-and-publications/Population-surveys/Health-and-Wellbeing-of-Adults-in-WA-2019.pdf

collection using the White Pages sample frame and CATI. The trials demonstrated that regardless of sample frame, online only mode had lower response rates and dual mode yielded superior response rates compared with CATI alone, Furthermore, online respondents were younger and reported better health status than CATI respondents. This made dual mode a more appropriate option for improving age representation in the HWSS respondent data.

By December 2020, the raw response rate to the White Pages sample frame had dropped to less than 18%. At the beginning of data collection in 2021, the White Pages was discarded as the HWSS sample frame and alternatives were implemented using a staged approach.

Initially an extract of names and addresses from the WA Electoral Roll was used for contacting households and HWSS data was collected using a fully online survey, as an existing data sharing arrangement between the WA Electoral Commission and WA Health did not allow for access to phone numbers. Sampled households were sent a letter with a web link and quick-response (QR) code, non-respondents were not followed up by CATI but instead were sent a reminder letter after two weeks. Respondents who preferred to complete the survey over the phone were able to call-in to the data collection agency, but no outbound calls were made as the sample list did not contain phone numbers. The survey response rate from this online only mode had a raw response rate of less than 9%.

To improve response rates, ethical approval was sought for the use of third-party databases with access to phone numbers from the Department of Health Human Research Ethics Committee. After ethical approval was granted, telephone numbers were appended from a third-party database to a second extract from the WA Electoral Roll using WA Health Data Linkage System methods. The HWSS began contacting households using this linked sample frame from June 2021. Data was collected using dual mode, where sampled households were sent a letter with a web link and QR code to encourage online completion of the survey. Non-responders were followed up by CATI which resulted in a raw response rate of 42%.

In December 2021 the HWSS stopped using the WA Electoral Roll online only survey mode as the low response rate of less than 9% (compared with the dual mode response rate of 42%) made online only completion an unsustainable survey mode to continue with.

1.2 Impact on respondent representation

Although the adaptations to the HWSS sampling frames and data collection methods improved response rates in 2021, they were insufficient in addressing the widening gap between the demographics of the sample respondents and the WA population (Figure 1).

When the online only respondent data was combined with the dual mode respondent data prior to weighting, the larger size of the older age groups in the CATI group simply outnumbered the younger demographic profile of the online respondent sample.

As seen in figure 1 below, the proportion of respondents aged 16 to 44 years was 7% in CATI mode, 24% in online mode and 14% when combined. In contrast, the proportion of respondents aged 65 years and over was 69% in CATI, 42% in online and 57% when combined. Additionally, the post-stratification weighting process was insufficient in improving the representativeness, stability and reliability of prevalence estimates generated from the 2021 HWSS collected data.

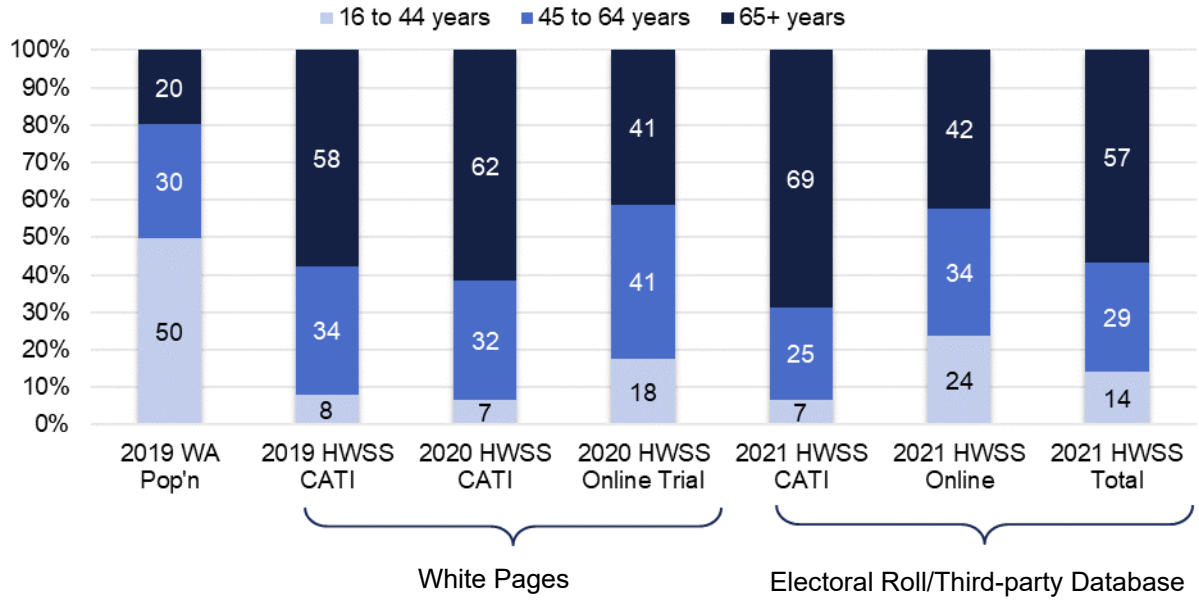

Figure 1: Unweighted age distribution in the HWSS respondent sample by sample frame compared with WA population (2019-21)

1.3 A potential break in series

With the introduction of new sample frames and online completion, the long-standing design and established methodology of the HWSS had changed. By introducing mobile as well as landline telephone numbers the design of the HWSS was no longer a household-based survey. Although duplicate addresses were avoided, more than one respondent per household was permitted to increase response rates, especially in rural and remote areas. This change meant there was no longer a need for a design weight in the weighting process. In addition, there was evidence from collected data and other research literature that online and CATI survey respondents differ in both demography and health.

In other jurisdictions, methodological changes such as these have resulted in a break in trend series. A break in series for the HWSS would cause a major disruption to the continuity of the system in reporting on trends of public health concern in WA.

It was therefore imperative to find a solution that would facilitate sample frame and mode changes, preserve the HWSS trend series, and improve the representativeness, reliability and stability of prevalence estimates generated by the system. A new weighting method needed to be identified, tested, and implemented for the HWSS to ensure 20 years of continuous trend series information was preserved and the HWSS remain a valid and reliable population health resource both in 2021 and into the future.

1.4 Formative research

A desktop search of modern weighting methods was conducted. The weighting methods of interstate, national and international longitudinal population health surveys were consulted along with a thorough literature search of statistical methods and peer-reviewed research articles on modern survey weighting and the impact of mode differences on longitudinal population health surveys.

This formative research identified the implementation of raked weighting in place of post-stratification weighting in the South Australian Population Health Survey[2]. The authors demonstrated improved congruence between their sample and population demographics, and improved stability and reliability of prevalence estimates when compared with post stratification weighting. We therefore evaluated raked weighting as a potential alternative to design and post stratification weighting for the HWSS.

2 Aims and objectives

We aimed to explore whether the raked weighting method was a suitable alternative to traditional weighting (design and post stratification weighting) for the HWSS. The evaluation objectives were as follows:

1. To compare the demographic distribution of the 2021 sample by weighting method
2. To compare the summary statistics and distribution of weights by weighting method
3. To compare the prevalence estimates generated using 2021 data by weighting method
4. To compare the trends over time for selected conditions and time periods by weighting method
5. To identify the necessity or otherwise for mode adjustment on trend data.

