

SF-6D utility scores for alcohol use disorder status and alcohol consumption risk levels in the US population

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Abstract:

Aims: To estimate US population health utilities for subgroups defined by alcohol use disorder (AUD) status and consumption level. **Design:** Cross-sectional survey. **Setting:** Community settings in the United States (i.e. excluding institutional settings). **Participants:** A total of 36,042 adults (age 18+) in non-institutional settings in the United States. **Measurements:** We used 12-item Short Form Survey (SF-12) data from the National Epidemiologic Survey on Alcohol and Related Conditions–III to calculate mean Short Form–6 dimension (SF-6D) utility scores across World Health Organization alcohol consumption risk levels—very high risk, high risk, medium risk, low risk and an additional abstinent level—for three groups: (1) the general population ($n = 36,042$), (2) individuals with life-time AUD ($n = 9925$) and (3) individuals with current AUD ($n = 5083$), and assessed minimally important differences (MIDs) between consumption levels. Each group is a subset of the previous group. **Findings:** The general population's mean SF-6D utility was higher than that of individuals with life-time or current AUD across all consumption risk levels (0.79 versus 0.76 for both AUD groups). For all groups, SF-6D utilities increased as consumption risk level decreased to non-abstinent levels, and reducing consumption from very high risk to any lower level was associated with a statistically significant and meaningful improvement in utility. For individuals with life-time or current AUD, becoming abstinent from high-, medium- and low-risk levels was associated with significantly and meaningfully worse utilities. **Conclusions:** Higher alcohol consumption risk levels appear to be associated with lower health index scores for the general population and individuals with a history of alcohol use disorder, meaning that higher alcohol consumption is associated with worse health-related quality of life.

Keywords: alcohol | cost-effectiveness analysis | cost–utility analysis | health utilities | quality of life | United States

Article:

Introduction

The physical, psychological and social harms of alcohol use disorders (AUDs) represent an important public health problem [1-3]. In 2017, approximately half of Americans aged 12 years or older (51.7%, 140.6 million) were current alcohol drinkers, and 14.5 million (5.3%) had an AUD [4]. Social costs of excessive alcohol consumption in the United States totaled nearly \$250 billion in 2010 [5]. Despite these consequences and the proven effectiveness of alcohol treatment interventions—including behavioral and pharmacological [6, 7] approaches—in 2016, only 7.7% of adults who needed treatment for an AUD received it [8]. One reason for low alcohol treatment rates may be a perception of modest treatment benefits, due in part to a lack of evidence showing that the effects of treatment justify the costs [9-11].

Cost-effectiveness analysis (CEA) compares the costs of interventions to their outcomes, and US and international best practice guidelines recommend that CEAs use quality-adjusted life years (QALYs) as the measure of health benefit [12-15]. QALYs combine mortality and morbidity into a single metric, reflect societal preferences for the value assigned to each year of life and can be used as a standard measure of health gains across diverse treatments and settings [13]. QALYs are years of life adjusted by the quality of those years, with quality measured by health state utilities anchored at 0 for dead and 1 for perfect health [13].

Alcohol CEAs have historically used consumption outcomes such as days abstinent rather than QALYs [10, 11, 16, 17]. Responding to regulatory requirements, researchers have increased the use of QALYs in alcohol CEAs in recent years [18-29]. The use of QALYs in alcohol CEAs is constrained, however, by a lack of data on the utility of alcohol health states [17] and, specifically, a lack of data on health utilities for alcohol consumption among individuals with AUD. Existing US population–based utilities are based on alcohol consumption categories based on derived Alcohol Use Disorders Identification Test (AUDIT-C) scores [30], which do not provide a formal diagnosis of AUD status [31-33]. Other population utilities are from a Canadian sample [27] and additional small or select samples [34-38]. These data limit our ability to assess US population health-related quality of life (HRQoL) across consumption risk levels within AUD, a promising alternative outcome to abstinence in clinical trials of interventions [39-41].

This study provides alcohol-related utility values necessary to construct QALYs that can be used in alcohol research. Recognizing the recent shift from abstinence to reduced drinking as a primary clinical outcome in AUD intervention studies [42-44], we estimated utilities for alcohol consumption risk levels as defined by the World Health Organization (WHO) for three samples: (1) the general population, (2) those who have experienced AUD at any point in their life-time and (3) those currently experiencing AUD. In each sample, we tested for differences in health utilities across WHO risk levels because shifts in WHO risk levels are increasingly considered to be valid outcomes to guide clinical recommendations and assess efficacy of alcohol interventions [39-41, 45-47].

The two AUD samples capture the population of interest for AUD treatment studies. For example, individuals with current AUD start treatment or are recruited into AUD clinical trials, making the current AUD sample relevant for AUD treatment studies and AUD trial recruitment. At the end of treatment or at the conclusion of a trial's data collection, the study population will be a mix of those with former and current AUD and may or may not be assessed for current AUD, making the life-time AUD sample relevant for treatment follow-up studies or trial outcome assessments. We present utilities for the general population to compare utilities across the full spectrum of consumption for those with history of AUD (target of psychosocial with or without pharmacological treatment [6, 7]) and the general population (target of primary and secondary prevention (e.g. taxation [48], screening and brief intervention [49])).

