The longitudinal patterns of alcohol use in older New Zealanders

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Disclaimer

This research has been carried out by an independent party under contract to HPA. The views, observations and analysis expressed in this report are those of the authors and are not to be attributed to HPA.

Comments

This report has not undergone external peer review.

The longitudinal patterns of alcohol use in older New Zealanders

Report 2b of 3

A report for the Health Promotion Agency

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COLLEGE OF HEALTH
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Executive summary

Older adults are at significant risk from alcohol-related harm, yet few studies have explored the patterns of older adult alcohol use over time. New Zealand in particular has very little evidence of research in this area, despite recent studies suggesting that the patterns of alcohol use in older New Zealanders may be more hazardous than seen in their counterparts in other countries.[1, 2]

This report presents a longitudinal assessment of the drinking patterns evident in older New Zealanders over 10 years (2006 to 2016) using data from the Ministry of Business, Innovation and Employment-funded New Zealand *Health, Work & Retirement Longitudinal Study* at Massey University.

The longitudinal patterns of alcohol use in older New Zealanders

Our analyses indicate that, within a large sample of New Zealanders aged 50 years and over, there are five distinct drinking profiles (Figure 1) which are relatively stable across time. They include a large cohort of older adults drinking relatively infrequently and consuming little on each occasion, but also a substantial number of older New Zealanders drinking frequently and consuming a lot of alcohol every time they drank.

Figure 1: Overview of the five profiles of older New Zealand drinkers

Profiles of Older Drinkers	Characteristics	Description
1	Low Frequency of Drinking Low Quantity per Occasion (34.8%; n = 915)	A group with a low frequency of drinking, low levels of consumption on days when they do drink, and who experience a small but gradual decrease over time in both drinking frequency and quantity.
2	High Frequency of Drinking Low Quantity per Occasion (30.1%; n = 791)	A group of very frequent drinkers who consume low amounts on each drinking occasion, and show no change (increase or decrease) in the frequency or quantity of alcohol use over time.
3	Moderate Frequency of Drinking High Quantity per Occasion (4.7%; n = 124)	A very small group of drinkers who drink with moderate frequency and they consume a lot on occasions when they do drink (infrequent heavy drinkers). However, both the frequency of drinking and the quantity consumed per occasion reduces across time.
4	Moderate Frequency of Drinking Low Quantity per Occasion (22.6%; n = 594)	A group that tends to drink with moderate frequency, consumes low quantity per drinking occasion, and both drinking frequency and quantity gradually decrease across time.
5	High Frequency of Drinking High Quantity per Occasion (7.9%; n = 207)	A small group of older drinkers who drink frequently and consume a high quantity of alcohol on each drinking occasion (frequent heavy drinkers). Also, while the average quantity consumed decreases slightly over time, the frequency of drinking does not.

Profiles 1, 2 and 4 include approximately 87% of older drinkers whose patterns of consumption pose low immediate risk to health (i.e., they drink either infrequently or

frequently but consume very few drinks on each drinking occasion). However, the remaining two profiles reflect approximately 13% of older drinkers whose alcohol consumption patterns pose serious and immediate risks to their health (i.e., they are drinking with moderate or high frequency and consuming many drinks on each occasion). Critical to identifying older drinkers whose consumption poses risks to their health is understanding who is likely to both drink with high frequency and consume high quantity per occasion.

Older drinkers consuming with higher frequency

The characteristics suggesting an older adult is likely to drink with higher frequency are:

- male
- at the younger stage of older adulthood (i.e., around 60-70 years of age)
- have a moderate to high level of education, and
- have a high economic living standard.

Older drinkers consuming higher quantity per occasion

Our analysis specify two separate sub-populations likely to consume alcohol in high quantities:

- **Heavy drinkers with health issues:** Those who drank large quantities of alcohol on each occasion with *moderate* frequency (i.e., a high-risk group) had the poorest physical and mental health, and were more likely to have three or more chronic health conditions than other groups of older drinkers.
- **Heavy drinkers without health issues:** Those who drank large quantities of alcohol on each occasion with *high* frequency (i.e., very high-risk group) had health profiles similar to those drinking at much lower quantities per occasion.

The single characteristic that jointly identified heavy drinking groups with and without health issues was that they were much more likely to be smokers than older drinkers who consumed fewer drinks per drinking occasion.

1.0 The longitudinal patterns of alcohol use in older New Zealanders

1.1 International research on longitudinal drinking patterns in older adults

There are many reasons why older adults choose to drink alcohol, including the use of alcohol for group bonding and social cohesion, as self-medication for perceived health benefits, and as a mechanism to reduce emotional or mental distress. [3-5] Similarly, there is a range of reasons that older adults choose to increase, reduce or give up drinking, including marital separation, retirement, the onset of poor health, the idea that reducing alcohol use would be beneficial, and because their doctor, family or friends suggested they should reduce their drinking. [6-9]

In order to understand the factors that might promote or inhibit drinking across older adulthood, we need to:

- explore whether frequency and quantity of drinking changes or remains stable over older adulthood
- explore whether frequency and quantity of drinking changes uniformly across older adults or distinct groups can be identified based on similar drinking patterns
- quantify the differential sociodemographic characteristics of older drinkers with disparate drinking patterns
- quantify how promoting/inhibiting factors for alcohol use influences drinking patterns.

1.1.1 Stability of drinking across older adulthood

Britton and her colleagues have utilised the Whitehall II longitudinal study of British Civil Servants to produce some of the most informative models of adult drinking patterns to date. The most recent publication by Knott, Bell and Britton [10] explored the longitudinal trajectories of seven groups of adult drinkers from mid-life through to early older adulthood.

When the Whitehall II participants were first interviewed in mid-life (aged 35-55), the authors identified groups of drinkers based on frequency and quantity of drinking. Using a United Kingdom standard drink equivalent of eight grams of alcohol, these groups included a non-drinking group, a light drinking group consuming up to approximately seven drinks weekly, and further graduated drinking groups up to the riskiest who were drinking more than 32 drinks weekly.

Following these groups across two decades, the authors found that drinking frequency and quantity were broadly stable for light to moderate drinking groups; those who were heavy consumers at baseline showed the greatest reduction in their drinking with the advance of age; and the probability of giving up alcohol was relatively unlikely for all groups.

These findings are in line with the results reported by McEvoy et al. [11] using the Rancho Bernardo Study of Healthy Ageing in the western United States. They modelled changes in alcohol use (frequency and quantity) over a 24-year period with a sample of community dwelling Californians aged 50-89 at baseline. They found that alcohol consumption remained relatively stable over two decades in all except the oldest adults at baseline, with a large proportion continuing to exceed recommended drinking guidelines. Similarly, Brennan, and Schutte [12] estimated change trajectories in average drinking over 20 years for community dwelling men and women aged 55-65 at first assessment in the eastern United States. They

found that average alcohol consumption was relatively stable and consistent through to 70 years of age, after which both men and women experienced a gradual decline. However, this decline was more pronounced in women.

In combination, international studies suggest that drinking frequency and quantity are relatively stable across mid-life and into older adulthood. Furthermore, they suggest that older adults should not be considered a homogenous drinking group; instead a wide range of drinking patterns are likely within any older cohort ranging from complete abstention through to excessive or risky drinking.

1.1.2 Potential differences in sociodemographic and health characteristics among older drinking groups

A recent study by Halonen et al. [13] provides more insight into the potential differences in sociodemographic and health characteristics that exist between distinct subgroups of older drinkers. The authors explored 12-year drinking trajectories of older public-sector employees in the transition from work to retirement in Finland. Using government guidelines defining risky drinking as weekly consumption of 16+ units (for women) or 24+ units (for men), they identified three distinct drinking groups:

(1) Consistent low-risk drinking (81% of the sample).
(2) Generally low-risk drinking, but with a spike in risky drinking immediately after retirement (12% of the sample).
(3) Consistent high-risk drinking with a gradual reduction across retirement (7%).

The authors found important sociodemographic differences among these drinking groups. Those in the consistent (yet gradually declining) risky drinking group were more likely to be male; with higher socioeconomic status and higher education level; a current or former smoker; experiencing mental health issues and reporting job strain; working in a city; and undertaking limited physical activity. Those in the group with a temporary increase in retirement-related drinking shared some of these same characteristics, but could be differentiated from consistent risky drinkers in that they had lower socioeconomic status and education levels; were more likely to be former smokers; and were less likely to work in a city.

These findings resonate the results reported by Moore et al. [14] and Platt, Sloan and Costanzo [15] who independently found distinct groups of drinkers in an older cohort from the United States. In both studies, high or increasing alcohol use was more likely to occur in individuals who were male; of European ethnicity; single; with higher socioeconomic status and education; and current smokers.

These findings suggest that subgroups of drinkers that are likely to exist within older adult populations can be differentiated based on critical sociodemographic and health characteristics. This offers a valuable potential vector for health professionals in their screening of older adults' alcohol use patterns, and their aim to identify those with potentially hazardous drinking behaviours.

1.2 The existing evidence in New Zealand

In their comprehensive literature review of alcohol use in older New Zealanders, Hodges and Maskill [16] highlighted the lack of available data with which to undertake extensive modelling of older New Zealanders' drinking patterns. Historically, older adults (aged 65+) were

excluded from national-level alcohol and drug use surveys between 2000 and 2010. While the reports themselves offer no rationale for this, such age-related exclusion is common worldwide and reflects on-going and concerning ageism in alcohol-related policy, research and service provision.[17]

However, more recent New Zealand efforts to explore older adults' alcohol use across time have been undertaken and reveal similar findings to international studies. Specifically, McKenzie, Carter and Filoche [18] used multiple waves from Statistics New Zealand's *Survey of Family, Income & Employment* (SoFIE) dataset to explore time-related drinking patterns in older New Zealanders. They found that New Zealand's older population expresses a range of drinking behaviours from abstention to light drinking, through to heavy or risky drinking. Furthermore, alcohol use was higher among older adults who were male, healthier and wealthier. Lastly, they found that across an 8-year timeframe, the rate and level of drinking were stable with minimal change.

