Residual Effects: Young Adult Diagnostic Drinking Predicts Late-Life Health Outcomes

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ABSTRACT. Objective: This study examined the residual effects of young adult diagnostic drinking on health outcomes four decades later in late life. Results were differentiated by drinking status during midlife. **Method:** A subsample of Vietnam Era Twin Registry members, all of whom had a lifetime diagnosis of alcohol dependence, was grouped according to life span drinking patterns as assessed by the Lifetime Drinking History interview in 2001. Those drinking at diagnostic levels (endorsing three or more alcohol dependence symptoms) before age 30 were then grouped based on their midlife drinking status (i.e., drinking at diagnostic levels vs. at minimal [nonsymptomatic] levels throughout midlife). Linear (or logistic) regression models were used to examine the association between life span drinking patterns and health outcomes in late life (about age 64). **Results:** Those who drank at diagnostic levels

in young adulthood and in midlife exhibited significant health liabilities on every late-life health measure; those who drank at diagnostic levels for 5 or more years in young adulthood but drank only at minimal levels or not at all in midlife still exhibited similar liabilities on most late-life health measures. Only those individuals who drank diagnostically for less than 5 years in young adulthood displayed normal levels of late-life health. **Conclusions:** This study identified residual effects resulting from persistent young adult diagnostic drinking (5 or more years) that resulted in negative health outcomes in late life even after decades of remission. There is a distal but surprisingly strong association between persistent early life diagnostic drinking and late-life morbidity. (*J. Stud. Alcohol Drugs*, 77, 859–867, 2016)

THE ALCOHOL LITERATURE exhaustively documents the negative impact of alcohol misuse and the positive benefits of recovery (Finney & Moos, 1991; Humphreys et al., 1997; Timko et al., 2000) but less often discusses residual effects that continue long after drinking has ceased. Some residual effects are obvious and short term (e.g., hangovers, alcohol-induced sickness), but others may not be obvious until permanent damage has occurred (e.g., cirrhosis of the liver, deterioration of the hippocampus [Room et al., 2005]). Although it is known that lifelong drinking seriously affects late-life health and mortality (Oslin, 2000), it is not clear whether drinking exclusively in early life is associated with health and mortality decades later in late life. The current study examined the late-life outcomes of those with chronic, remitted, and minimal drinking patterns across their lifetime.

Chronic alcoholism is closely associated with a variety of health and personal problems including late-life morbidity

and mortality (Oslin, 2000). Stable recovery has been shown to improve and may restore previous health and function (Dawson et al., 2005). However, less well known are reports of long-term consequences that persist even after drinking ceases (Schutte et al., 2003). For example, a general population survey conducted in Finland found that former problem drinkers scored the worst on most measures of physical and mental health and were comparable to those in the highest drinking category (Saarni et al., 2008). Schutte et al. (2003) found that, among older former problem drinkers (ages 55–65), mortality was 1.6 times higher than among lifetime non-problem drinkers. Roerecke and Rehm (2013) conducted a meta-analysis on drinking status and ischemic heart disease mortality and found significantly elevated mortality among former drinkers compared with long-term abstainers.

Mertens et al. (1996) reported that former drinkers often had a current illness, higher stress, lower friendship support, and an avoidant coping style. Schutte et al. (2003, p. 367) summarized the literature on former drinkers by observing that those achieving stable remission in later life “continued to experience financial, health-related, and life context deficits relative to older lifetime non-problem drinkers . . . suggesting that there are long-term costs associated with earlier drinking problems, even when remission is maintained.” Such findings support the contention that, in spite of the benefits of stable recovery, chronic heavy drinking can have long-term residual effects. The duration of such residual effects has not been well studied.

A substantial literature has developed on adolescent/young adult drinking and its proximal consequences, and a

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growing literature is developing on late-life drinking. However, the relationship between the two is rarely examined. Because later life is associated with reduced strength, lower resistance, and increased susceptibility to disorder and disease, the likelihood that latent residual effects will become apparent may increase with age. Our interest here was to examine whether diagnostic-level alcohol use in the adolescent/young adult period affected health in late life.