2.1 Evaluation criteria

Raked weighting was evaluated against the following criteria when compared with traditional weighting. To be selected as a superior weighting method, raked weighting would need to demonstrate the following:

1. Improved demographic distribution of the 2021 response sample
2. Improved summary statistics and distribution of weights in 2021 data
3. Improved stability and reliability of prevalence estimates generated using 2021 data
4. Improved stability and reliability of trends over time for selected conditions
5. Amelioration of differences by mode of completion regardless of the need for adjustment.

[2] Dal Grande E, Chittleborough C, Campostrini S, Tucker G, and Taylor A. 2015. Health Estimates Using Survey Raked-Weighting Techniques in an Australian Population Health Surveillance System. *American Journal of Epidemiology* 182:6, 544-56. https://doi.org/https://doi.org/10.1093/aje/kwv080.

3 Survey weighting

As it is not practical to contact all individuals in the WA population, the HWSS collects information from a sample of the population. Weighting ensures that the demographic profile of the respondent sample aligns with that of the total WA population. The HWSS can then be used to derive representative prevalence estimates for health conditions or risk factors in the WA community.

The two weighting methods described in this report are similar in that they aim to align the demographics of the sample with the demographics of the population from which it was drawn. However, they differ in the breadth of demographics which are covered in the adjustment process, the inclusion or exclusion of sampling or design weights, the population total used for trend series or combined period data, and in the computer processing power that is required to produce the weights.

3.1 Design and post-stratification weighting

We refer to the design and post-stratification weighting method as **traditional weighting**. This method has been used to report all HWSS data between 2002 and 2020. Traditional weighting is a two-step process comprising both a *design* weight and a *post-stratification* weight. The design weight is used to compensate for the sample selection process which relied upon a landline-based sample frame and is equal to the chance of the respondent being selected within the household, given they are in the sample frame.

The design weight is then calculated by dividing the number of people in the household within the same age group by the number of White Pages telephone listings in the household.

The post-stratification, or non-response weight, is used to compensate for differential non-response and relative under-sampling by aligning the sample by age group, sex, and geographic location. These factors are then applied to the Australian Bureau of Statistics (ABS) Estimated Resident Population (ERP) for the year prior to data collection, or for the midpoint year ERP when combining multiple years.

3.2 Raked weighting

Raked weighting is an intensive process that requires a significant amount of computing processing power. Advances in computing now allow for complex statistical processing analyses such as raking that were not feasible when the HWSS first began. In raked weighting weights are created and iteratively adjusted so that the proportions of certain demographic characteristics in the respondent sample are equal to the proportions found in the target population. In each iteration the distribution of one variable is applied to proportionally adjust all the survey weights within the sample.

During the raking process the data are gradually and iteratively adjusted to fit the margin totals (or population proportions) for each variable. The iterative process is finalised when the survey sample margin totals converge with the population margin totals within an acceptable predefined tolerance limit[2]. The weights are then trimmed at an upper limit set as the median plus six times the interquartile range[2]. This avoids the creation of small quantities of very large weights, which can introduce instability into the prevalence estimates. Scaling is then applied, where the balance of all weights above the upper limit value are equally distributed across the entire sample.

Population proportions are drawn from the ABS Census demographic factors for every five-year period. The proportions are applied to the ERP for the year prior to data collection regardless of whether data are analysed individually or grouped over multiple years.

3.3 Combining multiple years for trend series

In traditional weighting, a consistent population denominator was used across several years to produce trend or interval data. Trend series and interval weights were calculated based on the ERP for the midpoint year of the trend or interval period. With this approach, prevalence estimates were consistent relative to the same population over the period in question, allowing detection of upward or downward trends in a stable population. However, this resulted in double handling of weights for HWSS analysts, conflicting prevalence estimates between trend series prevalence estimates and point estimates for individual years, and the subsequent confusion for users as to which estimate should be used when individual year, interval and trend series estimates were reported.

In raked weighting, data are weighted only once to the ERP of the previous year and multiple years of raked weighted data are simply combined if interval or trend series analysis is required. This removes the need for re-weighting files to a midpoint year for interval or trend analysis. Prevalence estimates for each year in a trend series will match with the corresponding annual population rather than one fixed mid-point population across all years. This addresses the issue of conflicting results between annual estimates and trend series prevalence estimates that were previously encountered with traditional weighting.

3.4 Interpretation of results

Prevalence estimates are derived from the weighted HWSS respondent data. Prevalence refers to the proportion of individuals in a community who have a demographic characteristic, risk factor, health condition or lifestyle factor of interest, and is expressed as a percentage. Prevalence estimates will always contain some error because they are based on samples and not the entire population. Therefore, prevalence estimates are accompanied by a 95 per cent confidence interval, which is the range within which the true estimate would lie 95 out of 100 times.

The wider the confidence interval is around an estimate, the less precise the estimate is, and the more caution that should be applied with using it. If the confidence intervals do not overlap, then the estimates are considered significantly different. When the confidence intervals of the estimates do overlap, the estimates are deemed similar; however, this should be considered a guide only and a formal test of statistical significance would be required to arrive at statistically credible conclusion.

The level of stability around an estimate can also be guided by the relative standard error (RSE). The RSE is a measure of the extent to which the survey estimate is likely to be different from the actual population result. The smaller the RSE, the more likely it is that the estimate is an accurate reflection of the population. Estimates with RSEs less than 0.25 are considered accurate and reliable for most purposes. Estimates with RSEs between 0.25 and 0.50 should be interpreted with caution and estimates with RSEs above 0.50 are suppressed in HWSS reports.

4 Statistical methods

4.1 Statistical packages and methods

Traditional HWSS design and post-stratification weighting was conducted in SAS based on the method described *in Health and wellbeing of adults in Western Australia 2020*[3]. Raked weighting was conducted in SPSS using the RAKE module based on the method developed by Dal Grande et al[2] and currently used for the South Australian Population Health Survey[4]. Prevalence estimates, 95 per cent confidence intervals and relative standard errors for selected outcome variables for selected chronic conditions, lifestyle factors, biomedical risk factors and mental health were derived for both traditional weighting and raked weighting using SAS proc surveyfreq[5].

4.2 Estimated Resident Population

The 2020 ERP for WA for persons aged 16 years and over was used for weighting the 2021 data for both methods (2,114,546 persons)[6]. The trend data from 2002 to 2020 were weighted for each individual year using the ERP for the year prior to data collection and were obtained from the ABS.

4.3 Sociodemographic variables used for weighting

The Census is conducted by the ABS every five years, and provides demographic, socioeconomic and housing characteristics of the entire population. The 2016 Census was used to calculate the proportions for each dimension within the raked weighting procedure. The general community profiles based on place of usual residence were used for the WA state, the greater Perth area, and the Outback - North (equivalent to the Kimberley and Pilbara regions)[4].

Proportions were based on the total number of persons aged 16 years and over for age, sex, and location, country of birth, marital status, education level and employment status (See Appendix A)[6,7]. The variables were selected based on the method used by Dal Grande et al[2] and in the South Australian Population Health Survey[4], except for dwelling status and number of people living in the household.

These two variables were not selected for the WA raked weighting method for two reasons. Firstly, dwelling status was not collected in the 2002 HWSS data and so could not be included in the weighting process consistently across the entire data series. Secondly, the state of WA is geographically extremely large with small populations, especially in regional and remote areas. By selecting fewer raking variables with two or three groups within each, smaller and more refined weights are produced, and the raked weighting process is more efficient.