Despite this recent work exploring older adult drinking habits in New Zealand, a lot remains unclear. Specifically, it is not clear whether different yet consistent drinking profiles exist within the older adult population (e.g., abstainers, low-risk drinkers, moderate drinkers). Furthermore, it is important, from a public health screening and intervention perspective, to assess whether individuals with particularly risky drinking profiles might be distinguishable from non-risky drinkers based on key sociodemographic and health factors.

There is one dataset in New Zealand that has both the sample size, longitudinal data collection waves, and multitude of predictor variables to facilitate an extensive review of the longitudinal patterns and predictors of alcohol use in older adults: The New Zealand *Health, Work & Retirement Longitudinal Study* (NZHWR).

2.0 Aims of the current study

The current study intended to fill the gap between international research and existing national studies by exploring whether distinct drinking profiles existed within a sample of older New Zealanders; whether those drinking profiles were stable or drinking patterns changed across time; and whether such drinking profiles could be differentiated based on key sociodemographic and health-related factors.

Using the NZHWR longitudinal data from 2006 to 2016, the aims of the study were two-fold:

1. To identify whether distinct groups of New Zealand older adults could be identified based on their drinking patterns, and
2. If so, to identify whether these distinct groups of drinkers could be differentiated based on their sociodemographic and health characteristics.

3.0 The longitudinal dataset & measurements used

In order to identify the existence of distinct groups of New Zealand older drinkers, we used ten years of data (constituting six data waves from 2006 to 2016) from the NZHWR. [1]

The Massey University-based NZHWR is a government-funded study established in 2006 to follow thousands of New Zealanders aged 55-70 biennially to understand factors that determine health and independence in older adults, and aims to assess current health, wealth, social, working and demographic status of older New Zealanders.

Subsequent waves (from 2010 onward) expanded the age range of the sample to include New Zealanders aged 50 years and over. The NZHWR is a national-level study of healthy ageing reflective of New Zealanders aged 50 and over. The collection of data for the NZHWR relies on both postal survey of the sample and face-to-face interviews of a subsample of participants.

3.1 The NZHWR 2006-to-2016 sample

In order to use as many cases from across the ten years of data collection as possible, we included all individuals in the study who had started in 2006 (baseline) and had participated in *at least* two waves of the NZHWR.

Table 1 provides an overview of the demographics of the sample at baseline in 2006 in comparison to the 2006 New Zealand population aged 50 years and over. The NZHWR 2006 sample was broadly reflective of the wider 50 years and over population, though there were slightly more workers in the NZHWR sample. The NZHWR specifically over-samples Māori resulting in a greater Māori proportion than in the general population aged 50 years and over. This disparity in ethnicity is unlikely to reduce the representativeness of our results, given that our previous report (1) illustrates that ethnicity itself is not a driver of differential drinking patterns.

Table 1: Characteristics of the NZHWR longitudinal sample & NZ comparison population

	NZHWR longitudinal sample (2006)	NZ population aged 50+ (2006)
Demographics		
N	2,632	1,211,118
Mean age (S.D)	61.08 (4.53)	
% Female	53.4	52.7
% Māori	50.7	6.8
Employment status		
Working	66.3	48.8
Retired	21.7	47.2
Other	12.0	4.0
Marital Status		
Married/partnered	72.5	69.8
Divorced/separated	15.1	13.6
Widow/widower	8.2	13.1
Single/never married	4.5	4.5
Educational qualifications		
No qualification	33.2	32.4
High School	23.5	33.5
Post-High School/Trade	31.4	23.8
Tertiary	11.9	10.3

[1] Dr Andy Towers (report co-author) is a member of the Massey University team managing the NZHWR study. Access to the NZHWR data by the collaboration authoring this report was facilitated through Dr Towers.

3.2 The measurement of alcohol use in all NZHWR waves

The NZHWR has used the *Alcohol Use Disorders Identification Test – Consumption* (AUDIT-C) [19] screen to assess alcohol use in all waves from baseline in 2006. The AUDIT-C is a 3-item abbreviated form of the AUDIT [20] which is one of the world's most well-validated screening tools of risky or hazardous drinking. The AUDIT has been a key alcohol use screen for previous New Zealand alcohol use surveys [21]; is appropriate for use in older adults [22]; and recommended for use in New Zealand primary health care settings. [23, 24]

The AUDIT-C specifically focuses on 'consumption' indicators: the frequency and typical quantity of alcohol use, and the frequency of binge drinking. The 3-item AUDIT-C is equivalent to the 10-item AUDIT in identifying hazardous drinkers across a range of populations [25]; is recommended for use in primary health care by the United States National Institute on Alcohol Abuse and Alcoholism [26]; and has already been used in New Zealand older adult population surveys. [2] For the purpose of this report, which focuses on trends in drinking patterns over time, all non-drinkers at baseline were removed from the dataset.

The AUDIT-C items are as follows:

The questions from the AUDIT-C
1. ***Frequency:*** *How often do you have a drink containing alcohol?* 2. ***Quantity:*** *How many drinks containing alcohol do you have on a typical day when drinking?* 3. ***Binge drinking:*** *How often do you have six or more drinks on one occasion?*

3.3 The covariates identified for analysis

All covariates were based on self-report; however, age, gender, and Māori descent were cross-validated against participants' information registered in the Electoral Roll. The most recent NZHWR technical report provides significantly more detail regarding the longitudinal process of cross-validation for those interested. [27]

Additional demographic covariates included: marital status (married or in de facto relationship vs. neither married nor in de facto relationship); work status (working full- or part-time, retired, and other); educational qualification (no qualification, secondary school, post-secondary/trade certificate, tertiary); and place of residence (rural vs. urban).

Financial and economic wellbeing was assessed using the short form version of the 'Economic Living Standards Index' (ELSI) developed by the New Zealand Ministry of Social Development. [28]

Health-related covariates included: physical and mental health measured by the Short Form Health Survey 12v2 (SF12v2) [29]; number of alcohol-related chronic conditions diagnosed by a health care professional; and smoking (current smokers, past smokers, life-time non-smokers).

A more detailed description of the measures is reported in Appendix 1.

3.4 The analysis: Latent growth curve modelling, growth mixture modelling, and multinomial logistic regressions

To gain a better understanding of older New Zealanders' drinking patterns, we employed latent growth curve analysis and growth mixture modelling. In order to ascertain whether change in drinking frequency, quantity and bingeing over a 10-year period was steady or

changing, we employed Latent Growth Curve analysis testing both linear and non-linear change trajectories. [30] Next, we employed Growth Mixture Modelling, which allows researchers to identify subgroups (also called profiles) of individuals who demonstrate *similar* change trajectories over time along a number of dimensions. [31] In this case, we aimed to explore groups of older adults whose scores in terms of quantity and frequency of drinking were similar over a 10-year period. Finally, data were subjected to a Multinomial Logistic Regression analysis to determine which sociodemographic and health-related variables were predictive of profile membership. For a more detailed description of the data analytic plan, see Appendix 2.

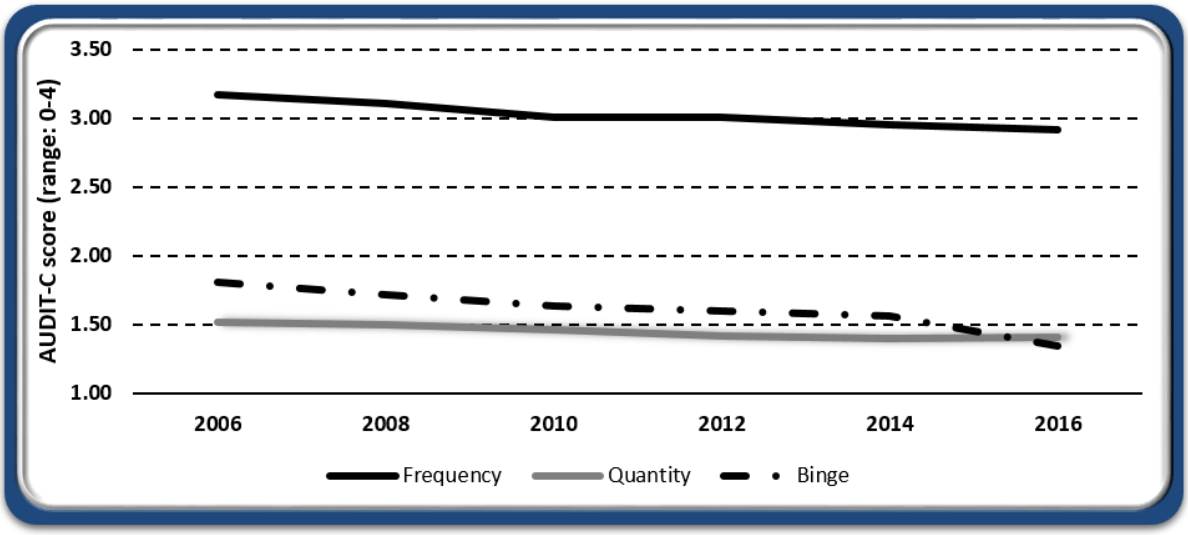
4.0 Results of the study

4.1 Alcohol use over time: Assessing the general stability of the measures

In order to understand the direction and rate of change in alcohol use across ten years of data from the NZHWR, we first estimated the trajectory of the three separate alcohol use variables (i.e., average levels of drinking frequency, quantity consumed and binge drinking frequency) to identify whether there was any observable change from 2006 to 2016.

Figure 2 illustrates the average of the change in frequency of alcohol use, the quantity consumed and the rate of binge drinking for the entire NZHWR sample between 2006 and 2016. There appeared to be a slight decrease in all drinking variables across this timeframe, with a particular drop in binge drinking between 2014 and 2016.