Thus, the current study examined adolescent/young-adult diagnostic-level drinkers (those who reported three or more alcohol dependence symptoms before age 30) and differentiated those who then (a) persisted in chronic drinking at diagnostic levels in midlife (ages 30–54) and those who (b) remitted and never reported another alcohol dependence symptom during midlife. Chronic and remitted drinkers were compared to each other and to minimal drinkers in terms of their late-life health. Our expectations were that (a) chronic diagnostic drinkers would exhibit significant late-life health problems compared with minimal drinkers; (b) remitted, former diagnostic drinkers would not experience significant health problems in late life (compared with minimal drinkers); and (c) among chronic and remitted drinkers, chronic diagnostic drinkers would experience more negative health consequences. (Only the first hypothesis was confirmed.)

Method

Participants

Participants were selected from members of the U.S. Department of Veterans Affairs Vietnam Era Twin (VET) Registry who were born between 1939 and 1957 and served in the United States military during the Vietnam War (1965–1975). The VET Registry is a large, unbiased (as to demographic variables), general population sample of male twins (Eisen et al., 1987; Goldberg et al., 1987; Henderson et al., 1990). Detailed information on the registry is available at the VET Registry website (Seattle Epidemiologic Research and Information Center, 1985), in VET Registry scientific reports (Eisen et al., 1987; Goldberg et al., 1987; Henderson et al., 1990), and in other published studies including those of this research group.

Data

Data were obtained from the VET Registry archive that encompasses military data and post-military assessments from 1992, 2001, 2003, and 2012 (and others). Of current importance was lifetime alcohol use data collected by this research group during the 2001 “Adult Offspring of Alcoholism Discordant Twins” study (Theodore Jacob, principal investigator). This was a high-risk study that enrolled 1,295 veteran twins selected because at least one member of the pair had a lifetime diagnosis for alcohol dependence ac-

cording to the *Diagnostic and Statistical Manual of Mental Disorders, Third Edition, Revised* (DSM-III-R; American Psychiatric Association, 1987), as assessed in their psychiatric interview in 1992 (Harvard Drug Study; Ming Tsuang, principal investigator, 1992).

An additional 479 high-risk veterans were obtained from an associated study in 2003 that focused on lifetime DSM-III-R drug dependence (Bucholz et al., 2000). Identical telephone interviews were conducted so data sets could be combined to create the 2001–2003 Family Twin Studies (FTS) data set ($n = 1,774$). In this larger sample, 841 cases had a history of alcohol dependence assessed in 1992 (note that normal controls and many co-twins did not have alcohol dependence histories, although many had a drinking history). Outcome data assessed in late life were obtained for these cases from the 2012 VET Registry study titled, “A Twin Study of the Course and Consequences of Post-Traumatic Stress Disorder in Vietnam Era Veterans” (VA Cooperative Studies Program #569 [CSP-569]; Jack Goldberg and Kathy Magruder, principal investigators). Data for 1,258 cases were available.

Predictor: Alcohol dependence history

The Lifetime Drinking History (LDH) measure is a lifetime retrospective report of age-specific drinking history that is collected in terms of distinct drinking phases. The measure was originally developed by Skinner and Sheu (1982) and was then modified by Jacob (1998; Koenig et al., 2009). In 2001–2003, it was administered as a structured telephone interview in which the first phase began at the age of first regular drinking or first intoxication, and subsequent phases began at the age of a significant change in alcohol consumption. Each phase provided DSM-IV (American Psychiatric Association, 1994) alcohol dependence symptoms and a diagnosis. On average, participants reported 4.1 phases ($SD = 1.4$) in their lifetime with a mean length of 7.9 years ($SD = 4.1$). The LDH has been shown to be a reliable and valid instrument for characterizing drinking over the life course (Gladsjo et al., 1992; Jacob et al., 2006; Koenig et al., 2009). These data were transformed into person-year data using a (site-developed) SAS (SAS Institute Inc., Cary, NC) program so that drinking was characterized for every year of age.