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[3] Epidemiology Directorate, 2021. Health and Wellbeing of Adults in Western Australia 2020. Overview and Trends. Department of Health, Western Australia. https://www.health.wa.gov.au/~/media/Corp/Documents/Reports-and-publications/Population-surveys/Health-and-Wellbeing-of-Adults-in-WA-2020.pdf

[4] Wellbeing SA. 2022. South Australian Population Health Survey 2021 Annual Report: Adults. https://www.wellbeingsa.sa.gov.au/assets/downloads/SAPHS/SAPHS-2021-Annual-Report_Adults.pdf

[5] SAS Institute Inc, 2013. The SURVEYFREQ Procedure. SAS/STAT® 13.1 User's Guide. North Carolina https://support.sas.com/documentation/onlinedoc/stat/131/surveyfreq.pdf

[6] Australian Bureau of Statistics. 2022, Community Profiles, ABS. https://www.abs.gov.au/census/guide-census-data/about-census-tools/community-profiles.

[7] Community profiles are grouped for persons aged 15 years and over for these variables.

Table 1 below compares the variables included in the traditional weighting method with those included in the raked weighting method.

Table 1: Variables used in HWSS weighting methods.

Variable	Categories	Traditional Weighting	Raked Weighting
White Pages listings	Number of White Pages listings for household	Yes	No
Number of residents by age	Number of adults aged 16-24 years, number of adults aged 25-64 years, number of adults aged 65+ years	Yes	No
Sex	Male, female	Yes	Yes
Age groups	16–24, 25-44, 35–44, 45–54, 55–64, 65–74, 75+ years	Yes	Yes
Area of residence	Metropolitan Perth, Kimberley/Pilbara, rest of state	Yes	Yes
Country of birth[7]	Australia, other	No	Yes
Marital status[7]	Married or living with partner, other (widowed, separated, divorced, never married)	No	Yes
Educational level[7]	Bachelor's degree or higher, other (none to some high school, trade, certificate, diploma)	No	Yes
Employment status[7]	Employed, other, (unemployed home duties, student, retired, unable to work)	No	Yes

For trend data, the most recent preceding Census year to the year of data collection was used to calculate the population proportions for each of the raking dimensions. Five Census years were used in the raking of the 2002 to 2022 HWSS data, with these years being 2001, 2006, 2011, 2016 and 2021. Therefore, the 2001 Census weighting proportions were used for HWSS data between 2002 to 2006, with the 2006 Census proportions used for HWSS data between 2007 and 2011 and so on.

5 Results

5.1 Demographic distribution by weighting method

Table 2 below displays the Census proportions for the WA population in 2016, the unweighted HWSS proportions, the traditional weighted HWSS proportions and the raked weighted HWSS proportions, as well as the margin differences compared to the Census proportions for each weighting method.

The unweighted margins show the biggest difference between the Census proportions and the HWSS respondent sample, confirming that weighting is required to improve the representativeness of any prevalence estimates.

Traditional weighting showed acceptable agreement with the margin totals for age groups, sex, and region of residence, but poor agreement for the remaining domains, as they are excluded from the traditional weighting process.

Raked weighting with trimming and scaling outperformed the traditional weighting method, as although the margins for age group, sex and region of residence were inflated slightly, the margins for the remaining domains of country of birth, marital status, education, and employment status were markedly improved.

Table 2: Census proportions compared with the unweighted, traditional weighted and raked weighted HWSS proportions and margin differences, adults 16 years and over, 2021.

Domain	2016 WA Census Population aged 16 years and over (n=2,114,546)	2021 HWSS adults 16 years and over (n=10,346)					
		Unweighted		Traditional Weighting		Raked Weighting	
	%	%	% Diff	%	% Diff	%	% Diff
Age Group							
16 to 24 years	14.25	2.66	-11.59	13.71	-0.54	10.62	-3.63
25 to 34 years	19.27	4.81	-14.46	18.39	-0.88	16.45	-2.82
35 to 44 years	17.53	6.74	-10.79	17.61	0.08	17.75	0.22
45 to 54 years	17.02	10.55	-6.47	16.38	-0.64	18.43	1.41
55 to 64 years	14.33	18.42	4.09	14.64	0.31	16.49	2.16
65 to 74 years	10.15	27.04	16.89	9.28	-0.87	11.68	1.53
75 years and over	7.45	29.78	22.33	10.00	2.55	8.58	1.13
Sex							
Female	50.29	58.3	8.02	50.50	0.21	52.67	2.38
Male	49.71	41.7	-8.02	49.50	-0.21	47.33	-2.38
Region of Residence							
Metro	78.77	52.16	-26.61	80.20	1.43	76.94	-1.83
Pilbara and Kimberley	3.69	6.75	3.06	3.54	-0.15	4.25	0.56
Rest of State	17.54	41.1	17.54	16.26	-1.28	18.82	1.28
Country of Birth							
Australia	59.58	67.31	7.73	68.14	8.56	57.52	-2.06
Other	40.42	32.69	-7.73	31.86	-8.56	42.48	2.06
Marital Status							
Married/Living with partner	52.73	67.58	14.85	68.52	15.79	63.12	10.39
Other	47.27	32.42	-14.85	31.48	-15.79	36.88	-10.39
Education							
None to some high school, trade, certificate, diploma	79.46	74.84	-4.62	64.68	-14.78	77.08	-2.38
Degree or higher	20.54	25.16	4.62	35.32	14.78	22.92	2.38
Employment							
Employed	55.23	40.54	14.69	65.32	10.09	59.47	4.24
Economically Inactive	44.77	59.46	-14.69	34.68	-10.09	40.53	-4.24

Note: Totals may not add to 100% due to rounding. Percentage differences are between 2016 Census and HWSS.

5.2 Summary statistics and distribution of weights

Table 3 below displays the summary statistics for each weighting method. Of note, the most common weight (represented as the mode statistic in this context) seen in the raked weighting is much higher than that of the traditional weighting method. This is an artefact of the trimming process where all weights above the upper limit were set to exactly that value. Importantly, the standard deviation and maximum weight are reduced for the raked weights, with the histograms showing improved distribution in the raked weighting method (demonstrated by a shorter right-hand tail). This means there are fewer large weights produced by raked weighting, thereby improving the stability of the data (see Figure 2).

Table 3: Summary statistics of traditional 2021 HWSS weights and raked HWSS weights.