Figure 2: Univariate model of NZHWR alcohol use variables across 10 years for entire longitudinal sample



Analyses (see Table 5 in Appendix 2) indicated that both the frequency of alcohol use and the average quantity consumed could be explained with a *linear* model (i.e., a gradual reduction over time in both). However, binge drinking best reflects a *quadratic* model such while it gradually decreased between 2006 and 2014, it decreased more rapidly between 2014 and 2016. This suggests that the relative frequency of drinking and average quantity consumed by this sample is slightly declining, but that binge drinking has recently reduced in a more rapid rate.

4.2 Identifying specific drinking profiles

Subsequent to exploring the general trend in alcohol use across time for the entire sample, our goal was to assess whether specific subgroups of older drinkers existed within the wider sample who shared similar patterns of drinking across time (e.g., high frequency but low quantity). Identifying such groups would allow us to understand:

- whether distinct groups of older drinkers exist
- the characteristics of distinct drinking frequency and quantity patterns
- the proportion of older adults characterized by specific drinking patterns
- if these drinking patterns have distinct sociodemographic and health-related correlates.

We attempted to identify distinct drinking profiles using all three alcohol use variables (frequency, quantity, and binge) available for the NZHWR sample. However, the difference in patterns between drinking frequency and quantity (linear trajectory) and binge drinking (quadratic trajectory) resulted in models with poor statistical 'fit'.

We thus dropped the binge drinking variable from our model, and proceeded to model drinking profiles based on the combination of drinking frequency and quantity. Individuals with risky drinking tendencies such as binge drinking would still be identified in the frequency-quantity based model, and the emerging drinking profiles clearly indicate subgroups of drinkers with binge drinking tendencies.

Using the revised 'frequency-quantity' approach, we compared models with a range of different drinking profiles (see Table 6 in Appendix 2). The 5-profile model produced the most statistically and theoretically sound solution. The general characteristics of the five profiles are highlighted in Figure 3 below.

Figure 3: Overview of the five profiles of older New Zealand drinkers

Profiles of Older Drinkers	Characteristics	Description
1	Low Frequency of Drinking Low Quantity per Occasion (34.8%; n = 915)	A group with a low frequency of drinking, low levels of consumption on days when they do drink, and who experience a small but gradual decrease over time in both drinking frequency and quantity.
2	High Frequency of Drinking Low Quantity per Occasion (30.1%; n = 791)	A group of very frequent drinkers who consume low amounts on each drinking occasion, and show no change (increase or decrease) in the frequency or quantity of alcohol use over time.
3	Moderate Frequency of Drinking High Quantity per Occasion (4.7%; n = 124)	A very small group of drinkers who drink with moderate frequency and they consume a lot on occasions when they do drink (infrequent heavy drinkers). However, both the frequency of drinking and the quantity consumed per occasion reduces across time.
4	Moderate Frequency of Drinking Low Quantity per Occasion (22.6%; n = 594)	A group that tends to drink with moderate frequency, consumes low quantity per drinking occasion, and both drinking frequency and quantity gradually decrease across time.
5	High Frequency of Drinking High Quantity per Occasion (7.9%; n = 207)	A small group of older drinkers who drink frequently and consume a high quantity of alcohol on each drinking occasion (frequent heavy drinkers). Also, while the average quantity consumed decreases slightly over time, the frequency of drinking does not.

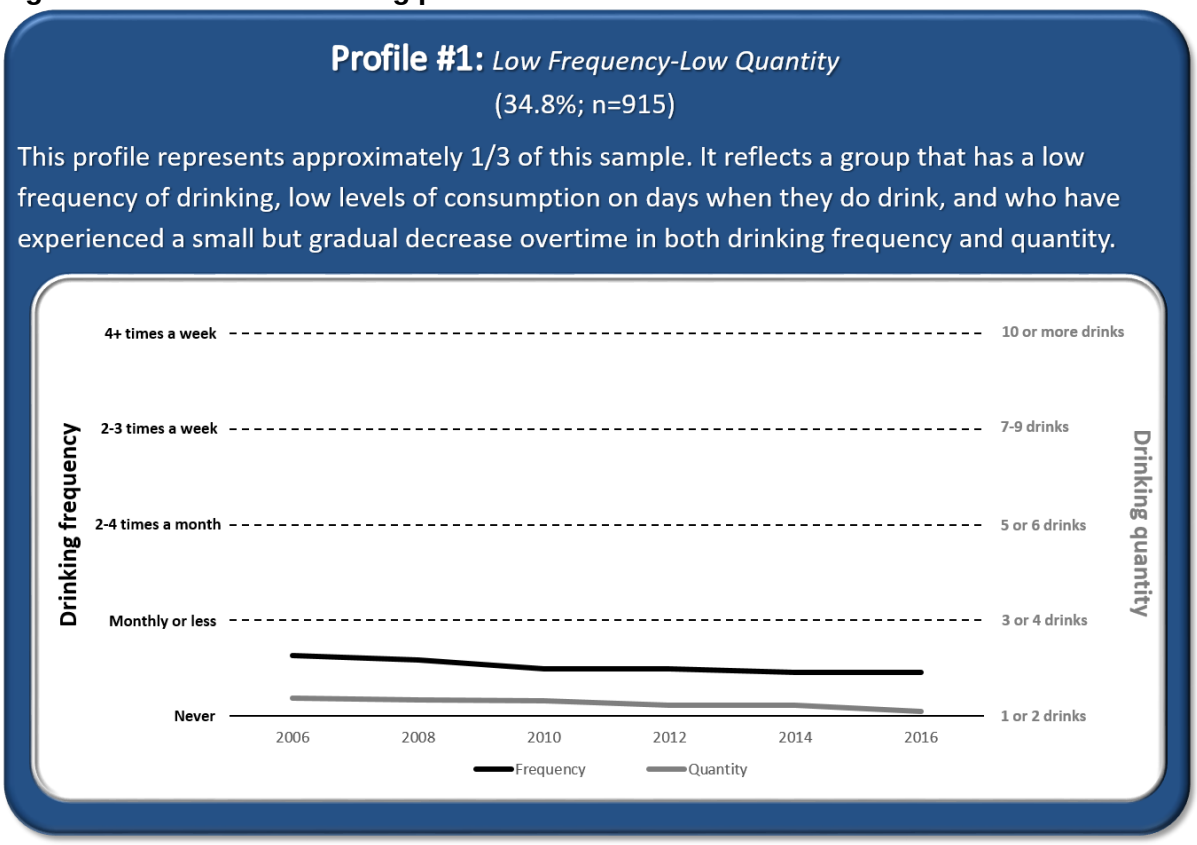
Note: Profile numbers indicate the order in which drinking groups emerged from the analysis - they are not suggesting increasing risk.

Figures 4 to 8 display the longitudinal trajectories of drinking frequency and quantity for the five distinct profiles of older drinkers across time. Each graph illustrates the 'average' level of drinking frequency and quantity for older adults with that profile in each year of the study. Consequently, some graphs will illustrate drinking frequency and/or quantity levels that fall

between levels of the scale (e.g., between '1 or 2' drinks and '3 or 4' drinks). This simply reflects the *statistical* averaging of individual responses and indicates that grouped responses tended to fall across these scale anchors.

The results in Figures 4 to 8 illustrate that the five profiles have distinct patterns of drinking frequency and average consumption quantity. While some patterns were stable across time (e.g., Profile 2), others show decreases either in frequency or in quantity consumed or both (e.g., Profile 3). What is potentially concerning is the finding that two of these profiles (Profiles 3 and 5) reflected small groups of older drinkers who, when drinking, consumed 5-6 drinks on each occasion. The Health Promotion Agency advises people to drink no more than 4 (for women) and 5 (for men) standard drinks on a single occasion to reduce the risk of injury[2].

Figure 4: Older adult drinking profile #1



[2] https://www.alcohol.org.nz/help-advice/advice-on-alcohol/low-risk-alcohol-drinking-advice

Figure 5: Older adult drinking profile #2

Profile #2: *High Frequency-Low Quantity*

30.1% (n=791)

Representing almost a further 1/3 of this sample this profile reflects the popular conception of older adult drinkers as frequent but low-quantity consumers. There is no perceptible change (increase or decrease) in the frequency or quantity of alcohol use over time.

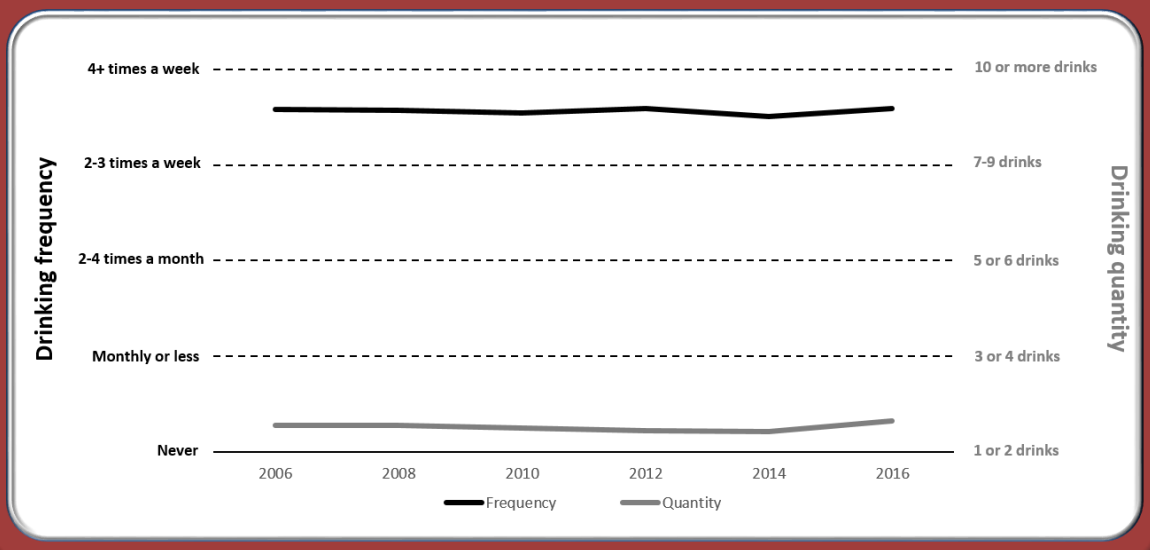


Figure 6: Older adult drinking profile #3

Profile #3: *Moderate Frequency-High Quantity*

4.7% (n=124)

This reflects a very small group of older adults who drink moderately frequently but when they do drink they consume a lot on each occasion. Both the frequency of drinking and the quantity consumed per occasion reduces across time.