Methods

Data

We used data from the National Epidemiologic Survey on Alcohol and Related Conditions–III (NESARC-III), conducted in 2012–13 by the National Institute on Alcoholism and Alcohol Abuse (NIAAA) [43]. When weighted, NESARC-III data are representative of the civilian, non-institutionalized US population aged 18 years or older, including people living in non-institutional group quarters.

Measures

Measures included AUD status, ethanol consumption and health state utility. We used the NESARC-III classification of AUD, which assesses diagnoses defined by criteria from the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5) [based on the Alcohol Use Disorder and Associated Disabilities Interview Schedule–5 (AUDADIS-5)] [50]. NESARC-III reports average daily ethanol consumption for the past 12 months in ounces for each survey respondent [51, 52]. We converted ethanol consumption to grams [one standard drink contains 0.6 ounces (or 14 g) of ethanol] and assigned each respondent to one of the four mutually exclusive WHO consumption risk levels ([53], p. 52); low risk, defined as 1–20 g/day for women and 1–40 g/day for men; medium risk, 21–40 g/day women, 41–60 g/day men; high risk, 41–60 g/day women, 61–100 g/day men; and very high risk, > 60 g/day women, > 100 g/day men. Respondents with no alcohol consumption in the past 12 months were assigned to a fifth category of abstinence.

In NESARC-III, HRQoL is measured using version 2 of the 12-item Short Form Health Survey developed for the Medical Outcomes Study (SF-12v2). This validated health status questionnaire measures physical functioning, mental functioning and overall wellbeing [54]. Using an established algorithm from the SF-12v2, we derived the six-dimensional (physical functioning, role limitations, social functioning, bodily pain, mental health, vitality) health state classification (SF-6D)—a preference-based utility measure that has been valued by a representative sample of the UK general population using the standard gamble technique [55]. The psychometric properties of the SF-6D have been tested in many disease areas [55], and SF-6D utilities are commonly used to assess HRQoL [55, 56].

Study sample

We analyzed three samples for this study: (1) all survey respondents (i.e. the general population), (2) those with life-time AUD and (3) those with current AUD. Of the 36 309 NESARC-III respondents, 123 had missing data on alcohol consumption and 144 had missing data on SF-6D scores. Because fewer than 1% (267 of 36 309) of the total sample had missing data, we considered the data to be missing completely at random and used complete case analysis. The general population analysis sample included all NESARC-III participants with non-missing average daily alcohol consumption and SF-6D score ($n = 36,042$); the life-time AUD sample was a subset of those in the general population sample with past-year and/or before past-year AUD ($n = 9925$). The current AUD sample was a subset of those in the life-time AUD sample with any past-year AUD ($n = 5083$), regardless of before past-year AUD. Descriptive statistics of the three samples are shown in Table 1.

Table 1. Descriptive statistics for each sample.

Characteristic	General population	Life-time AUD	Current AUD
<i>n</i>	36,042	9925	5083
Age, years (%)			
20–29	20	27	37
30–39	20	23	25
40–49	19	20	18
50–59	18	18	14
60–69	13	9	5
70–79	7	3	1
80–89	3	1	0
Female (%)	56	44	42
Race/ethnicity (%)			
White	53	62	53
Black	21	17	22
Asian	5	3	4
Hispanic	19	16	19
Other	1	2	2
Consumption risk level (%)			
Abstinent	53	24	3
Low risk	37	50	53
Medium risk	4	10	15
High risk	2	6	11
Very high risk	3	9	17

AUD = alcohol use disorder.

Sample characteristics without survey weights applied; life-time AUD includes current and/or prior AUD. AUD is defined as in the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* based on the Alcohol Use Disorder and Associated Disabilities Interview Schedule–5 (AUDADIS-5). WHO consumption risk levels are: low risk, 1–20 g/day women, 1–40 g/day men; medium risk, 21–40 g/day women, 41–60 g/day men; high risk, 41–60 g/day women, 61–100 g/day men; and very high risk, > 60 g/day women, > 100 g/day men.

Analysis

Data were analyzed in Stata version 15 [57], and results were weighted with the NESARC-III sampling weights to yield nationally representative estimates for non-institutionalized adults. Mean and median SF-6D scores were computed for the three study samples—general population, life-time AUD and current AUD—and stratified by WHO drinking risk level within each sample. We conducted pairwise comparisons of means between drinking risk levels (at P -value < 0.05) to evaluate the effect of different consumption levels within the general population and AUD samples. We used the Bonferroni method to adjust the P -values for multiple comparisons [58, 59]. We also assessed whether differences in SF-6D scores across risk levels exceeded the generally accepted minimally important difference (MID) threshold: the smallest change in SF-6D score that is considered important or meaningful [60]. MID for SF-6D utilities has been estimated in a variety of ways, from a mean of 0.027 to 0.040 [60, 61]. We did not test for differences across samples, because each sample is a subset of the preceding sample; therefore, they do not represent distinct populations to be compared.