Weighting Method	Traditional Weighting	Raked Weighting
N	10,346	10,346
Mean	204.4	204.4
Median	89.6	91.8
Mode	119.8	1,098.8
Standard Deviation	324.2	275.9
Minimum	19.5	4.4
Maximum	4,151.9	1,098.8
Lower Quartile	49.8	41.1
Upper Quartile	137.7	208.9
Interquartile Range	87.9	167.8
Sum	2,114,546	2,114,546

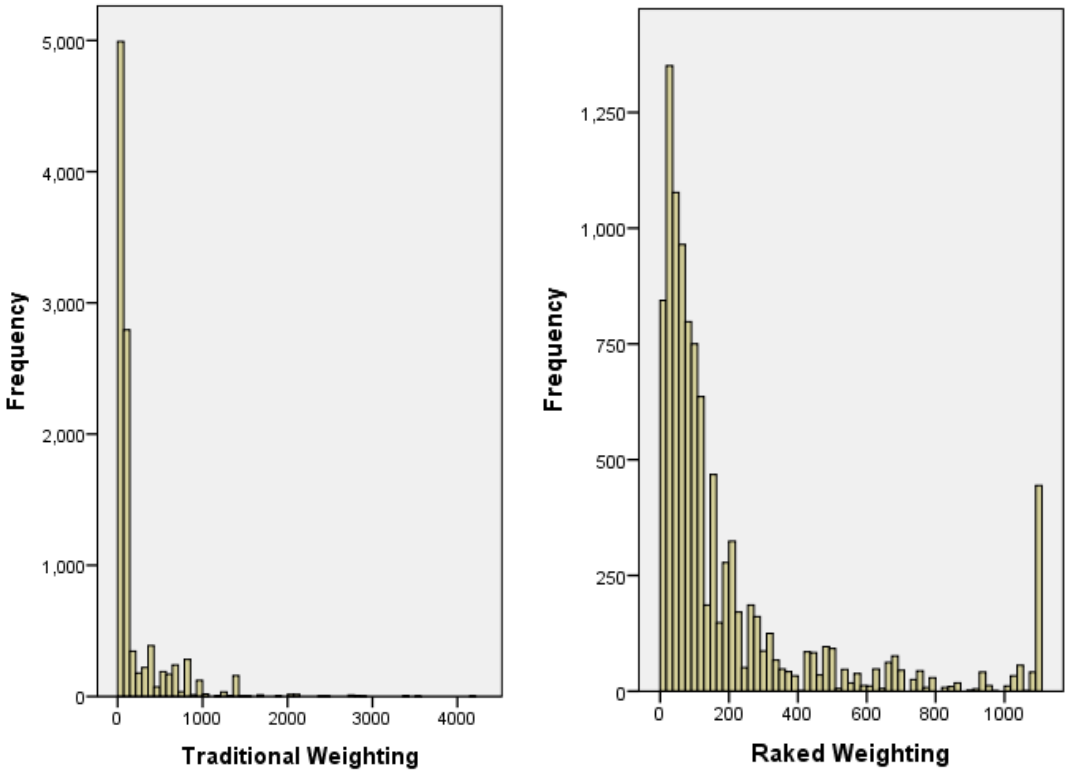

Figure 2: Distribution of 2021 HWSS weights for traditional weighting and raked weighting.*
*Note different scales between histograms

5.3 Differences in prevalence estimates by weighting method 2021

Prevalence estimates for all conditions and behaviours captured by the HWSS were produced for 2021 data using both traditional weighting and raked weighting and then compared (See Appendix B). Overall, there were no major differences in the prevalence estimates produced, however, there were some minor shifts within categories for three health topics.

The first instance of difference was a statistically significant increase for raked weighting in the prevalence of respondents who reported that they were ex-smokers (used to smoke but no longer did; 28.3% compared with 25.0%). The second instance was a statistically significant decrease in the proportion of those who reported having never smoked or never smoked more than 100 cigarettes (59.9% compared with 64.2%). The final instance of difference was a statistically significant increase in the proportion of respondents who reported not belonging to any social groups or clubs (43.6% compared with 39.8%).

The shift within the prevalence of smoking status within the ex-smoker category is of little concern as public health interest is usually targeted toward current smoking status. While there is also a slight increase in the prevalence of current smokers, this increase is not statistically significant and more likely indicates a refined estimation of smoking prevalence that more accurately reflects true smoking status in the population.

An increase in the number of respondents reporting that they belonged to zero clubs or associations may be an artefact of the impact of COVID-19 restrictions and the corresponding reduced ability for respondents to attend church, social, sporting, political and professional groups.

5.4 Trend series data

Selected HWSS behaviours and conditions were analysed to compare the impact of raked weighting method on trends over time. Due to the large amount of information produced, only results for current smoking status and high-risk alcohol consumption for long-term harm are presented here as they are major topics of public health interest.

The major benefit of the raked weighting method for trend series data is that weighting is performed only once, with data for all years able to be analysed individually, for intervals, or in a trend series. This vastly improved the stability of estimates generated for both trend series and aggregated time periods as the sum of all the yearly weights was much higher than one single mid-point year. Utilising this approach also addresses the methodological fallacy that the population is stable over the trend period when a single midpoint year population is used to weight a trend series.

For the trend series of current smoking status, raked weighting produced higher prevalence estimates when compared with traditional weighting, though both sets of estimates followed the same downward trend over time (Figure 3).

The 95 per cent confidence intervals for the estimates by weighting method overlapped for males and females for all years, as well as for persons for all years excluding 2003, 2005, 2009 and 2010. Estimates for these years for all persons were statistically significantly higher for raked weighting compared to traditional weighting. This indicates that the traditional weighting method may have under-represented current smoking status as raked weighting has better alignment with population demographics.

The downward trend for current smoking status seen in traditional weighting is also replicated in raked weighting, with estimates closer between traditional and raked weighting for males, females, and persons from 2011 to 2021.

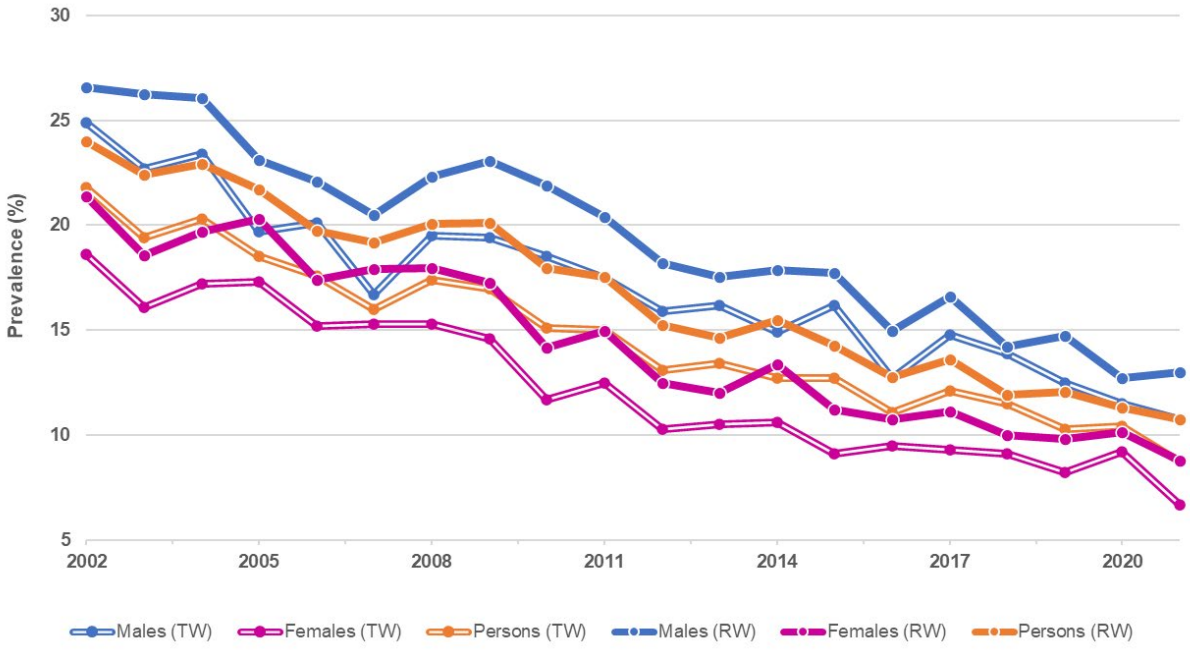

Figure 3: Current smoker trend by weighting method, males, females, and persons, HWSS adults 18 years and over, 2002-2021.