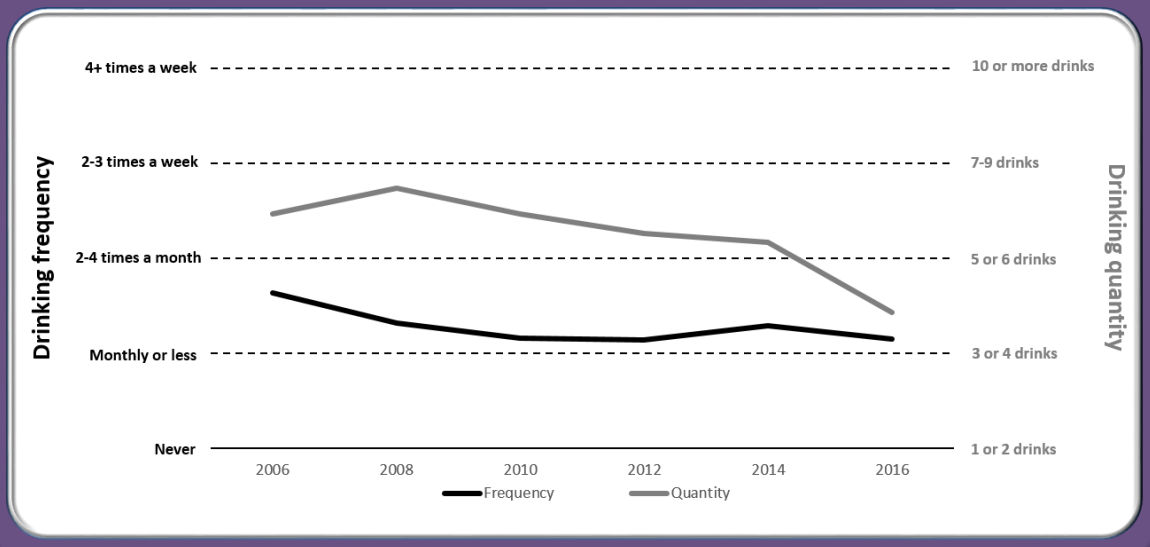


Figure 7: Older adult drinking profile #4

Profile #4: *Moderate Frequency-Low Quantity*

22.6% (n=594)

This profile represents approximately 1/4 of this sample of older New Zealanders. This group of drinkers tends to drink with moderate frequency, consumes low quantity per drinking occasion, and both drinking frequency and quantity gradually decrease across time.

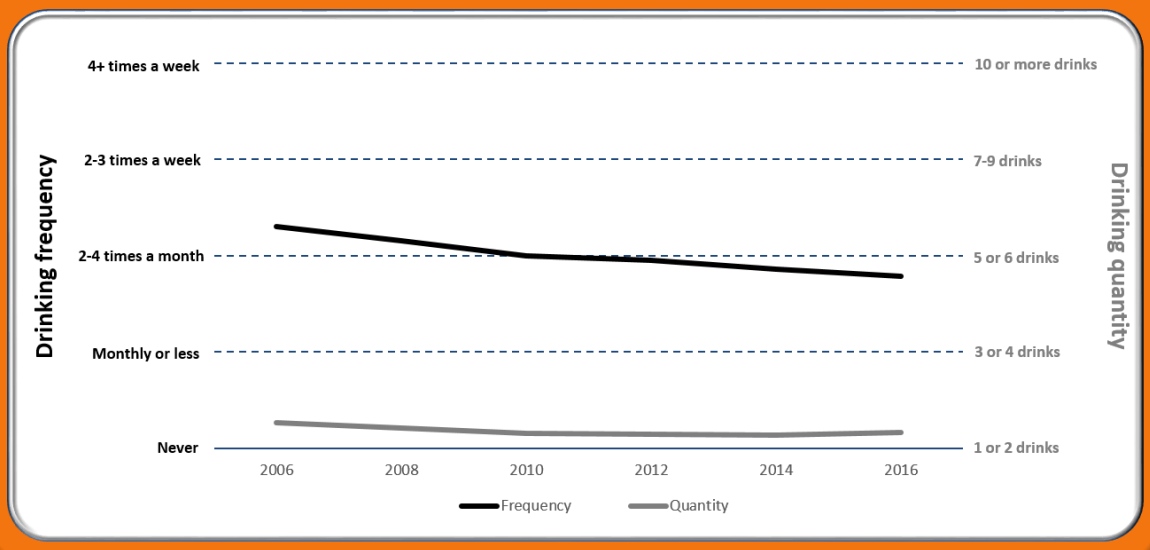


Figure 8: Older adult drinking profile #5

Profile #5: *High Frequency-High Quantity*

7.9% (n=207)

This profile reflects a small sub-set of older drinkers who drink frequently and consume a high amount on each drinking occasion. While the average quantity consumed decreases slightly over time the frequency of drinking does not.

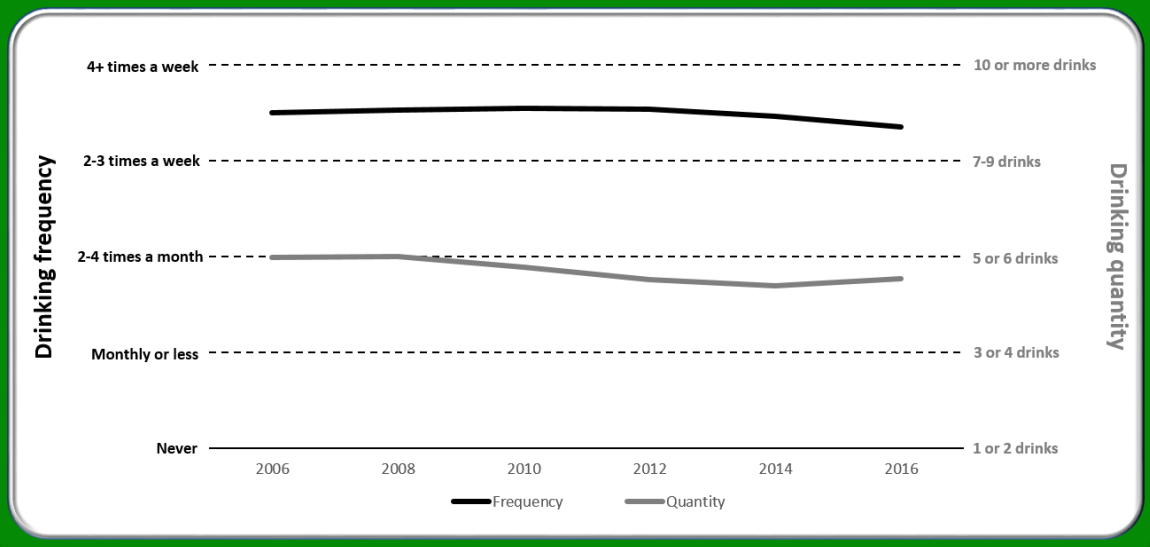


Table 2: A demographic breakdown of each of the five drinking profiles					
	Profile 1	**Profile 2**	**Profile 3**	**Profile 4**	**Profile 5**
	Low Frequency – Low Quantity	*High Frequency – Low Quantity*	*Moderate Frequency – High Quantity*	*Moderate Frequency – Low Quantity*	*High Frequency – High Quantity*
Age: *mean (standard deviation)*	61.35 (4.58)	61.22 (4.57)	60.31 (4.42)	60.94 (4.50)	60.17 (4.22)
Gender					
Female	70.1%	45.8%	36.3%	55.2%	13.5%
Male	29.9%	54.2%	63.7%	44.8%	86.5%
Educational Qualification					
No qualification	41.7%	21.0%	63.8%	28.2%	39.8%
Secondary school	22.4%	24.9%	14.7%	25.8%	21.9%
Post-secondary/trade	27.2%	36.7%	19.0%	33.8%	29.4%
Tertiary	8.7%	17.3%	2.6%	12.2%	9.0%
Marital Status					
Married or de facto	64.7%	81.3%	54.8%	74.0%	76.4%
Not married nor de facto	35.3%	18.7%	45.2%	26.0%	23.6%
Work Status					
Retired	30.2%	23.8%	20.2%	20.1%	20.8%
Working	69.8%	76.2%	79.8%	79.9%	79.2%
Place of Residence					
Rural	21.1%	19.9%	21.8%	18.8%	23.8%
Urban	78.9%	80.1%	78.2%	81.2%	76.2%
Economic Living Standard					
Hardship	26.2%	5.0%	38.1%	12.5%	13.0%
Comfortable	37.8%	27.7%	29.9%	38.1%	29.2%
Good	36.0%	67.3%	32.0%	49.4%	57.8%

Note: All % reflect column (within profile) proportions not row (between profile) proportions

Table 2 on page 13 provides a breakdown of the basic sociodemographic characteristics of each of these five profiles. Approximately 70% of the drinkers in Profile 1 (Low Frequency-Low Quantity) were female, which stands in direct contrast to Profile 5 (High Frequency-High Quantity) of which females constituted less than 14%. Further, approximately 64% of those in Profile 3 (Moderate Frequency-High Quantity) had no school qualifications in comparison to only 21% of Profile 2 drinkers (High Frequency-Low Quantity). However, these were only *potential* disparities in sociodemographic characteristics, and required further statistical assessment as to their ability to predict actual differences among drinking profiles.

4.3 Predicting profile membership

Next, we explored differences in sociodemographic composition among drinking profiles. Specifically, we used multinomial logistic regression to compare the characteristics of members of Profiles 2 through 5 with the characteristics of members in Profile 1 (low frequency-low quantity). This indicates the degree to which each profile is unique in comparison to Profile 1, or whether they share common sociodemographic characteristics. The blue box below provides the sociodemographic characteristics of Profile 1 members from Table 2, against which all other profiles were compared.