Group construction

From these data, groups reflecting different life span drinking patterns were constructed in three steps. First, using age grouping criteria from the San Diego Prospective Study (Schuckit & Smith, 2011), drinking status across two age periods was identified. Individuals were classified as “young adult” diagnostic drinkers if they endorsed three or more symptoms before age 30 and were classified as “midlife”

diagnostic drinkers if they endorsed three or more symptoms between ages 30 and 54 (in the above person-year data set). Groups were not mutually exclusive.

Second, “young adult” and “midlife” drinking statuses were used to construct the “Chronic” and “Remitted” groups. Individuals placed in the Chronic group were those who experienced three or more symptoms in both the young adult and midlife periods ($n = 322$). Individuals placed in the Remitted group were those who experienced three or more symptoms in young adulthood but did not endorse a single alcohol dependence symptom in any year during the midlife period (ages 30–54) ($n = 106$).

Third, as a comparison group, the “Minimal” drinkers group was created and included those who did not endorse any alcohol dependence symptom in any year of their life. Thus, this group included both those who drank non-symptomatically and those who abstained from alcohol use altogether ($n = 509$). (Those who endorsed only one or two symptoms during a period were excluded from analyses [$n = 321$].) The Chronic, Remitted, and Minimal groups were modeled as predictors of late-life health outcomes.

Outcome: Late-life health (at mean age of 64)

Late-life health status was a focus of the Veterans Affairs 2012 VET Registry Posttraumatic Stress Disorder study (CSP-569; see the *Data* section above). That study selected a general range of late-life physical and mental health assessments with strong psychometric properties and recognized high regard in the literature. From these, the current study selected a broadly representative subset that comprised the following:

- Current number of health conditions was collected via a standard Veterans Affairs form querying medical history for 44 health conditions (e.g., heart disease, diabetes) including “treatment in the past year”; a sum score (0–44) was created.
- Current general health was assessed by the 36-item, SF-36 Health Survey, Standard Version (Ware et al., 2008) and included information such as general health, physical functioning, physical role impairment, bodily pain, vitality, social functioning, emotional role impairment, and mental health. Responses were rated on three- to six-level Likert scales to provide three summary scores: physical health, mental health, and overall health (current status). Reliability and validity were demonstrated by Ware et al. (Ware, 2004; Ware Jr. et al., 1996).
- Current depression was measured by the Patient Health Questionnaire (PHQ-9; Pfizer Inc.). Good reliability and validity have been demonstrated in multiple primary care settings and community samples (Kroenke & Spitzer, 2002).

- Current social support was measured by the Medical Outcomes Study (MOS) Social Support Survey Instrument from RAND Health, Measures of Quality of Life, Core Survey (Sherbourne & Stewart, 1991). Early reports of acceptable reliability and validity of this instrument were provided by McHorney et al. (1994).
- Current disability was assessed by the World Health Organization, Disability Assessment Schedule II (WHO-DAS), Phase 2 Field Trials—Health Services Research 36-item self-administered version. Excellent internal validity and convergent validity have been shown in the primary care setting (Chwastiak & Von Korff, 2003).
- Current resilience was assessed by the 10-item Connor-Davidson Resilience Scale (Connor & Davidson, 2003). This instrument demonstrated good reliability, internal consistency, and construct validity (Campbell-Sills & Stein, 2007).
- Mortality was determined by a VET Registry effort that searched state death certificate databases regarding the status all unreachable Registry members per institutional review board–approved protocol.

Demographics

Also obtained from 2001–2003 FTS data were single-item demographic characteristics for each participant (current age, education, employment status, marital status, and total annual family income).

Missing data

In the 2012 data collection, 28.8% of the 2001 selected cases did not participate. As a result, the Chronic, Remitted, and Minimal groups were reduced to $n = 221$, 75, and 368, respectively. Tests of attrition were conducted to determine whether group membership (which differed by life span severity of alcohol use) affected late-life participation. Prevalence of missing cases did not differ significantly by group.