To further support future CEAs, we present means of SF-6D utilities for each population by sex and age categories (decade of age) in Supporting information, Tables S1–S3 because both health utilities [56] and the effects of alcohol treatment may vary by these characteristics [62–64]. We also present SF-6D utilities for the WHO risk levels stratified by AUD severity in Supporting information, Table S4 to explore possible heterogeneity across AUD severity levels. Future work will present SF-6D utilities for alcohol and common co-occurring conditions (i.e. ‘joint’ health state utilities).

This analysis has not been pre-registered on a publicly available platform, and results should be considered exploratory

Table 2. SF-6D descriptive statistics for general population, life-time AUD and current AUD samples, by consumption risk level.

Sample		All	Abstinent	Low risk	Medium risk	High risk	Very high risk
General population	N (%)	36,042	19 114 (53)	13 397 (37)	1599 (4)	889 (2)	1043 (3)
	Mean (SD)	0.79 (0.14)	0.78 (0.16)	0.81 (0.13)	0.79 (0.14)	0.78 (0.15)	0.73 (0.16)
	Median	0.80	0.80	0.86	0.80	0.80	0.72
Life-time AUD	N (%)	9925	2414 (24)	4988 (50)	974 (10)	641 (6)	908 (9)
	Mean (SD)	0.76 (0.14)	0.73 (0.15)	0.78 (0.13)	0.77 (0.14)	0.77 (0.15)	0.72 (0.16)
	Median	0.78	0.72	0.80	0.78	0.78	0.72
Current AUD	N (%)	5083	175 (3)	2713 (53)	780 (15)	562 (11)	853 (17)
	Mean (SD)	0.76 (0.14)	0.71 (0.16)	0.77 (0.13)	0.77 (0.14)	0.76 (0.14)	0.72 (0.16)
	Median	0.75	0.68	0.78	0.76	0.78	0.72

AUD = alcohol use disorder; SD = standard deviation.

Life-time AUD includes current and/or prior AUD. AUD is defined as in the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* based on the Alcohol Use Disorder and Associated Disabilities Interview Schedule–5 (AUDADIS-5) [50]; n = sample size from unweighted data. Survey weights were applied to all values.

Results

Table 2 shows the survey-weighted SF-6D means, standard deviations, medians and interquartile ranges for each sample by drinking risk level. Across all samples, mean SF-6D scores decrease (i.e. worsen) as consumption risk level increases, and mean SF-6D scores are lower (i.e. worse) for the abstinent group than the low- and medium-risk consumption groups. The subsamples with

life-time or current AUD report lower SF-6D utilities than the general population throughout all consumption levels.

Table 3 shows the pairwise comparisons of mean SF-6D utilities for the general population, life-time AU and current AUD samples. For all three samples, relative to consuming alcohol at a very high-risk level, consuming alcohol at a high-, medium- or low-risk level is associated with a statistically significant higher (i.e. better) SF-6D score that exceeds the MID threshold of 0.027–0.041. Differences in SF-6D scores increased in magnitude from a high- to low-risk consumption level (i.e. the difference was largest between very high- and low-risk consumption, and smallest between very high-risk and high-risk, but all were 0.04 or greater). For life-time and current AUD, abstinence was associated with statistically significant lower (i.e. worse) SF-6D scores compared with consumption at the low-, medium- or high-risk levels, in the range of 0.04–0.06, but was not significantly different from consumption at the very high-risk level. For the general population, abstinence was associated with a significantly higher SF-6D score compared with the very high-risk level.

Table 3. Differences in SF-6D mean scores in pairwise comparisons across consumption risk levels, general population, life-time AUD and current AUD samples.

	Abstinent		Low risk		Medium risk		High risk	
General population								
Very high risk	0.043	<i>P</i> < 0.001	0.073	<i>P</i> < 0.001	0.059	<i>P</i> < 0.001	0.048	<i>P</i> < 0.001
High risk	–0.004	NS	0.025	NS	0.011	NS	–	
Medium risk	–0.016	<i>P</i> = 0.006	0.014	NS	–		–	
Low risk	–0.030	<i>P</i> < 0.001	–		–		–	
Life-time AUD								
Very high risk	0.008	NS	0.055	<i>P</i> < 0.001	0.049	<i>P</i> < 0.001	0.044	<i>P</i> < 0.001
High risk	–0.036	<i>P</i> < 0.001	0.011	NS	0.005	NS	–	
Medium risk	–0.041	<i>P</i> < 0.001	0.006	NS	–		–	
Low risk	–0.047	<i>P</i> < 0.001	–		–		–	
Current AUD								
Very high risk	–0.013	NS	0.049	<i>P</i> < 0.001	0.049	<i>P</i> < 0.001	0.038	<i>P</i> = 0.002
High risk	–0.051	<i>P</i> = 0.014	0.011	NS	0.010	NS	–	
Medium risk	–0.061	<i>P</i> = 0.002	0.000	NS	–		–	
Low risk	–0.062	<i>P</i> = 0.001	–		–		–	

AUD = alcohol use disorder; NS = not significant at *P* < 0.05 (Bonferroni-adjusted); MID = minimally important difference; SF-6D = Short Form–6 dimension.