Profile 1

(Low Frequency-Low Quantity)

- **Average age**: 61
- **Gender**: 70% Female
- **Marital status**: 65% married/partnered
- **Work status**: 70% working
- **Education**: 64% high school only or no qualifications
- **Place of residence**: 79% urban
- **Living Standard**: 74% comfortable or good level

The results of the initial model indicated that, despite apparent differences in Table 2 among profiles in marital status, work status and place of residence, none of these three characteristics could reliably differentiate among profiles. This means that members of drinking Profiles 2 through 5 were statistically just as likely as those in Profile 1 to be married/partnered, be working, and be living in a city or large town (See Appendix 2 for the actual statistical calculations and model outcomes).

We then excluded these three factors from our analysis and re-ran our model. The revised model indicated that membership in Profiles 2 through 5 could be reliably differentiated from membership of Profile 1 based on age, gender, education level, and economic living standard. Table 3 on the following page illustrates the key differences in sociodemographic characteristics that could be used to differentiate members of Profiles 2 through 5 from the members of Profile 1 who were low frequency and low quantity drinkers.

In general, compared to those in profiles with more frequent and/or higher quantity drinking, our lowest level drinkers (Profile 1) tended to be slightly older, female, and have a lower economic living standard.

Table 3: The meaningful demographic differences between Profiles 2-5 in comparison to characteristics of Profile 1 members				
	Profile 2	**Profile 3**	**Profile 4**	**Profile 5**
	High Frequency – Low Quantity	*Moderate Frequency – High Quantity*	*Moderate Frequency – Low Quantity*	*High Frequency – High Quantity*
Age	No difference to Profile 1	Slightly more likely to be younger	No difference to Profile 1	Slightly more likely to be younger
Gender	More likely to be male	Much more likely to be male	More likely to be male	Much more likely to be male
Educational qualification	Much more likely to have higher educational qualifications	More likely to have lower educational qualifications	Slightly more likely to have higher educational qualifications	Slightly more likely to have lower educational qualifications
Economic living standard	Slightly more likely to have a higher living standard	No difference to Profile 1	Slightly more likely to have a higher living standard	Slightly more likely to have a higher living standard

Finally, we assessed the accuracy of our classification of participants into the five profiles based solely on information about their age, gender, education level, and economic living standard. The results in Table 4 indicate that the classification for Profiles 1 and 2 would be relatively accurate (64% and 71%, respectively). This is not surprising given the large size of these profiles. However, for Profiles 3 and 4, we would not be able to identify group members just based on these sociodemographic data, and classification was also poor for Profile 5 (4%). This suggests that other variables beyond age, gender, education level, and economic living standard are responsible for dictating membership of the last three drinking profiles.

Table 4: Accuracy of profile classification based solely on age, gender, education level and living standard

	Predicted Profile Membership					
Observed Profile Membership	Profile 1	Profile 2	Profile 3	Profile 4	Profile 5	Percent Correct
Profile 1	483	275	0	0	2	63.6%
Profile 2	218	530	0	0	3	70.6%
Profile 3	49	39	0	0	5	0.0%
Profile 4	234	297	0	0	3	0.0%
Profile 5	43	130	0	0	7	3.9%
Overall Percentage	44.3%	54.8%	0.0%	0.0%	0.9%	44.0%

4.4 Potential clinical implications

These results suggest that those seeking to identify older drinkers consuming at higher frequency (but not higher quantity) should consider screening males who are at the younger stage of older adulthood (i.e., approximately between the ages of 60-70), with a moderate to high level of education, and who likely have a high economic living standard.

4.5 Comparing levels of health & health behaviours across drinking profiles

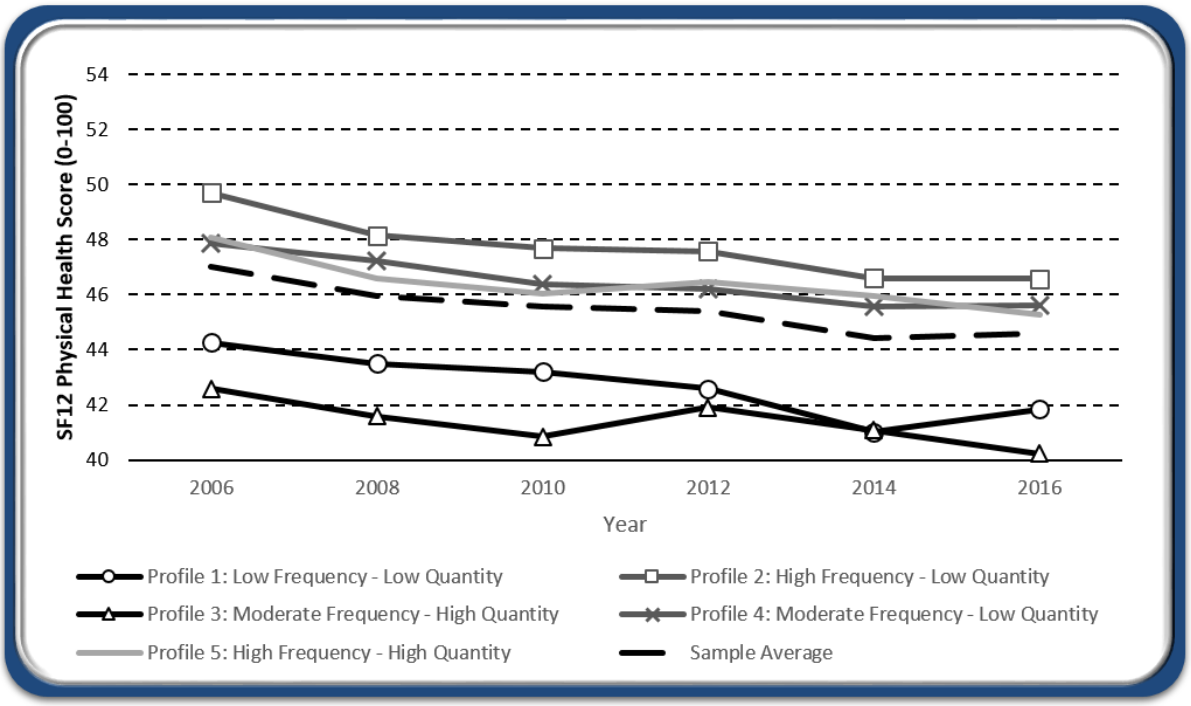
Having identified key sociodemographic similarities and differences in the membership of each drinking profile, we then assessed whether profiles could be differentiated based on levels of health and health behaviours.

4.5.1 Physical & mental health trends

Levels of physical health are strongly associated with alcohol use in the existing international literature, both as a correlate and a likely outcome of risky or long-term alcohol use. [32]

Figure 9 illustrates the levels of physical health for each of the five drinking profiles at baseline and across the subsequent 10 years, with higher SF12 scores indicating better physical health. It is clear that the five profiles did not share the same level of health at baseline, and that these differences between groups were largely maintained across time.

Figure 9: Physical health trends for each drinking profile from 2006 to 2016



Our analysis showed that there was a significant difference among profiles in levels of physical health at baseline in 2006.[3] Specifically, those in Profile 1 (Low Frequency-Low Quantity) and Profile 3 (Moderate Frequency-High Quantity) had significantly lower physical health scores than the other three profiles. Those in Profile 2 (High Frequency-Low Quantity) reported significantly better physical health than all profiles, except Profile 5 (High Frequency-High Quantity).

Over the 10 years of study, levels of physical health significantly declined for those in Profiles 1, 2, 4, and 5 which is a general pattern of age-related physical health decline found around the world.[33] In contrast, those in Profile 3 (Moderate Frequency-High Quantity) had levels of physical health that started low and remained low over the course of the study, with no statistically significant change.

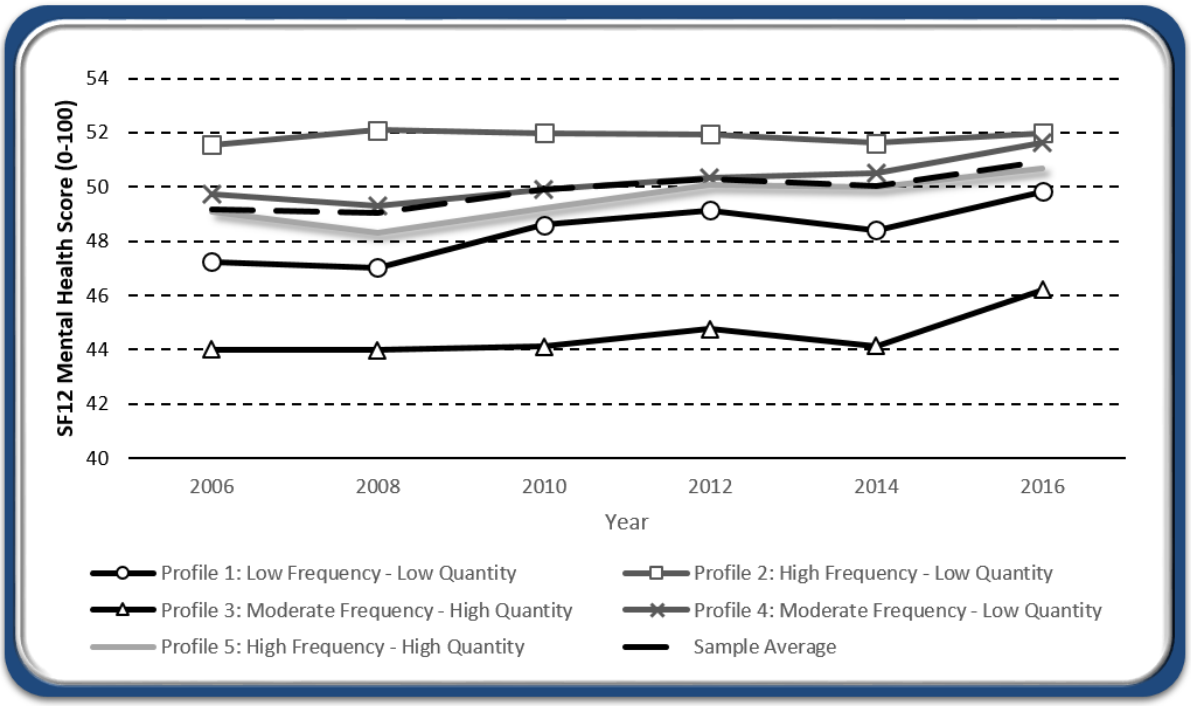
[3] $F(4,2376) = 37.44$, $p < .001$, $\mu^2 = 0.06$

The finding that older adults consuming at higher frequency but lower quantity (i.e., commonly associated with 'moderate' drinking) have better health than other drinkers may appear to reflect the common assumption that moderate drinking is protective of health. However, we would advise strongly against making this assumption. It is more likely that these trends reflect distinctions among drinking profiles in the levels of economic living standards.