Traditional weighting (TW) is shown by the compound lines, raked weighting (RW) is shown by the solid lines.

For the trend series of high risk of long-term harm from alcohol consumption (consumes more than two standard drinks per day), the trend line produced by raked weighting was smoother and closely followed the traditional weighting prevalence estimates (Figure 4).

The 95 per cent confidence intervals were narrower for raked weighting compared with traditional weighting and overlapped for each weighting method for each year by males, females, and persons (results not shown). Additionally, the RSEs for raked weighting were smaller than for traditional weighting (not shown). This indicates raked weighting produces more stable and reliable estimates than traditional weighting for long-term alcohol related harm.

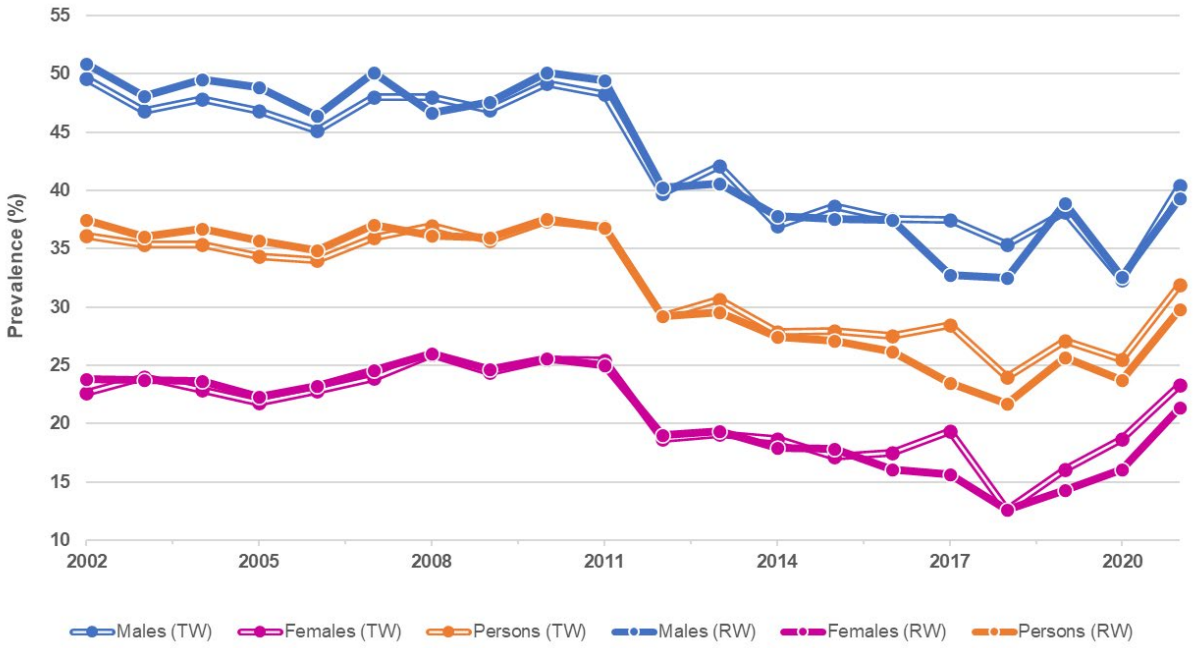

Figure 4: High risk for long-term harm from alcohol consumption by weighting method, males, females, and persons, HWSS adults 16 years and over, 2002-2021.
Traditional weighting (TW) is shown by the compound lines, raked weighting (RW) is shown by the solid lines.

Overall, raked weighting resulted in smoothed trend data, narrower confidence intervals (i.e. more precise estimates) and smaller RSEs (i.e. more reliable estimates) than traditional weighting for many other HWSS topics not presented in this report.

5.5 Adjustment for mode

Professional advice was sought from an independent expert in survey design[8] on the need for adjustment to historical HWSS data due to the introduction of online mode in 2021. The expert advice was to use a general linear model to predict the likelihood that a respondent to a CATI HWSS survey during 2002 to 2020 would have responded online had the option been available. The model included age, sex, and statistically significant variables that differed by mode in the 2021 collected data, including smoking status, psychological distress, and physical activity level. For data from 2002 to 2020, weights were adjusted upward for respondents predicted to complete the survey by CATI. Next, all weights were scaled to ensure the sum of weights was equal to the total population. Prevalence estimate trends were then compared based on weighting method (results not shown).

Adjustment for mode did not appear to provide any further benefit to raked weighting. In fact, significant differences between modes for certain sensitive topics such as tobacco smoking and psychological distress were exaggerated and could not otherwise be explained. An extensive literature search did not find any compelling evidence that the introduction of online mode to a longitudinal survey warranted adjustment for mode, and no evidence of adjustment in trend data for online mode was found in any other Australian population health survey. Considering this and with expert consultation, it was decided that any mode differences would have already been adequately ameliorated by the raked weighting and mode adjustment would only introduce further instability to the data.

[8] David Lawrence, Professor of Mental Health, School of Population Health, Curtin University, WA.

6 Summary and outcomes

Several improvements have been made to operational aspects of the HWSS from 2021 onwards to increase response rates and the representativeness of unweighted and weighted respondent data. Initially these improvements included the use of modern sample frame and data collection modes and resulted in better response rates. However, the demographic representation of the collected HWSS data could not be improved using the traditional weighting method that had been in use since 2002.

An alternative weighting method, raked weighting, was compared against the traditional method for five criteria and demonstrated the following improvements when compared with traditional weighting:

1. improved demographic distribution of the 2021 respondent sample
2. improved summary statistics and distribution of weights for 2021 data
3. improved stability and reliability of prevalence estimates generated using 2021 data
4. improved stability and reliability of trends over time for selected conditions
5. amelioration of differences by mode of completion and no need for adjustment for mode of completion.

Raked weighting produced improved congruence between demographic factors in the respondent sample and the total population when compared with traditional weighting. By including more demographic factors in the weighting process such as country of birth, marital status, education level and employment status, raked weighting reduced the number of extremely large weights which had previously introduced instability into prevalence estimates.

Raked weighting produced prevalence estimates for health conditions and behaviours that were similar to the previous traditional weighting method with the added advantage of improved alignment across demographic subgroups and improved stability. Most importantly, these improvements were seen across all years of data collection (i.e. in trend series), demonstrating that raked weighting could ensure the preservation of 20 years of HWSS data from 2002 to 2021 without a break in series.

Finally, raked weighting adequately addressed the introduction of online mode and sufficiently ameliorated the significant differences between online and CATI respondents, and the need for adjustment for mode in historical trend data was not indicated.

6.1 Reporting HWSS from 2021 onwards

Raked weighting was successful in addressing all evaluation criteria. The results presented in this report were key to the decision to cease use of traditional weighting for reporting prevalence estimates for HWSS 2021 data. Using raked weighting for the first time, reports on the health and wellbeing of adults and children for 2021 were released in early 2023, followed by the release of the 2022 reports on the health and wellbeing of adults and children in late 2023. These annual reports differed from previous HWSS releases in the following areas:

- Methodological changes in HWSS sample frame
- Methodological changes in HWSS data collection mode
- Methodological changes in HWSS weighting method
- Reporting changes, where trend series data were not reported
- Reporting changes, where Health Region estimates were reported.