Entries are column utility minus row utility; shaded cells indicate differences in utility scores exceeding minimally important difference lower bound of 0.027 and cells shown in bold type indicate differences in utility scores falling between the range of estimated MID for SF-6D (0.027–0.040). Survey weights were applied to all values.

We also stratified all analyses by age groups and gender to provide more detailed estimates of health utilities for alcohol researchers, and by AUD severity to explore possible heterogeneity within the AUD sample. Supporting information, Tables S1–S4 display these stratified results. Although the general patterns across risk levels within AUD samples seen in Table 3 hold for most age and gender groups, they do not hold universally and become more pronounced as age increases. In the general population, SF-6D scores gradually declined with increasing age, and females reported lower SF-6D scores than males across age categories. Within a risk level, SF-6D scores decline as AUD severity increases. Although somewhat attenuated, we generally find

the same pattern across WHO risk levels as we found in the main analysis, but at progressively lower levels of utility as AUD severity increases. Within mild and severe AUD, we find that abstinent individuals have the lowest health utility, followed by very high-risk drinkers. For individuals with moderate AUD, there is no discernable difference across risk level except for abstinence, which has the lowest average SF-6D score. Particularly for moderate and severe AUD, the findings for the abstinence group should be interpreted cautiously, given the very small sample size in those groups.

Discussion

This study provides the field with US population-based, ‘off-the-shelf’ health utilities for alcohol-related health states defined by AUD status and consumption risk level. These utilities are derived from a 2012–13 nationally representative sample of the US population using SF-6D scores, reflecting current standard practice for QALY estimation for CEA [65]. The consumption risk levels follow the WHO definition for males and females, and the AUD status defines current year AUD and life-time AUD (which includes current or prior AUD) using DSM-5 criteria. This level of specificity in health states allows for economic evaluation of AUD interventions that achieve reductions in consumption as well as the conventional outcome of abstinence, enabling more precise estimates of benefits to evaluate alcohol interventions using CEA.

Our results indicate that higher alcohol consumption risk levels are associated with lower SF-6D scores for the general population and individuals with a history of AUD, meaning that higher consumption is associated with worse HRQoL. Very high-risk consumption is associated with meaningful and statistically significant worse health utility than lower-risk consumption levels. Moreover, SF-6D scores are lower (i.e. worse) for individuals with life-time or current AUD than for the general population across all consumption levels. These findings corroborate previous research estimating alcohol-related utilities in the US population [30], the Canadian population [27] and other clinical trial and smaller sample data [34, 36-38]. Our stratified results presented in the Supporting information Appendix were consistent with those reported in Hammer & Kaplan's [56] study of nationally representative SF-6D utilities using the 2011 Medical Expenditure Panel Survey Household Component [66], where scores decreased with increasing age, and females’ scores were lower than males’, further confirming the validity of our results. Our findings add to the existing literature by extending previous US population values to confirmed AUD states. Although a prior study estimated utilities for a spectrum of alcohol health states [30], it estimated SF-6D scores for alcohol health states defined by the AUDIT-C, so it could not assess AUD status. The NESARC-III uses the AUDADIS-5, which can validly assess DSM-5 AUD, so our paper is the first, to our knowledge, to present nationally representative health utilities for AUD health states stratified by WHO consumption risk levels.

Our findings suggest that very high-risk consumption has a substantial connection to HRQoL. Among the general population and both AUD groups, individuals who consumed alcohol at the very high-risk level had significantly lower (i.e. worse) SF-6D scores compared with those whose consumption was at lower-risk levels. In all three groups, this difference surpassed the generally accepted lower bound for a meaningful difference of 0.027 [60, 61]. Recent research shows significant improvements in physical health and quality of life [47] and a lower risk of AUD [45] for reductions in consumption, and supports the use of the WHO risk level reductions

as an outcome measure for AUD treatment [46]. This research, in combination with our results, might support a harm reduction approach to alcohol intervention outcomes that stops short of complete abstinence.

Furthermore, our findings show that, among individuals with a history of AUD, complete abstinence is associated with statistically significant and potentially meaningful reductions in HRQoL relative to any of the WHO consumption risk levels except very high risk. Individuals with a history of AUD who become abstinent may have other co-occurring alcohol-related health conditions that affect their HRQoL, so alcohol consumption is causally related to lower quality of life among abstinent individuals. Alternatively, a history of AUD may cause lasting impairments to one or more SF-6D domains that are partially mitigated by alcohol use, so low levels of alcohol use have beneficial effects among this population.

This pattern was also observed for the general population wherein abstinence was associated with lower HRQoL than the low- to high-risk consumption levels, but still higher than the very high-risk level. This finding is consistent with prior research measuring HRQoL among US male veterans [67] and among the general population in the western New York State area [68].