Recent research in New Zealand shows that apparent health benefits of moderate drinking is actually the result of older moderate drinkers being wealthier than other drinking groups and, therefore, being able to afford healthier lifestyles.[34] In line with that finding, our results in Table 3 show that older drinkers in Profiles 1 and 3 did have significantly lower levels of economic living standards than those in other drinking profiles. In this respect, we suggest that differences in physical health among profiles are likely to be driven by disparities in wealth, rather than drinking pattern. This is also consistent with later findings in this report concerning the links between risky drinking and chronic health conditions.

Figure 10 illustrates the differences among drinking profiles in the levels of mental health both at baseline and across the 10 years of study, with higher SF12 scores indicating better mental health.

Figure 10: Mental health trends for each drinking profile from 2006 to 2016



Disparities in mental health levels resembled those seen with physical health, with the five profiles displaying markedly different levels of mental health at the start of the study in 2006.[4] Again, those in Profile 3 (Moderate Frequency-High Quantity) had significantly poorer mental health at baseline than the other four profiles. Those in Profile 2 (High Frequency-Low Quantity), on the other hand, showed significantly better mental health than the rest of the profiles.

[4] $F(4,2376) = 23.03$, $p < .001$, $\mu^2 = 0.04$

Mental health trajectories were stable for Profiles 1, 2, 3, and 5, indicating no significant increase or decrease in mental health over 10 years. For Profile 4 (Moderate Frequency-Low Quantity), results revealed a slight significant increase in mental health from 2008 to 2016.

4.5.2 Chronic conditions related to alcohol use

Figure 11 displays the percentage of those indicating three or more alcohol-related chronic conditions (i.e., cancer; diabetes, blood pressure; heart trouble; and stroke) in each profile across 10 years of the study.

There was a significant difference among profiles in reporting three or more alcohol-related chronic conditions in any of the data collection waves.[5] One quarter of participants in Profile 3 (Moderate Frequency-High Quantity) reported three or more chronic conditions in one or more data collection waves. This contrasts with the lower proportion of such conditions in Profile 1 (19%; Low Frequency-Low Quantity), Profile 2 (7%; High Frequency-Low Quantity), Profile 4 (11%; Moderate Frequency-Low Quantity), and Profile 5 (10%; High Frequency-High Quantity), which suggests that Profile 3 is a distinct group of sick older drinkers.

This suggests that higher levels of alcohol-related chronic conditions are evident in the profile characterised by moderately frequent but decreasing consumption levels (Profile 3). Previous research shows that the onset of alcohol-related chronic conditions we measured (i.e., cancer, diabetes, blood pressure, heart trouble and stroke) are likely to trigger a significant reduction or total cessation in drinking in older populations. [(9, 35-38)] Furthermore, the finding that those in Profile 1 (the least risky drinkers) have the second highest levels of such conditions may actually support this suggestion. It is possible that those in Profile 1 (the least risky drinkers) may be reporting high rates of alcohol-related chronic conditions, partly because they *were previously* drinking at more risky levels prior to entry into this study.

4.5.3 Smoking status

We compared the proportion of smokers in each of the five drinking profiles with the results illustrated in Figure 12. Our analysis indicates a significant difference among profiles in smoking status.[6] The results in Figure 12 highlight that drinking quantity rather than frequency is strongly associated with smoking status. Specifically, those profiles whose members consumed the highest average quantity (Profiles 3 and 5) were much more likely to be active smokers than members of the other profiles.

The largest proportion of active smokers was in Profile 3 (Moderate Frequency-High Quantity), with over one-third of members being active smokers in each data collection wave. This stands in contrast to Profile 4 (Moderate Frequency-Low Quantity), where the proportion of active smokers never exceeded 15% in any given wave and was often less than 10%.

[5] χ^2 (4) = 70.83, p < .001, Cramer's V = .164
[6] χ^2 (4) = 109.27, p < .001, Cramer's V = .204

Figure 11: Proportion in each profile that report three or more chronic health conditions

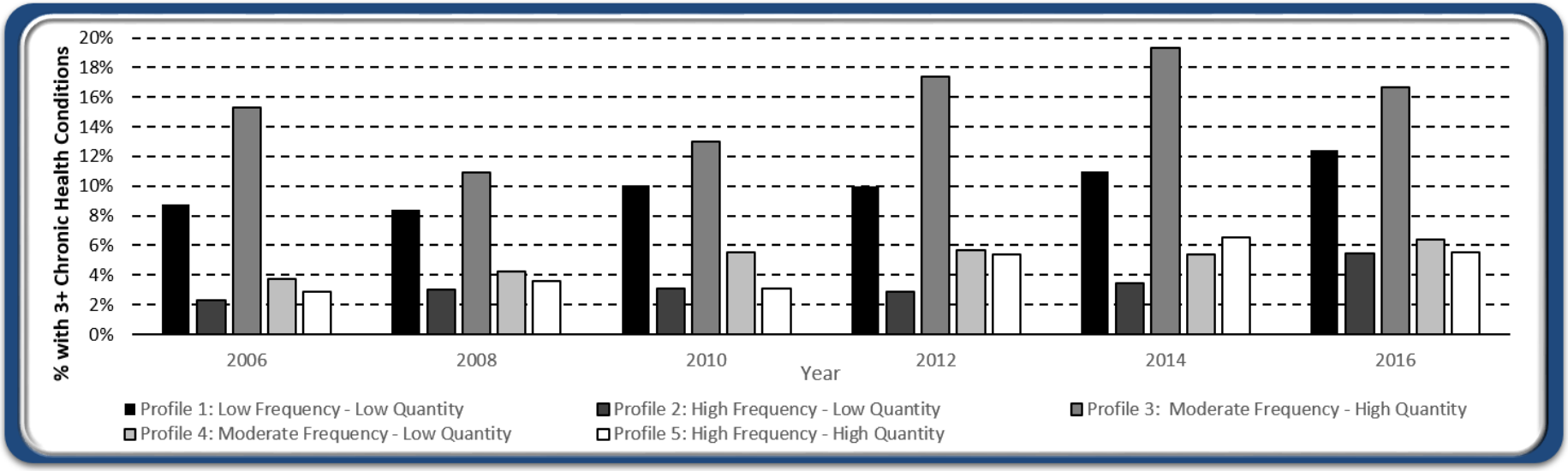
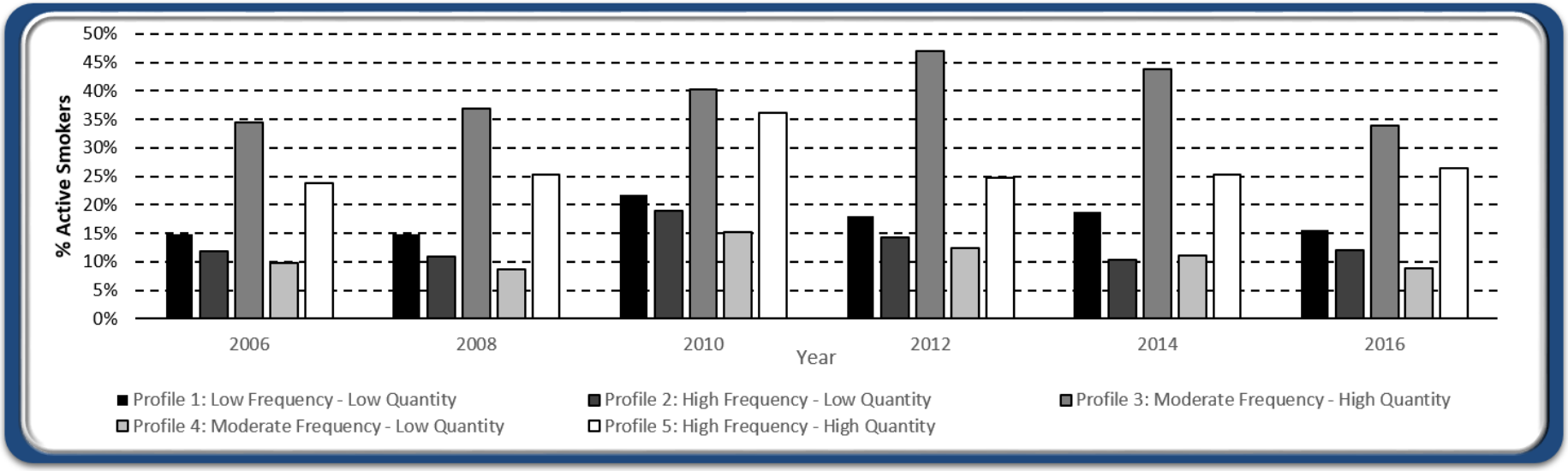


Figure 12: Proportion of active smokers in each profile across 10 years



Appendix 1

Description of sociodemographic and health-related covariates

Gender, age and ethnicity: The gender and date of birth reported by participants are assessed for consistency against those previously reported (gender, date of birth) and information from the Electoral Roll (gender, year of birth range). Information on Māori descent is populated from the Electoral Roll but participants complete a longer section on Māori identity. We use the Māori descent indicators here because oversampling was based on descent as opposed to self-identification.