The variability of missing data in outcome measures was also examined. Although some measures approximated complete data (e.g., current number of health conditions, resilience, mortality), other measures had missingness up to 8% that appeared to reflect random item omissions. The one exception was the lengthy VR-36 instrument, which encompassed many subscales and items. In this case, apparent random omissions resulted in a 16% listwise missing data rate for the physical and mental summary variables and an overall (combined) missing rate of 20%. Although the assumption that cases were missing completely at random could not be met with certainty, inclusion of other more complete measures permitted cautious use of VR-36 given that results were consistent with general patterns. Complete-

TABLE 1. Sample characterization: Mean (*SD*) or percentage and missingness by group compared with the reference group for each demographic and drinking variable

Variable	Group 1 Chronic drinkers (<i>n</i> = 221)		Group 2 Remitted drinkers (<i>n</i> = 75)		Group 3 Minimal drinkers (reference) (<i>n</i> = 368)	
	<i>M</i> (<i>SD</i>) or %	#miss	<i>M</i> (<i>SD</i>) or %	#miss	<i>M</i> (<i>SD</i>) or %	#miss
Demographics						
Age at interview, in years	51.5 (3.0)***	0	51.1 (2.9)***	0	52.3 (3.0)	1
Married, %	73%***	0	88%	0	85%	0
Education in years	13.4 (1.8)***	0	13.7 (2.1)**	0	14.2 (1.9)	2
Employment, % full time	82%**	0	84%*	0	90%	0
Annual income	54K (20K)***	2	59K (19K)**	2	70K (23K)	2
Drinking						
Lifetime AD (1992)	81%***	0	79%***	0	13%	0
Current QF (2001)	136 (1,342)*	0	3.4 (7.6)	0	7.8 (16.3)	0
QF always under 60, %	14%***	0	23%***	0	90%	0
Highest monthly QF	199 (203)***	0	196 (287)***	0	20.7 (27.8)	0
Lifetime QF (sum of years)	3,338 (3,703)***	0	1,120 (1,831)***	0	324 (543)	0
Years with QF ≥60	16.0 (11.1)***	0	4.4 (3.6)***	0	1.1 (4.8)	0
<i>M</i> QF per drinking year	117 (125)***	0	106 (215)***	0	13.7 (19.1)	0
Years AD positive	16.5 (10.2)***	0	3.9 (4.1)***	0	0 (0)	0
Lifetime AD symptoms (sum)	94.3 (39.1)***	0	24.9 (16.3)***	0	0 (0)	0
Treatment % obtained (ever)	36%***	0	16%***	0	2%	0

Notes: #miss = count of missing cases per variable for each group; K = thousands of dollars. Drinking variables: (a) Lifetime AD = ever alcohol dependent (≥3 *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*, symptoms in 12 months); (b) QF = quantity–frequency (average number of drinks per day multiplied by the number of drinking days per month) (assessed in 2001); (c) prevalence of QF under 60; (d) highest monthly QF; (e) sum of highest QF scores each year of life; (f) the number of years with a QF ≥ 60; (g) mean QF across drinking years; (h) years AD positive = number of years that AD criteria were met; (i) lifetime AD symptoms = sum of lifetime AD symptoms across each year of life; and (j) treatment % obtained = indicator of any alcohol treatment.

p* ≤ .05; *p* ≤ .01; ****p* ≤ .001.

case analyses (with and without VR-36 variables) were conducted. Inclusion of VR-36 variables appeared reasonable for current purposes.

Data analysis

Data analyses were conducted in three steps. First, the three groups were characterized by computing means and standard deviations with respect to demographic (covariates) and drinking characterization variables (Table 1). Given the substantial sample loss in the 2012 CSP-569 data collection, differences in attrition prevalence across groups were examined. As well, within-variable missing data were examined.

Second, linear (or logistic) regression models were used to test specific contrasts while controlling for sociodemographic differences (age, education, employment, marital status, and income). Test 1 contrasted the Chronic drinkers group (i.e., those who endorsed three or more symptoms in young adulthood and midlife) with the Minimal drinkers group (i.e., those who were nonsymptomatic in both adolescence/young adulthood and midlife). Test 2 contrasted the Remitted drinkers group (i.e., those who endorsed three or more symptoms in young adulthood and no symptoms in midlife) with the Minimal drinkers group. Test 3 contrasted Chronic and Remitted groups. Both groups

experienced three or more symptoms in young adulthood; the groups differed only in midlife, with endorsement of three or more symptoms (Chronic) or endorsement of none (Remitted).