Clearer understanding of the connection between abstinence and health conditions, including but not limited to AUD, is an area worthy of further research to fully understand the quality of life implications of abstinence. Such an understanding would more effectively inform the appropriateness of abstinence as the ‘gold standard’ outcome measure for AUD interventions [45, 69]. It could also provide evidence to further refute, or perhaps bolster, the perception that low levels of alcohol use may have beneficial health effects [70]. Assessing the joint utility of alcohol consumption and related comorbidities is a next step in our research, to further understand the meaning of low utility scores for abstinent health states [71].

Although our findings shed light upon the nuance of alcohol-related health states and emerging patterns, there are some caveats to be considered in interpreting our results. This cross-sectional study cannot assess whether changes in alcohol consumption were associated with changes in preference weights, and further research should evaluate the longitudinal relationship of changes in WHO risk levels and HRQoL. In addition, drinking state assignment was based on self-reported alcohol consumption which, despite being subject to recall bias, offers a reliable approach to measuring alcohol consumption [72]. The NESARC-III data allow only for the derivation of SF-6D utilities, which are one of several ‘generic’ utility measures [73]. Utility instruments generally differ on the dimensions of health included and the precision with which each dimension is measured, as reflected in the number of dimensions and levels in each instrument [73]. Research suggests that the SF-6D is sensitive to mild health conditions, making it particularly suitable to use for the full spectrum of alcohol consumption risk levels that include mild and severe conditions [55, 74, 75]. Furthermore, the primary alternative to the SF-6D, the EuroQol-5D (EQ-5D), does not perform well for some alcohol health states [34]. Nevertheless, the SF-6D is still limited in what it can capture, and may exclude some of the important effects of these health states [76]. Moreover, the SF-6D scoring algorithm is based on values collected from a UK population sample [77], which may differ from those of a US population. US population values have not yet been confirmed, so their unavailability limits us to the UK source [78]. We believe that the quality of the NESARC-III sample and data outweigh any limitations of

this utility measure or the associated values, and future work should apply a US valuation set to our results when available to confirm these findings.

In addition, we have assessed our results based on mean values which, while useful for population inferences, do not take into consideration potential heterogeneity in values. Our findings by age and gender reveal patterns found in other utility studies, which serve as a validity check on our results but do not inform patterns that may be specific to population subgroups that are relevant to evaluations of interventions, such as veterans or individuals with comorbid substance use. Further work should take advantage of large data sets such as NESARC-III to explore utility heterogeneity across intervention-relevant subgroups.

Our study provides nationally representative utilities for alcohol consumption risk levels by AUD status that will enable more and better-quality CEAs of alcohol interventions and inform health-care resource allocation decisions. The existence of statistically significant differences in HRQoL across consumption levels informs treatments that reduce consumption, as an outcome distinct from abstinence. Our results facilitate CEAs that use QALYs as the measure of health benefit to allow for comparisons between AUD interventions and interventions for other health conditions.

Declaration of interests

None.

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Author contributions

Carolina Barbosa: Conceptualization; data curation; formal analysis; funding acquisition; investigation; methodology; project administration; supervision; validation. **Jeremy Bray:** Conceptualization; formal analysis; funding acquisition; methodology; validation. **William Dowd:** Formal analysis; methodology; validation. **Alan Barnosky:** Formal analysis; methodology; validation. **Eve Wittenberg:** Conceptualization; funding acquisition; methodology.

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Supplemental Information

Table S1. Both Sexes: Mean SF-6D Scores for General Population, Lifetime AUD, and Current AUD Samples, by Consumption Risk Level and Age