Marital status: Participants' marital status was included in all NZHWR waves as a checklist containing the following six categories: legally married; civil union/de facto/partnered relationship; permanently separated from legal spouse; divorced or marriage dissolved; widow/widower; and never legally married. For analytical purposes, the first two and the last three response options were combined into married or in de facto relationship and neither married nor in de facto relationship categories.

Work status: Work status was assessed in all NZHWR waves using a checklist containing the following categories: full time paid employment (including self-employment); part-time paid work (including self-employment); retired with no paid work; full-time homemaker; full-time students; unemployed and seeking work; and not in the workforce – other. For analytical purposes, three broader categories were created: working (full- or part-time), retired, and other.

Highest educational qualification: In all waves of the NZHWR, participants were asked to indicate their highest level of attained educational qualification using the following four categories: no qualification; secondary school; post-secondary/trade certificate; tertiary.

Place of residence: Participants' categorisation into either rural or urban residence was based on participant address and the corresponding meshblock unit for that address.

Economic living standard: The short form version of the 'Economic Living Standards Index' (ELSI) developed by the New Zealand Ministry of Social Development was used to assess financial and economic wellbeing. [28] ELSI is a multi-dimensional measurement tool assessing: restrictions on ownership of assets and social participation; economising behaviour; and self-reported satisfaction with standard of living. A total score can be derived by summing all items (range: 0 - 31) with higher scores indicating better financial and economic wellbeing.

Physical health and mental health: Participant levels of physical health and mental health were measured using the respective physical health and mental health component summary scores on the self-report SF-12v2. [29] The physical heath score reflects perceptions of four domains of physical wellbeing: physical functioning; physical limitations; bodily pain; and perceived general health. The mental health score reflects perceptions of four domains of mental wellbeing: vitality; social functioning; emotional problems; and perceived mental health. Participant physical and mental health summary scores were normed for the older New Zealand population using coefficients developed from the New Zealand Health Survey. [39]

Chronic health conditions: The calculation of total number of co-morbid health conditions experienced was based on the use of chronic condition checklists included in all waves of the NZHWR. For each iteration of this checklist across each NZHWR wave, participants were required to indicate whether a doctor, nurse, or other health care professional had told them they had any of the following health problems: skin cancer; other cancer; diabetes; epilepsy; blood pressure; heart trouble; asthma; respiratory conditions; ulcers; chronic liver trouble; bowel disorders; hernia or rupture; chronic kidney or urinary tract condition; chronic skin condition; arthritis or rheumatism; hepatitis; sight impairment; hearing impairment; and stroke. In our analyses, we focused only on the existence of specific conditions that previous research has linked to alcohol use, specifically: cancer; diabetes, blood pressure; heart trouble; and stroke.

Smoking status: Participants in all waves of the NZHWR were asked to indicate if they considered themselves to be a regular smoker (yes/no). Those who responded 'yes' were asked to indicate the number of cigarettes smoked on an average day. Non-regular smokers were asked to indicate if they had ever been a regular smoker (yes/no). For analytical purposes, two variables were created. The first one makes a distinction between current smokers and current non-smokers. The second variable further differentiates among current smokers, past smokers, and life-time non-smokers.

Appendix 2

Statistical analysis and data analytic plan

To gain a better understanding of older New Zealanders' drinking patterns, we employed latent growth curve analysis and growth mixture modelling. Latent growth curve analysis was used to model change in drinking frequency, quantity and bingeing over a 10-year period and tested both linear and non-linear change trajectories. [30] Latent growth curve models have two important parameters: intercept and slope. The intercept refers to the average baseline score, whereas the slope indicates the average rate of change over time.

The slope can be positive (gradually increasing over time), negative (gradually decreasing over time), or non-significant (stable over time). Importantly, with this technique, researchers can estimate non-linear change trajectories as well. For example, it is possible that quantity increases only up to a certain point when it slowly plateaus out.

Next, we employed growth mixture modelling. This data analytic strategy allows researchers to identify subsets of individuals who demonstrate similar change trajectories over time along a number of dimensions. [31] In this case, we aimed to explore groups of older adults whose scores in terms of quantity and frequency of drinking were similar over a 10-year period.

One of the main advantages of growth mixture modelling is that it accounts for heterogeneity in the sample. [40] As opposed to assuming that quantity and frequency of drinking are generally decreasing, increasing or stable in older adults, this data analytic technique is capable of detecting groups of individuals whose alcohol use might increase over time and simultaneously find groups with decreasing or stable alcohol use.

Finally, data were subjected to a multinomial logistic regression analysis to determine which socio-demographic and health variables were predictive of profile membership. One profile was selected to be the reference group. This means that the likelihood of being assigned to one of the profiles is relative to the likelihood of being assigned to the reference group based on socio-demographic characteristics or health variables.

Statistical analysis for the growth mixture models

Table 5 provides the results of our analysis to identify the model that best explains the patterns of alcohol use frequency, quantity and binge drinking for this sample between 2006 and 2016.

The results indicated that both the frequency of alcohol use and the average quantity consumed could be explained with a *linear* model. This suggests that any change over time in the frequency of use and the average quantity consumed is actually steady (in this case, a gradual reduction). However, these results also indicated that trends in binge drinking best reflected a *quadratic* model, such that trends abruptly change at points over time (in this case, a more rapid reduction in binge drinking in 2014 than seen prior to this point).

Table 5: Models explaining simple (univariate) change in alcohol use variables over time								
	χ2	df	χ2/df	CFI	RMSEA (90%CI)	SRMR	ΔCFI	Best Fit
Frequency								
Intercept	831.93	19	43.79	0.944	0.128 (.120; .135)	.052		
Linear	134.51	16	8.41	0.992	0.053 (.045; .062)	.018	0.048	✓
Quadratic	51.78	12	4.32	0.997	0.035 (.026; .046)	.014	0.005	
Quantity								
Intercept	307.63	19	16.19	0.952	0.079 (.071; .087)	.094		
Linear	101.91	16	6.37	0.986	0.047 (.038; .056)	.044	0.034	✓
Quadratic	55.47	12	4.62	0.993	0.039 (.029; .049)	.020	0.007	
Binge								
Intercept	939.17	19	49.43	0.874	0.139 (.131; .146)	.185		
Linear	231.67	16	14.48	0.970	0.073 (.065; .082)	.069	0.096	
Quadratic	119.15	12	9.93	0.985	0.059 (.050; .069)	.034	0.015	✓

Recommended thresholds for indices of model fit:

- **CFI** > .95
- **RMSEA** < .06 with the upper bound of the confidence interval lower than .08
- **SRMR** < .08
- CFI-difference test (**ΔCFI**): Model fit improved If increase in CFI > .01

Change in alcohol use over time: Growth mixture modelling

Subsequent to establishing the general trends in alcohol use for the entire sample across time, our goal was to assess whether cohorts of older drinkers existed who shared similar patterns of drinking across time.

Table 6 illustrates the fit indices for the five different models produced, comparing solutions with profiles ranging from 2 to 6. Technically the threshold for a viable profile is that each profile represents at least 5% of the sample. This 5-profile model includes one group (Profile 3), which only just reaches this threshold. However, we have chosen to retain this profile and the 5-profile solution because it is statistically and theoretically sound. The resultant profiles reflect very interesting and quantitatively discrepant groups of drinkers that will help inform our understanding of the very broad nature of drinking in older New Zealanders.

Table 6: Fit indices for the growth mixture models							
# of drinking profiles	LMR-LRT	AIC	BIC	ABIC	Entropy	Posterior Probabilities	Best Fit
2 profiles	10135.276***	56766.35	56889.73	56823.01	.936	.981-.984	
3 profiles	4204.604***	52464.97	52617.72	52535.11	.945	.954-.980	
4 profiles	2267.345***	50150.04	50332.17	50233.67	.916	.919-.967	
5 profiles	1653.67*	48464.37	48675.87	48561.49	.925	.924-.970	✓
6 profiles	1226.943 *ns*	47216.27	47457.15	47326.88	.924	.913-.970	

Recommended thresholds for indices of model fit:

- **LMR-LRT**: Model with this # of profiles produces significantly better fit than previous model.
- **AIC, BIC,** and **AIC**: Lower values indicate better fit
- **Entropy**: Above .80 but closer to 1.0 is best
- **Posterior probabilities**: Above .80 but closer to 1.0 is best

Multinomial logistic regression for assessing demographic differences in profile membership

The initial multinomial logistic regression analysis compared Profiles 2 through 5 with the demographic characteristics of Profile 1 using the demographic variables highlighted in Table 2. Table 7 offers an overview of the proportion of the sample represented by each of the five profiles, as well as an indication of the alcohol use frequency and quantity for each profile (including whether this frequency and quantity changes over time). This analysis indicated that marital status, work status, and place of residence were non-significant predictors. They were thus excluded from the final model.

Table 7: Descriptions of each drinking profile in the 5-profile model

	N	% of sample	Initial Drinking Frequency	Frequency slope	Initial Drinking Quantity	Quantity slope
Profile 1	915	34.8%	Low	-6.392***	Low	-5.202***
Profile 2	791	30.1%	High	-0.664, *ns*	Low	-0.219, *ns*
Profile 3	124	4.7%	Moderate	-2.116***	Moderate	-3.678***
Profile 4	594	22.6%	Moderate	-6.419***	Low	-4.053***
Profile 5	207	7.9%	High	-0.996, *ns*	Moderate	-2.324*

*p<.05; *** p<.001; *ns* = no significant change over time

Table 8 highlights the indicators of model fit for this final model. It reveals that the final model has a good statistical fit to the data, and that it is a significantly better fit than an intercept-only model. The likelihood ratio statistics indicated that each of the predictors in the final model had a significant effect on the overall model.