HWSS annual reports prior to 2021 will not be re-released and will remain publicly available. Due to the alterations in weighting methodology and updates to population denominators, users are advised to avoid comparing reports that used the traditional weight (2002 to 2020) with reports using raked weights (2021 and onwards).

6.2 Future reporting

From 2023 onwards, all HWSS data from 2002 will be analysed using raked weights to ensure consistency between data requests and published information. The development of an online portal for accessing HWSS information (weighted using raked weighting for all years) is underway. The data in the portal is planned to supersede publications prior to 2021. This will ensure ease of access to HWSS information and the continued value of the HWSS in monitoring trends in population health and supporting health system management and public health planning into the future.

7 Contact

Please contact the Health and Wellbeing Surveillance System team, Epidemiology Directorate, WA Department of Health at DOH.HWSS@health.wa.gov.au for further information.

Appendix A

Table 1: Census Proportions WA 2016 used for weighting domains for adults aged 16 years and over.

Domain	Census Proportion	Derived from Age
Sex		
Male	0.4971	16 plus
Female	0.5029	16 plus
Age groups		
16 to 24	0.1425	16 plus
25 to 34	0.1927	16 plus
35 to 44	0.1753	16 plus
45 to 54	0.1702	16 plus
55 to 64	0.1433	16 plus
65 to 74	0.1015	16 plus
75 plus	0.0745	16 plus
Area of residence		
Metro	0.7990	16 plus
Pilbara/Kimberley	0.0369	16 plus
Rest of State	0.1641	16 plus
Country of Birth		
Australia	0.5509	15 plus
Other	0.4491	15 plus
Marital status		
Married (registered, social)	0.6013	15 plus
Other (widowed, separated, divorced, never married)	0.3987	15 plus
Educational level		
Bachelor's degree or higher	0.2054	15 plus
Other (none to some high school, trade certificate, diploma)	0.7946	15 plus
Employment status		
Employed	0.5795	15 plus
Not Employed	0.4205	15 plus

Appendix B

Comparison of prevalence estimates using traditional weighting and raked weighting, HWSS 2021, adults 16 years and over.

Table 1: General health

	Traditional weighting				Raked weighting				Sig diff
	%	95% CI		RSE	%	95% CI		RSE	
Self-reported health									
Excellent	17.6	16.1	19.0	0.0420	16.2	15.0	17.5	0.0389	
Very good	38.7	36.9	40.5	0.0234	37.2	35.7	38.8	0.0216	
Good	30.8	29.2	32.5	0.0273	31.6	30.1	33.1	0.0241	
Fair	10.1	9.1	11.2	0.0508	11.5	10.4	12.5	0.0451	
Poor	2.7	2.2	3.2	0.0967	3.5	2.9	4.0	0.0786	
Disability in the family									
No	82.4	81.1	83.8	0.0083	81.5	80.3	82.8	0.0078	
Yes	17.6	16.2	18.9	0.0390	18.5	17.2	19.7	0.0342	
Impact of disability on respondent and family									
Not much of an impact	14.5	11.3	17.8	0.1148	14.0	11.4	16.6	0.0949	
Some impact	34.0	29.8	38.2	0.0628	31.0	27.5	34.5	0.0573	
A fairly big impact	25.1	21.6	28.5	0.0700	25.8	22.5	29.1	0.0652	
A big impact	13.8	11.2	16.4	0.0950	14.6	12.1	17.0	0.0852	
A very big impact	12.6	10.2	15.0	0.0965	14.7	12.1	17.2	0.0890	

Table 2: Chronic conditions

	Traditional weighting				Raked weighting				Sig diff
	%	95% CI		RSE	%	95% CI		RSE	
Arthritis									
No	79.8	78.7	81.0	0.0073	77.8	76.7	78.9	0.0074	
Yes	20.2	19.0	21.3	0.0288	22.2	21.1	23.3	0.0260	
Osteoporosis									
No	94.2	93.7	94.7	0.0027	93.4	92.8	94.0	0.0033	
Yes	5.8	5.3	6.3	0.0445	6.6	6.0	7.2	0.0461	
Heart disease									
No	93.2	92.6	93.8	0.0032	92.4	91.7	93.0	0.0035	
Yes	6.8	6.2	7.4	0.0434	7.6	7.0	8.3	0.0425	
Stroke									
No	98.0	97.7	98.3	0.0018	97.7	97.3	98.1	0.0021	
Yes	2.0	1.7	2.3	0.0875	2.3	1.9	2.7	0.0873	
Cancer									
No	93.2	92.6	93.8	0.0034	92.7	92.1	93.4	0.0035	
Yes	6.8	6.2	7.4	0.0460	7.3	6.6	7.9	0.0444	
Skin cancer									
No	86.6	85.8	87.5	0.0050	87.1	86.3	87.9	0.0047	
Yes	13.4	12.5	14.2	0.0325	12.9	12.1	13.7	0.0314	
Diabetes									
No	92.4	91.6	93.2	0.0043	91.2	90.4	92.0	0.0044	
Yes	7.6	6.8	8.4	0.0518	8.8	8.0	9.6	0.0459	
Type 2 diabetes									
No	94.5	94.0	95.1	0.0030	93.4	92.8	94.0	0.0034	
Yes	5.5	4.9	6.0	0.0510	6.6	6.0	7.2	0.0487	

	Traditional weighting				Raked weighting				Sig diff
	%	95% CI		RSE	%	95% CI		RSE	
Injury in the past 12 months									
No	93.3	92.4	94.3	0.0052	93.0	92.1	93.8	0.0045	
Yes	6.7	5.7	7.6	0.0728	7.0	6.2	7.9	0.0602	
Current asthma									
No	89.3	88.1	90.4	0.0067	89.7	88.7	90.7	0.0056	
Yes	10.7	9.6	11.9	0.0555	10.3	9.3	11.3	0.0489	
Lifetime asthma									
No	80.9	79.4	82.4	0.0095	81.9	80.6	83.2	0.0080	
Yes	19.1	17.6	20.6	0.0400	18.1	16.8	19.4	0.0361	
Current chronic respiratory condition other than asthma									
No	97.1	96.7	97.5	0.0020	96.6	96.2	97.1	0.0022	
Yes	2.9	2.5	3.3	0.0681	3.4	2.9	3.8	0.0630	
Lifetime chronic respiratory condition other than asthma									
No	95.8	95.2	96.3	0.0027	95.1	94.5	95.7	0.0030	
Yes	4.2	3.7	4.8	0.0619	4.9	4.3	5.5	0.0591	
Anxiety									
No	84.2	82.8	85.7	0.0089	84.1	82.8	85.4	0.0078	
Yes	15.8	14.3	17.2	0.0476	15.9	14.6	17.2	0.0413	
Depression									
No	88.1	86.8	89.4	0.0076	87.4	86.2	88.5	0.0068	
Yes	11.9	10.6	13.2	0.0566	12.6	11.5	13.8	0.0468	
Stress-related problem									
No	83.4	81.9	84.8	0.0089	83.4	82.1	84.7	0.0080	
Yes	16.6	15.2	18.1	0.0447	16.6	15.3	17.9	0.0398	
Any other mental health problem									
No	93.7	92.6	94.7	0.0059	93.9	93.0	94.8	0.0049	
Yes	6.3	5.3	7.4	0.0876	6.1	5.2	7.0	0.0745	