Note that these are family twin data that involve nested subgroups where subjects can be correlated on specific traits, and this can violate the assumption of independence of observations. To control for familial clustering, final analyses were conducted with STATA (StataCorp LP, College Station, TX) using the Huber–White robust variance estimator to adjust for twin resemblance.

Third, given that results were not as hypothesized, additional examination was necessary to verify that early-life chronic diagnostic drinking affected late-life health. Thus, a post hoc test was designed that partitioned the Chronic diagnostic drinking group into low and high persistence groups. Low persistence was conceptualized as drinking at diagnostic levels during a limited period such as college years or a military enlistment, these generally being 4 years or less. Thus, low persistence was modeled as 1–4 years where three or more symptoms were exhibited during the young-adult period, and high persistence was modeled as 5–17 years. Results would determine whether changes in the level of persistence were associated with changes in late-life health outcomes.

Results

Sample description

Table 1 lists means (*SD*) for each demographic and alcohol characterization variable (with missingness counts) across the Chronic, Remitted, and Minimal groups (significance is reported in reference to the Minimal group). As observed, means were in the expected direction, and most were significant. Specifically, experiencing three or more symptoms in young adulthood (i.e., Chronic and Remitted groups) was associated with younger age, lower education, and lower household income, and most drinking variables were markedly more severe in the Chronic and Remitted groups than in the reference group. Individuals classified in the Chronic drinkers group were also less often married and were less likely to be employed full time. Differences between both drinking groups and the minimal drinking group were robust.

Group comparisons

Test 1 (Table 2) found robust significant contrasts between Chronic drinkers and Minimal drinkers with respect to all nine late-life health outcome measures. Examination of means by group showed that Chronic drinkers exhibited higher rates of physical, mental, and social difficulty; lower resilience; and higher mortality in late life compared with minimal drinkers.

Test 2 found robust significant contrasts between Remitted drinkers and Minimal drinkers with respect to seven of the nine late-life health outcome measures. Examination of means by group showed that Remitted drinkers exhibited higher rates of physical and mental difficulty and lower resilience in late life compared with minimal drinkers. In the Remitted group, social support and mortality were not significant.

In Test 3, note that the Chronic and Remitted groups were concordant for diagnostic-level drinking in young adulthood but were discordant for diagnostic-level drinking in midlife. No significant contrasts emerged between the Chronic and Remitted groups in late-life health outcomes.

Post hoc analysis

Post hoc analyses were conducted to determine whether change in persistence of diagnostic-level drinking (three or more symptoms) in young adulthood was associated with changes in late-life health outcomes. As seen in Table 3 (Group 1a), results indicated that low persistence of diagnostic drinking in young adulthood (i.e., 4 or fewer years) was not associated with late-life health problems (compared with Minimal drinkers). However, as also seen in Table 3 (Group 1b), a robust association was evident for those with a high

persistence of diagnostic drinking in young adulthood (i.e., 5 or more years) compared with Minimal drinkers with respect to all nine of the late-life health problems (Table 3, column 2).

Discussion

This retrospective study examined the residual effects of drinking across the life span, that is, the effects of adolescent/young-adult diagnostic drinking and midlife diagnostic drinking on late-life health outcomes. Findings indicated that those who reported extended young-adult diagnostic drinking (those who endorsed three or more symptoms for 5 or more years before age 30) had significantly more negative late-life health outcomes. Furthermore, negative effects on late-life health were also found for those who stopped symptomatic drinking before age 30. Thus, the residual effects of young-adult diagnostic drinking appeared to contribute to health difficulties in late life even after three decades of stable remission.

Generally speaking, recovery from chronic alcohol use is associated with improved health (Finney & Moos, 1991; Schutte et al., 2003; Timko et al., 2000), but seldom are midlife and late-life outcomes distinguished. Given that midlife recovery is most proximal to late life, we expected similarity in health status. As a distal factor, the effect of young-adult drinking on late life was expected to be small. Although results showed that lifelong chronic diagnostic drinking was associated with negative late-life health outcomes (as anticipated; see Test 1), young-adult (rather than midlife) diagnostic drinking was the stronger predictor of late-life health outcomes. Further, results indicated that even three decades of remission did not reduce the negative residual effects that followed from 5 or more years of diagnostic-level drinking in young adulthood. These were counterintuitive findings, which we consider below.