Table 8: Indicators of final model fit

	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Goodness-of-fit Indices				
Pearson	-	6841.043	7024	.940
Deviance	-	4771.776	7024	1.000
Model Fit Indices				
Intercept Only	5485.623			
Final	4915.850	569.773	16	.000
Individual Predictors				
Age 2006	4939.620	23.770	4	.000
ELSI Short Form Score 2006	5108.884	193.034	4	.000
Highest Educational Qualification 2006	4977.720	61.870	4	.000
Gender	5149.073	233.223	4	.000

Pseudo R-square results for this model indicate how well the predictors in the final model explain group membership. These results (Cox & Snell: 0.218; Nagelkerke: 0.232;

McFadden: 0.088) indicated that this model had some predictive power, but that the limited number of predictors did not necessarily explain the majority of variance in group membership

The results in Table 9 illustrate the parameter estimates in our multinomial logistic regression, indicating the degree to which each predictor differs statistically for each profile in comparison to Profile 1.

Table 9: Multinomial logistic regression results

In comparison to Profile 1		B	Std. Error	Wald	df	Sig.	Exp (B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Profile 2	Intercept	-2.378	.802	8.784	1	.003			
	Age Wave 1	-.009	.012	.568	1	.451	.991	.967	1.015
	ELSI 2006	.122	.010	140.091	1	.000	1.130	1.107	1.153
	Education	.258	.055	21.765	1	.000	1.294	1.161	1.442
	[Gender=Male]	-.860	.113	57.566	1	.000	.423	.339	.528
Profile 3	Intercept	4.770	1.632	8.539	1	.003			
	Age Wave 1	-.079	.026	8.879	1	.003	.924	.878	.973
	ELSI 2006	-.018	.015	1.563	1	.211	.982	.954	1.010
	Education	-.463	.126	13.597	1	.000	.629	.492	.805
	[Gender=Male]	-1.684	.239	49.659	1	.000	.186	.116	.297
Profile 4	Intercept	-.125	.826	.023	1	.880			
	Age Wave 1	-.024	.013	3.402	1	.065	.977	.952	1.001
	ELSI 2006	.058	.009	39.645	1	.000	1.059	1.041	1.079
	Education	.129	.058	4.919	1	.027	1.137	1.015	1.274
	[Gender=Male]	-.516	.120	18.470	1	.000	.597	.472	.755
Profile 5	Intercept	3.173	1.272	6.219	1	.013			
	Age Wave 1	-.079	.020	15.661	1	.000	.924	.888	.961
	ELSI 2006	.074	.015	23.185	1	.000	1.076	1.045	1.109
	Education	-.183	.088	4.292	1	.038	.832	.700	.990
	[Gender=Male]	-2.731	.239	130.731	1	.000	.065	.041	.104

Table 10 shows how accurately we could classify participants into the five profiles just based on information about their age, gender, education level, and ELSI score. Based on these analyses, we can conclude that age, gender, education and ELSI significantly differentiated among drinking profiles. However, they did so much better for Profiles 1 and 2, while they did not explain the profile configurations for Profiles 3 through 5.

Table 10: Accuracy of profile classification based solely on age, gender, education level and living standard						
		Predicted Profile Membership				
Observed Profile Membership	Profile 1	Profile 2	Profile 3	Profile 4	Profile 5	Percent Correct
Profile 1	483	275	0	0	2	63.6%
Profile 2	218	530	0	0	3	70.6%
Profile 3	49	39	0	0	5	0.0%
Profile 4	234	297	0	0	3	0.0%
Profile 5	43	130	0	0	7	3.9%
Overall Percentage	44.3%	54.8%	0.0%	0.0%	0.9%	44.0%

Exploring differential levels of physical and mental health for each profile and changes across time

Table 11 illustrates the results of pairwise comparisons between each pair of profiles with regard to their physical and mental health, and highlights significant differences. At baseline (2006), those in Profile 2 had significantly higher levels of physical health than all other profiles except Profile 5, and significantly higher levels of mental health than all other profiles.

Table 11: Pairwise comparison of baseline physical and mental health across profiles							
Pairwise Comparisons			Mean Difference	s.e.	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Physical Health 2006	Profile 1	Profile 2	-5.44*	0.50	0.00	-6.79	-4.09
		Profile 3	1.68	1.01	0.46	-1.07	4.43
		Profile 4	-3.62*	0.54	0.00	-5.09	-2.16
		Profile 5	-3.84*	0.79	0.00	-5.99	-1.68
	Profile 2	Profile 1	5.44*	0.50	0.00	4.09	6.79
		Profile 3	7.12*	1.01	0.00	4.35	9.88
		Profile 4	1.82*	0.55	0.01	0.32	3.31
		Profile 5	1.60	0.80	0.26	-0.57	3.77
	Profile 3	Profile 1	-1.68	1.01	0.46	-4.43	1.07
		Profile 2	-7.12*	1.01	0.00	-9.88	-4.35
		Profile 4	-5.30*	1.03	0.00	-8.12	-2.48
		Profile 5	-5.52*	1.18	0.00	-8.75	-2.28
	Profile 4	Profile 1	3.62*	0.54	0.00	2.16	5.09
		Profile 2	-1.82*	0.55	0.01	-3.31	-0.32
		Profile 3	5.30*	1.03	0.00	2.48	8.12
		Profile 5	-0.21	0.82	1.00	-2.46	2.03
	Profile 5	Profile 1	3.84*	0.79	0.00	1.68	5.99
		Profile 2	-1.60	0.80	0.26	-3.77	0.57
		Profile 3	5.52*	1.18	0.00	2.28	8.75
		Profile 4	0.21	0.82	1.00	-2.03	2.46

Table 11 (Continued)							
Pairwise Comparisons			Mean Difference	s.e.	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Mental Health 2006	Profile 1	Profile 2	-4.30*	0.53	0.00	-5.76	-2.84
		Profile 3	3.23*	1.09	0.02	0.27	6.20
		Profile 4	-2.49*	0.58	0.00	-4.07	-0.90
		Profile 5	-1.83	0.85	0.20	-4.16	0.49
	Profile 2	Profile 1	4.30*	0.53	0.00	2.84	5.76
		Profile 3	7.53*	1.09	0.00	4.55	10.52
		Profile 4	1.82*	0.59	0.02	0.21	3.42
		Profile 5	2.47*	0.86	0.03	0.12	4.81
	Profile 3	Profile 1	-3.23*	1.09	0.02	-6.20	-0.27
		Profile 2	-7.53*	1.09	0.00	-10.52	-4.55
		Profile 4	-5.72*	1.11	0.00	-8.76	-2.68
		Profile 5	-5.07*	1.28	0.00	-8.55	-1.58
	Profile 4	Profile 1	2.49*	0.58	0.00	0.90	4.07
		Profile 2	-1.82*	0.59	0.02	-3.42	-0.21
		Profile 3	5.72*	1.11	0.00	2.68	8.76
		Profile 5	0.65	0.89	0.95	-1.77	3.08
	Profile 5	Profile 1	1.83	0.85	0.20	-0.49	4.16
		Profile 2	-2.47*	0.86	0.03	-4.81	-0.12
		Profile 3	5.07*	1.28	0.00	1.58	8.55
		Profile 4	-0.65	0.89	0.95	-3.08	1.77

Table 12 illustrates the results for models estimating the trajectories of change in physical and mental health over the 10 years of the study. The results in this table highlight that models exploring the rate or trajectory of change did not fit for Profile 3 (Moderate Frequency-High Quantity), but did for the four remaining profiles. This is because – as evidenced in Table 12 – Profile 3 was the only profile in this sample that did not show any change over time in either physical health or mental health (i.e., they had the lowest physical and mental health at baseline, and across time these health levels did not change). Levels of physical health followed a linear decline in all other profiles, while only Profile 4 illustrated a change in mental health (an improvement) from baseline to 2016.

Table 12: Models explaining simple (univariate) change in physical and mental health over time						
	$\chi 2$	df	$\chi 2$/df	CFI	RMSEA (90%CI)	SRMR
Profile 1	95.92	51	1.88	0.988	.031 (.021; .041)	0.035
Profile 2	127.2	51	2.49	0.974	.043 (.034; .053)	0.046
Profile 3	94.74	51	1.86	0.909	.084 (.057; .109)	0.119
Profile 4	130.7	51	2.56	0.966	.051 (.041; .062)	0.063
Profile 5	70.23	51	1.38	0.976	.043 (.011; .066)	0.079

Recommended thresholds for indices of model fit:

- **CFI** > .95
- **RMSEA** < .06 with the upper bound of the confidence interval lower than .08
- **SRMR** < .08

We assessed the stability of physical and mental health trends for each profile across time. The results in Table 13 indicate that all *except* Profile 3 experienced significant decline in physical health across waves, with the greatest rate of decline evident in Profile 1 whose baseline health was the lowest of all Profiles.

The results for mental health illustrate that all *except* Profile 4 experienced stable levels of mental health across time. Those in Profile 4 (who had moderate levels of mental health at baseline) experienced the only significant increase across time; there has been a low but significant increase the past 4 years after an initial reduction post-baseline.

Table 13: Intercepts and slopes of mental and physical health across profiles

	N	Initial Physical Health	Physical health slope (linear)	Physical health slope (quadratic)	Initial Mental Health	Mental Health slope (linear)	Mental Health slope (quadratic)
Profile 1	915	Low	-5.497***	1.992*	Moderate	0.705 *ns*	0.309 *ns*
Profile 2	791	High	-6.273***	2.487*	High	0.502 *ns*	-0.999 *ns*
Profile 3	124	Low	-1.202 *ns*	0.407 *ns*	Low	-1.084 *ns*	1.272 *ns*
Profile 4	594	Moderate	-4.142***	1.695 *ns*	Moderate	-1.118 *ns*	2.054*
Profile 5	207	Moderate	-3.024**	1.329 *ns*	Moderate	-1.234 *ns*	1.662 *ns*

*p<.05; **p<.01; *** p<.001; *ns* = no significant change over time

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