Age	All		Abstinent		Low Risk		Medium Risk		High Risk		Very High Risk		
	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	
General population	20-29	7033	0.812 (0.131)	2791	0.819 (0.135)	3327	0.813 (0.126)	408	0.798 (0.124)	233	0.794 (0.137)	274	0.761 (0.141)
	30-39	6852	0.804 (0.143)	3186	0.804 (0.151)	2928	0.813 (0.129)	327	0.783 (0.150)	179	0.772 (0.149)	232	0.711 (0.172)
	40-49	6509	0.792 (0.146)	3299	0.786 (0.162)	2505	0.805 (0.126)	302	0.788 (0.131)	169	0.779 (0.150)	234	0.728 (0.166)
	50-59	6330	0.770 (0.153)	3517	0.753 (0.164)	2163	0.796 (0.134)	293	0.785 (0.143)	164	0.742 (0.159)	193	0.733 (0.173)
	60-69	4457	0.772 (0.148)	2832	0.752 (0.157)	1318	0.805 (0.125)	144	0.817 (0.132)	90	0.810 (0.141)	73	0.704 (0.166)
	70-79	2467	0.767 (0.140)	1752	0.748 (0.147)	612	0.806 (0.113)	63	0.813 (0.123)	26	0.813 (0.141)	14	0.767 (0.196)
	80-89	1174	0.731 (0.138)	888	0.724 (0.145)	236	0.745 (0.118)	33	0.750 (0.118)	14	0.775 (0.133)	3	0.829 (0.149)
	All	36 042	0.788 (0.145)	19 114	0.776 (0.156)	13 397	0.806 (0.128)	1599	0.792 (0.135)	889	0.781 (0.147)	1043	0.733 (0.163)
Lifetime AUD	20-29	2575	0.783 (0.127)	283	0.768 (0.137)	1541	0.788 (0.123)	312	0.790 (0.121)	191	0.787 (0.131)	248	0.759 (0.138)
	30-39	2229	0.768 (0.139)	429	0.760 (0.144)	1222	0.780 (0.127)	228	0.768 (0.146)	140	0.761 (0.143)	210	0.704 (0.173)
	40-49	1915	0.762 (0.142)	476	0.726 (0.161)	927	0.786 (0.123)	178	0.762 (0.138)	131	0.771 (0.157)	203	0.720 (0.162)
	50-59	1726	0.737 (0.150)	601	0.712 (0.148)	689	0.757 (0.143)	166	0.765 (0.150)	105	0.726 (0.167)	165	0.720 (0.171)
	60-69	897	0.745 (0.142)	405	0.720 (0.145)	337	0.774 (0.130)	53	0.775 (0.127)	50	0.778 (0.139)	52	0.670 (0.162)
	70-79	314	0.750 (0.138)	156	0.737 (0.149)	123	0.760 (0.117)	15	0.795 (0.149)	11	0.770 (0.156)	9	0.724 (0.216)
	80-89	58	0.721 (0.109)	35	0.711 (0.111)	16	0.741 (0.094)	5	0.747 (0.116)	1	0.723 (0.000)	1	0.482 (0.000)
	All	9925	0.762 (0.140)	2414	0.733 (0.149)	4988	0.780 (0.128)	974	0.774 (0.136)	641	0.769 (0.145)	908	0.725 (0.161)
Current AUD	20-29	1807	0.780 (0.124)	63	0.755 (0.128)	1048	0.785 (0.120)	280	0.784 (0.122)	174	0.780 (0.130)	242	0.759 (0.138)
	30-39	1213	0.757 (0.148)	41	0.733 (0.165)	671	0.771 (0.135)	182	0.770 (0.149)	123	0.754 (0.146)	196	0.699 (0.171)
	40-49	896	0.749 (0.143)	32	0.640 (0.194)	426	0.761 (0.128)	135	0.754 (0.137)	114	0.769 (0.154)	189	0.722 (0.159)
	50-59	677	0.736 (0.158)	19	0.627 (0.146)	290	0.742 (0.147)	120	0.779 (0.150)	91	0.710 (0.167)	157	0.715 (0.170)
	60-69	245	0.752 (0.144)	7	0.623 (0.071)	117	0.767 (0.143)	37	0.770 (0.126)	41	0.783 (0.131)	43	0.681 (0.160)
	70-79	55	0.749 (0.124)	1	0.567 (0.000)	35	0.755 (0.108)	5	0.769 (0.199)	6	0.733 (0.112)	8	0.731 (0.222)
	80-89	7	0.743 (0.146)			2	0.681 (0.000)	4	0.792 (0.200)	1	0.723 (0.000)		
	All	5083	0.763 (0.139)	175	0.712 (0.158)	2713	0.773 (0.129)	780	0.773 (0.135)	562	0.763 (0.144)	853	0.725 (0.159)

Abbreviations: AUD, alcohol use disorder; SD, standard deviation.

N = sample size from unweighted data; survey weights were applied to mean and SD.

Table S2. Males: Mean SF-6D Scores for General Population, Lifetime AUD, and Current AUD Samples, by Consumption Risk Level and Age