Table 3: Nutrition and physical activity

	Traditional weighting				Raked weighting				Sig diff
	%	95% CI		RSE	%	95% CI		RSE	
Serves of fruit consumed daily									
Doesn't eat fruit	5.7	4.9	6.6	0.0759	6.2	5.4	7.0	0.0645	
Eats less than one serve of fruit daily	15.4	14.0	16.8	0.0467	16.0	14.7	17.3	0.0404	
Eats one serve of fruit daily	37.1	35.4	38.8	0.0239	36.6	35.1	38.2	0.0217	
Eats two or more serves of fruit daily	41.8	40.0	43.6	0.0216	41.1	39.6	42.7	0.0196	
Fruit consumption guidelines									
Does not eat recommended daily serves of fruit	58.2	56.4	60.0	0.0155	58.9	57.3	60.4	0.0137	
Eats recommend daily serves of fruit	41.8	40.0	43.6	0.0216	41.1	39.6	42.7	0.0196	
Serves of vegetables consumed daily									
Doesn't eat vegetables	0.7	0.4	0.9	0.2234	1.0	0.6	1.4	0.1840	
Eats less than one serve of vegetables daily	5.1	4.2	5.9	0.0863	6.0	5.1	6.8	0.0702	
Eats one to two serves of vegetables daily	51.1	49.3	52.9	0.0181	52.3	50.7	53.9	0.0158	
Eats three to four serves of vegetables daily	32.8	31.1	34.5	0.0260	31.2	29.8	32.7	0.0241	
Eats five or more serves of vegetables daily	10.4	9.3	11.5	0.0539	9.5	8.5	10.4	0.0507	

	Traditional weighting				Raked weighting				Sig diff
	%	95% CI		RSE	%	95% CI		RSE	
Vegetable consumption guidelines									
Does not eat recommended daily serves of vegetables	91.4	90.5	92.4	0.0054	92.0	91.2	92.9	0.0046	
Eats recommend daily serves of vegetables	8.6	7.6	9.5	0.0571	8.0	7.1	8.8	0.0534	
Milk									
Full fat/ whole	46.5	44.7	48.3	0.0198	46.4	44.8	48.1	0.0178	
Low/reduced fat/skim	35.5	33.8	37.2	0.0242	35.4	33.8	36.9	0.0219	
Other	8.0	6.9	9.0	0.0676	7.8	6.9	8.7	0.0595	
Don't use milk	10.0	8.9	11.1	0.0559	10.4	9.4	11.5	0.0505	
Food security - ran out of food and couldn't afford to buy more									
No	96.4	95.6	97.1	0.0039	95.5	94.7	96.3	0.0041	
Yes	3.6	2.9	4.4	0.1036	4.5	3.7	5.3	0.0873	
Teeth or dentures affect food eaten (65+ years)									
No	88.7	87.8	89.6	0.0051	87.6	86.5	88.7	0.0064	
Yes	11.3	10.4	12.2	0.0404	12.4	11.3	13.5	0.0449	
Fast food									
Never	33.9	32.3	35.5	0.0238	35.8	34.3	37.3	0.0208	
Less than once a week	28.0	26.4	29.7	0.0294	28.0	26.6	29.5	0.0264	
Once or twice a week	30.7	28.9	32.4	0.0294	29.1	27.5	30.6	0.0274	
Three or more times per week	7.4	6.3	8.5	0.0780	7.1	6.1	8.1	0.0705	
Potato chips									
Never	23.8	22.4	25.3	0.0305	25.4	24.0	26.7	0.0267	
Less than once a week	30.2	28.6	31.9	0.0279	29.3	27.9	30.8	0.0253	
Once or twice a week	38.2	36.4	40.0	0.0238	37.6	36.0	39.2	0.0217	
Three or more times per week	7.7	6.6	8.8	0.0726	7.7	6.8	8.7	0.0643	
Sweet snacks									
Never	20.5	19.1	21.9	0.0353	22.0	20.7	23.4	0.0307	
Less than once a week	13.0	11.8	14.3	0.0487	12.6	11.5	13.7	0.0442	
Once or twice a week	28.9	27.2	30.5	0.0294	28.8	27.3	30.3	0.0264	
Three or more times per week	37.6	35.9	39.4	0.0236	36.6	35.0	38.1	0.0216	
Salty snacks									
Never	33.0	31.4	34.6	0.0246	35.1	33.6	36.6	0.0216	
Less than once a week	21.6	20.0	23.1	0.0365	20.1	18.8	21.4	0.033	
Once or twice a week	31.2	29.5	33.0	0.0280	31.1	29.5	32.6	0.0253	
Three or more times per week	14.2	12.8	15.5	0.0493	13.7	12.5	14.9	0.0445	
Sugar sweetened soft/energy drinks									
Never	61.9	60.1	63.8	0.0152	63.4	61.8	65.0	0.0131	
Less than once a week	10.3	9.1	11.6	0.0615	9.4	8.3	10.4	0.0562	
Once or twice a week	13.2	11.9	14.6	0.0520	12.9	11.7	14.0	0.0464	
Three or more times per week	14.5	13.1	15.9	0.0494	14.4	13.1	15.6	0.0433	
Processed meats									
Never	22.0	20.5	23.5	0.0357	23.2	21.8	24.6	0.0303	
Less than once a week	17.4	16.1	18.7	0.0379	17.5	16.3	18.8	0.0352	
Once or twice a week	36.4	34.7	38.2	0.0241	35.9	34.3	37.4	0.0218	
Three or more times per week	24.2	22.6	25.8	0.0339	23.4	22.0	24.8	0.0308	

	Traditional weighting				Raked weighting				Sig diff
	%	95% CI		RSE	%	95% CI		RSE	
Self-reported physical activity									
Very active	13.8	12.5	15.1	0.0472	13.5	12.3	14.6	0.0436	
Active	23.9	22.4	25.4	0.0325	23.6	22.2	24.9	0.0293	
Moderately active	37.1	35.3	38.8	0.0236	37.6	36.1	39.2	0.0211	
Not very active	21.3	19.8	22.9	0.0374	21.1	19.8	22.5	0.0324	
Not at all active	3.9	3.2	4.7	0.0938	4.2	3.5	4.9	0.0805	
Physical activity levels									
Does no leisure time physical activity	11.2	10.1	12.2	0.0481	12.1	11.1	13.2	0.0430	
Does less than 150 minutes of moderate physical activity per week	21.3	19.8	22.8	0.0363	22.5	21.1	23.9	0.0321	
Does at least 150 minutes of moderate physical activity per week	67.5	65.8	69.2	0.0129	65.4	63.8	67.0	0.0124	
How usually spend day									
Mostly sitting	56.6	54.8	58.4	0.0162	55.1	53.4	56.7	0.0151	
Mostly standing	17.5	16.2	18.9	0.0391	17.7	16.5	19.0	0.0359	
Mostly walking	16.6	15.4	17.9	0.0380	17.8	16.7	19.0	0.0332	
Mostly doing heavy labour or physically demanding work	9.2	8.1	10.4	0.0648	9.4	8.3	10.4	0.0565	
Time spent watching TV/DVDs or using computer/tablet									
None	1.1	0.8	1.5	0.1675	1.3	0.9	1.7	0.1544	
Less than 7 hrs	21.6	20.0	23.2	0.0374	21.1	19.7	22.5	0.0336	
7 to less than 14 hrs	20.1	18.5	21.6	0.0389	18.6	17.3	19.9	0.0355	
14 to less than 21 hrs	24.2	22.7	25.7	0.0322	23.4	22.0	24.8	0.0301	
21+ hrs	33.0	31.4	34.6	0.0252	35.5	34.0	37.1	0.0217	
Sufficient sleep									
Sleeps the recommended hours	66.8	65.2	68.5	0.0125	63.9	62.4	65.4	0.0123	
Sleeps less than recommended hours	28.8	27.2	30.4	0.0280	31.3	29.8	32.8	0.0244	
Sleeps more than recommended hours	4.4	3.8	5.0	0.0680	4.8	4.2	5.3	0.0613	