	Age	All		Abstinent		Low Risk		Medium Risk		High Risk		Very High Risk	
		N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)
General population	20-29	3127	0.833 (0.119)	960	0.849 (0.117)	1730	0.831 (0.118)	158	0.815 (0.115)	142	0.804 (0.135)	137	0.801 (0.120)
	30-39	2943	0.820 (0.129)	1018	0.823 (0.135)	1545	0.828 (0.117)	142	0.791 (0.143)	113	0.793 (0.143)	125	0.720 (0.159)
	40-49	2857	0.808 (0.137)	1145	0.803 (0.158)	1352	0.819 (0.119)	118	0.801 (0.127)	114	0.784 (0.133)	128	0.749 (0.167)
	50-59	2858	0.785 (0.145)	1291	0.766 (0.156)	1219	0.807 (0.130)	126	0.787 (0.138)	110	0.747 (0.164)	112	0.765 (0.160)
	60-69	1967	0.784 (0.144)	1005	0.764 (0.151)	776	0.808 (0.129)	71	0.810 (0.144)	63	0.819 (0.151)	52	0.708 (0.164)
	70-79	1036	0.782 (0.128)	634	0.764 (0.137)	365	0.809 (0.108)	16	0.794 (0.128)	16	0.809 (0.115)	5	0.869 (0.172)
	80-89	421	0.739 (0.132)	275	0.729 (0.141)	124	0.747 (0.111)	12	0.806 (0.114)	7	0.873 (0.125)	3	0.829 (0.149)
	All	15742	0.805 (0.135)	6671	0.794 (0.147)	7273	0.819 (0.122)	654	0.801 (0.132)	575	0.792 (0.144)	569	0.758 (0.155)
Lifetime AUD	20-29	1351	0.807 (0.119)	102	0.818 (0.123)	869	0.808 (0.118)	128	0.806 (0.113)	120	0.799 (0.133)	132	0.800 (0.117)
	30-39	1190	0.787 (0.127)	185	0.777 (0.137)	682	0.799 (0.113)	114	0.781 (0.141)	91	0.786 (0.137)	118	0.719 (0.163)
	40-49	1048	0.781 (0.137)	224	0.748 (0.164)	543	0.801 (0.118)	79	0.776 (0.130)	87	0.772 (0.138)	115	0.742 (0.164)
	50-59	984	0.753 (0.145)	296	0.731 (0.140)	427	0.771 (0.139)	83	0.767 (0.147)	77	0.728 (0.170)	101	0.743 (0.157)
	60-69	597	0.760 (0.139)	240	0.737 (0.143)	245	0.783 (0.127)	33	0.798 (0.111)	39	0.789 (0.152)	40	0.684 (0.160)
	70-79	220	0.771 (0.129)	107	0.759 (0.138)	97	0.781 (0.114)	6	0.751 (0.163)	7	0.822 (0.105)	3	0.757 (0.201)
	80-89	42	0.731 (0.101)	25	0.731 (0.106)	12	0.729 (0.085)	3	0.776 (0.091)	1	0.723 (0.000)	1	0.482 (0.000)
	All	5542	0.781 (0.133)	1194	0.753 (0.144)	2947	0.796 (0.121)	454	0.787 (0.130)	430	0.781 (0.143)	517	0.749 (0.153)
Current AUD	20-29	1004	0.802 (0.119)	27	0.797 (0.124)	616	0.804 (0.118)	121	0.802 (0.113)	110	0.791 (0.134)	130	0.800 (0.117)
	30-39	686	0.775 (0.135)	16	0.723 (0.180)	384	0.793 (0.119)	95	0.778 (0.140)	82	0.775 (0.139)	109	0.713 (0.162)
	40-49	503	0.770 (0.136)	13	0.618 (0.220)	248	0.783 (0.120)	57	0.772 (0.122)	79	0.772 (0.136)	106	0.751 (0.160)
	50-59	418	0.747 (0.154)	8	0.606 (0.138)	185	0.756 (0.143)	61	0.781 (0.149)	65	0.708 (0.170)	99	0.743 (0.159)
	60-69	184	0.764 (0.147)	1	0.538 (0.000)	92	0.768 (0.143)	24	0.792 (0.117)	33	0.802 (0.144)	34	0.686 (0.166)
	70-79	36	0.784 (0.111)	1	0.567 (0.000)	27	0.785 (0.106)	2	0.834 (0.029)	4	0.797 (0.077)	2	0.795 (0.208)
	80-89	4	0.802 (0.135)			1	0.681 (0.000)	2	0.922 (0.000)	1	0.723 (0.000)		
	All	2931	0.781 (0.133)	71	0.730 (0.171)	1621	0.791 (0.123)	370	0.789 (0.127)	382	0.774 (0.142)	487	0.751 (0.152)

Abbreviations: AUD, alcohol use disorder; SD, standard deviation.

N = sample size from unweighted data; survey weights were applied to mean and SD.

Table S3. Females: Mean SF-6D Scores for General Population, Lifetime AUD, and Current AUD Samples, by Consumption Risk Level and Age