Table 4: Alcohol, tobacco and drug use

	Traditional weighting				Raked weighting				Sig diff
	%	95% CI		RSE	%	95% CI		RSE	
Alcohol harm – long term									
Doesn't drink	30.8	29.1	32.5	0.0279	32.9	31.4	34.4	0.0238	
Low risk (1 to 2 drinks/day)	38.3	36.6	40.0	0.0228	37.2	35.7	38.7	0.021	
Risky (Over 2 drinks/day)	30.9	29.1	32.6	0.0286	29.9	28.4	31.4	0.026	
Alcohol harm – short term									
Doesn't drink	30.8	29.1	32.5	0.0279	32.9	31.4	34.4	0.0238	
Low risk (Up to 4 drinks/occasion)	58.0	56.2	59.8	0.0159	56.1	54.4	57.7	0.0147	
Risky (Over 4 drinks/occasion)	11.2	9.9	12.4	0.0569	11.0	9.9	12.1	0.0507	

	Traditional weighting				Raked weighting				Sig diff
	%	95% CI		RSE	%	95% CI		RSE	
Smoking status (18+ years)									
I smoke daily	5.9	5.1	6.7	0.0728	7.2	6.3	8.0	0.0605	
I smoke occasionally	2.6	1.9	3.2	0.1299	2.8	2.2	3.4	0.1135	
I don't smoke now but I used to	25.0	23.7	26.4	0.0275	28.3	26.9	29.6	0.0242	Sig
I've tried it a few times but never smoked regularly	12.5	11.2	13.8	0.0533	10.8	9.8	11.9	0.0503	
I've never smoked	54.1	52.3	55.8	0.0168	51.0	49.4	52.6	0.0162	
Lifetime smoking status (18+ years)									
Smoker	8.5	7.4	9.5	0.0628	9.9	8.9	11.0	0.0525	
Ex-smoker	27.3	25.9	28.7	0.0267	30.1	28.7	31.5	0.0235	
Never smoked or never smoked more than 100 cigarettes	64.2	62.6	65.9	0.0130	59.9	58.4	61.5	0.0132	Sig
Smoking in the home (18+ years)									
The home is smoke free	96.4	95.5	97.2	0.0044	96.2	95.5	96.8	0.0036	
People occasionally smoke in the house	1.8	1.2	2.3	0.1524	2.1	1.6	2.6	0.1291	
People frequently smoke in the house	1.9	1.2	2.5	0.1805	1.7	1.3	2.2	0.1292	
Ever tried an e-cigarette (18+ years)									
No	84.4	82.9	85.9	0.0091	84.7	83.4	86.0	0.0080	
Yes	15.6	14.1	17.1	0.0495	15.3	14.0	16.6	0.0443	
Tried an e-cigarette past 12 months (18+ years)									
No	50.7	45.2	56.1	0.0548	53.0	48.1	57.8	0.0467	
Yes	49.3	43.9	54.8	0.0563	47.0	42.2	51.9	0.0526	
Illicit Drug Use in past 12 months									
No	89.2	87.9	90.4	0.0072	89.4	88.3	90.5	0.0063	
Yes	10.8	9.6	12.1	0.0592	10.6	9.5	11.7	0.0534	

Table 5: Biomedical risk factors

	Traditional weighting				Raked weighting				Sig diff
	%	95% CI		RSE	%	95% CI		RSE	
Lifetime high cholesterol									
No	64.7	63.0	66.4	0.0135	63.2	61.6	64.8	0.0129	
Yes	35.3	33.6	37.0	0.0248	36.8	35.2	38.4	0.0222	
Current high cholesterol									
No	77.2	75.9	78.6	0.0091	76.1	74.8	77.4	0.0087	
Yes	22.8	21.4	24.1	0.0307	23.9	22.6	25.2	0.0277	
Lifetime high blood pressure									
No	71.1	69.7	72.6	0.0105	69.2	67.8	70.6	0.0102	
Yes	28.9	27.4	30.3	0.0258	30.8	29.4	32.2	0.0230	
Current high blood pressure									
No	79.4	78.2	80.6	0.0076	77.9	76.8	79.1	0.0075	
Yes	20.6	19.4	21.8	0.0294	22.1	20.9	23.2	0.0266	
BMI categories									
Not overweight or obese	26.8	25.1	28.6	0.0331	25.7	24.1	27.2	0.0302	
Overweight	39.0	37.2	40.8	0.0235	38.0	36.4	39.6	0.0217	
Obese	34.2	32.5	35.9	0.0256	36.3	34.7	37.9	0.0222	

Table 6: Mental health

	Traditional weighting				Raked weighting				Sig diff
	%	95% CI		RSE	%	95% CI		RSE	
Psychological distress									
Low	58.6	56.7	60.4	0.0161	58.5	56.9	60.2	0.0143	
Moderate	22.4	20.8	23.9	0.0354	22.8	21.4	24.3	0.0320	
High	12.5	11.1	13.8	0.0573	12.0	10.9	13.2	0.0491	
Very high	6.6	5.5	7.7	0.0818	6.6	5.7	7.5	0.0705	
Often or always perceive lack of control over life in general									
No	90.7	89.4	92.0	0.0071	91.2	90.1	92.2	0.0058	
Yes	9.3	8.0	10.6	0.0694	8.8	7.8	9.9	0.0601	
Often or always perceive lack of control over personal life									
No	91.4	90.1	92.6	0.0070	92.2	91.2	93.2	0.0054	
Yes	8.6	7.4	9.9	0.0744	7.8	6.8	8.8	0.0640	
Often or always perceive lack of control over health									
No	89.7	88.6	90.9	0.0067	89.0	87.9	90.1	0.0062	
Yes	10.3	9.1	11.4	0.0589	11.0	9.9	12.1	0.0503	
Thought about seriously ending own life in the past 12 months									
No	92.0	90.8	93.2	0.0065	91.8	90.8	92.8	0.0055	
Yes	8.0	6.8	9.2	0.0744	8.2	7.2	9.2	0.0619	
Number of groups/associations belonging to									
None	39.8	38.1	41.6	0.0226	43.6	41.9	45.2	0.0189	Sig
One	23.8	22.3	25.3	0.0328	23.8	22.4	25.2	0.0293	
Two	17.8	16.4	19.2	0.0390	16.7	15.5	17.8	0.0362	
Three	10.1	9.0	11.3	0.0588	8.7	7.8	9.6	0.0517	
Four or more	8.5	7.5	9.5	0.0600	7.3	6.5	8.1	0.0570	

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