	Age	All		Abstinent		Low Risk		Medium Risk		High Risk		Very High Risk	
		N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)
General population	20-29	3906	0.791 (0.139)	1831	0.800 (0.144)	1597	0.789 (0.131)	250	0.783 (0.128)	91	0.775 (0.139)	137	0.706 (0.148)
	30-39	3909	0.788 (0.155)	2168	0.793 (0.160)	1383	0.791 (0.142)	185	0.777 (0.156)	66	0.724 (0.147)	107	0.698 (0.188)
	40-49	3652	0.777 (0.152)	2154	0.775 (0.162)	1153	0.786 (0.134)	184	0.780 (0.132)	55	0.764 (0.191)	106	0.696 (0.155)
	50-59	3472	0.757 (0.160)	2226	0.745 (0.169)	944	0.781 (0.137)	167	0.783 (0.147)	54	0.732 (0.146)	81	0.683 (0.180)
	60-69	2490	0.760 (0.151)	1827	0.744 (0.160)	542	0.799 (0.118)	73	0.824 (0.119)	27	0.794 (0.121)	21	0.696 (0.172)
	70-79	1431	0.754 (0.149)	1118	0.737 (0.153)	247	0.801 (0.121)	47	0.821 (0.120)	10	0.820 (0.167)	9	0.697 (0.165)
	80-89	753	0.725 (0.141)	613	0.722 (0.146)	112	0.742 (0.126)	21	0.713 (0.107)	7	0.709 (0.090)		
	All	20300	0.772 (0.151)	12443	0.765 (0.160)	6124	0.788 (0.133)	945	0.785 (0.137)	314	0.759 (0.150)	474	0.697 (0.166)
Lifetime AUD	20-29	1224	0.752 (0.129)	181	0.735 (0.137)	672	0.758 (0.124)	184	0.774 (0.124)	71	0.763 (0.121)	116	0.698 (0.145)
	30-39	1039	0.741 (0.150)	244	0.745 (0.148)	540	0.749 (0.145)	114	0.754 (0.151)	49	0.702 (0.136)	92	0.680 (0.184)
	40-49	867	0.737 (0.146)	252	0.704 (0.155)	384	0.761 (0.128)	99	0.750 (0.143)	44	0.768 (0.203)	88	0.684 (0.145)
	50-59	742	0.714 (0.156)	305	0.691 (0.154)	262	0.732 (0.146)	83	0.762 (0.153)	28	0.721 (0.161)	64	0.681 (0.188)
	60-69	300	0.711 (0.143)	165	0.688 (0.142)	92	0.749 (0.137)	20	0.729 (0.150)	11	0.746 (0.096)	12	0.625 (0.158)
	70-79	94	0.698 (0.150)	49	0.680 (0.163)	26	0.690 (0.106)	9	0.830 (0.121)	4	0.679 (0.193)	6	0.707 (0.220)
	80-89	16	0.686 (0.128)	10	0.642 (0.097)	4	0.781 (0.117)	2	0.642 (0.124)				
	All	4383	0.735 (0.145)	1220	0.710 (0.152)	2041	0.753 (0.134)	520	0.760 (0.141)	211	0.741 (0.147)	391	0.686 (0.163)
Current AUD	20-29	803	0.748 (0.125)	36	0.721 (0.122)	432	0.755 (0.118)	159	0.764 (0.127)	64	0.759 (0.116)	112	0.698 (0.145)
	30-39	527	0.726 (0.162)	25	0.741 (0.151)	287	0.732 (0.154)	87	0.760 (0.160)	41	0.702 (0.148)	87	0.679 (0.182)
	40-49	393	0.719 (0.148)	19	0.655 (0.174)	178	0.726 (0.132)	78	0.739 (0.147)	35	0.760 (0.204)	83	0.675 (0.137)
	50-59	259	0.717 (0.163)	11	0.648 (0.149)	105	0.717 (0.152)	59	0.778 (0.150)	26	0.714 (0.162)	58	0.665 (0.177)
	60-69	61	0.715 (0.128)	6	0.633 (0.069)	25	0.762 (0.144)	13	0.714 (0.134)	8	0.724 (0.068)	9	0.660 (0.133)
	70-79	19	0.672 (0.120)			8	0.665 (0.069)	3	0.720 (0.250)	2	0.621 (0.083)	6	0.707 (0.220)
	80-89	3	0.659 (0.089)			1	0.681 (0.000)	2	0.642 (0.124)				
	All	2152	0.733 (0.143)	104	0.698 (0.143)	1092	0.743 (0.133)	410	0.756 (0.143)	180	0.736 (0.144)	366	0.682 (0.158)

Abbreviations: AUD, alcohol use disorder; SD, standard deviation.

N = sample size from unweighted data; survey weights were applied to mean and SD.

Table S4. SF-6D Descriptive Statistics for Mild, Moderate, and Severe Current AUD Samples, by Consumption Risk Level

Sample		All	Abstinent	Low Risk	Medium Risk	High Risk	Very High Risk
Current AUD, Mild Severity	N (%)	2,605	152 (6)	1,746 (67)	346 (13)	173 (7)	188 (7)
	Mean (SD)	0.79 (0.13)	0.72 (0.16)	0.79 (0.13)	0.80 (0.13)	0.81 (0.13)	0.78 (0.15)
	Median	0.80	0.72	0.80	0.86	0.85	0.79
Current AUD, Moderate Severity	N (%)	1,169	13 (1)	601 (52)	223 (19)	156 (13)	176 (15)
	Mean (SD)	0.76 (0.14)	0.67 (0.15)	0.76 (0.13)	0.76 (0.14)	0.76 (0.15)	0.76 (0.16)
	Median	0.74	0.66	0.74	0.73	0.78	0.74
Current AUD, Severe	N (%)	1,297	10 (1)	359 (28)	209 (16)	232 (18)	487 (37)
	Mean (SD)	0.72 (0.14)	0.67 (0.17)	0.73 (0.12)	0.74 (0.13)	0.73 (0.14)	0.69 (0.15)
	Median	0.71	0.66	0.72	0.72	0.72	0.66

Abbreviations: AUD, alcohol use disorder; SD, standard deviation.

N = sample size from unweighted data; survey weights were applied to mean and SD.

Note: AUD severity is a function of the number of AUD symptoms. Mild: 2-3, Moderate: 4-5, Severe: 6+