The first analysis was designed to confirm the well-documented finding that chronic alcohol dependence is associated with wide-ranging health consequences in late life (e.g., Oslin, 2000). In Test 1 (as seen in Table 2), those drinking at diagnostic levels in both young adulthood and midlife (the Chronic drinkers group) were shown to have more late-life medical conditions, poorer physical health, poorer mental health, double the rate of depression, lower social support, lower resilience, almost double the disability rate, and almost twice the mortality risk compared with the reference group. Findings confirmed that chronic drinking across the life span seriously and negatively affects late-life health.

The second analysis tested the impact of adolescent/young-adult diagnostic drinking alone on late-life health outcomes. The underlying question was whether stable remission throughout midlife would result in significantly better late-life health outcomes compared with the reference group. If true, the implication would be that negative

TABLE 2. Top half: Univariate tests (with covariates): Chronic vs. Reference, Remitted vs. Reference, and Chronic vs. Remitted contrasts predicting late-life health outcomes. Bottom half: Means, *SD*, and missingness by group for each health outcome

Tests, <i>p</i> values	Test 1 Group 1 vs. Group 3		Test 2 Group 2 vs. Group 3		Test 3 Group 1 vs. Group 2	
	Chronic (<i>n</i> = 221) vs. Minimal (<i>n</i> = 368)		Remitted (<i>n</i> = 106) vs. Minimal (<i>n</i> = 368)		Chronic (<i>n</i> = 221) vs. Remitted (<i>n</i> = 106)	
Current number of health conditions	.002		.004		.75	
Current physical health score: VR-36	.000		.002		.57	
Current mental health score: VR-36	.000		.001		.92	
Current overall health score: VR-36	.000		.001		.79	
Depression (current) by PHQ-9	.000		.000		.92	
Social support (current) by MOS	.000		.09		.30	
Resilience (current) by CDRS	.000		.000		.76	
Disability by WHO-DAS	.000		.000		.76	
Mortality by state death certificates	.02		.31		.66	
Means by group, <i>M</i> (<i>SD</i>) and comparison with reference group	Group 1: Chronic (<i>n</i> = 221)	#miss	Group 2: Remitted (<i>n</i> = 106)	#miss	Group 3: Minimal (ref.) (<i>n</i> = 368)	#miss
Current number of health conditions	2.9 (3.3)**	2	3.1 (3.7)**	0	2.0 (2.4)	12
Current physical health score: VR-36	68.2 (21.4)***	45	67.3 (22.4)**	12	77.3 (19.6)	84
Current mental health score: VR-36	69.0 (19.4)***	41	69.4 (20.2)***	12	78.8 (16.2)	83
Current overall health score: VR-36	68.8 (19.1)***	45	68.4 (20.2)***	12	78.0 (16.8)	94
Depression (current) by PHQ-9	4.8 (5.4)***	13	5.0 (5.7)***	2	2.5 (4.0)	19
Social support (current) by MOS	52.9 (19.8)***	5	55.4 (18.1)	4	61.0 (17.6)	8
Resilience (current) by CDRS	70.4 (19.6)***	1	70.5 (20.4)***	0	80.7 (17.6)	3
Disability by WHO-DAS	17.7 (16.6)***	18	17.4 (18.6)***	8	9.2 (13.1)	25
Mortality by state death certificates	0.11 (0.31)**	0	0.08 (0.28)	0	0.06 (0.23)	0

Notes: **Bold** indicates statistical significance. Linear (or logistic) regression models adjusted for covariates (age, education, employment, marital status, and income) were used to test for group differences as indicated. #miss = count of missing cases per variable for each group. Current reports at time of study (2012): Health conditions from medical history questionnaire; VR-36 = Veteran RAND 36-item health assessment; PHQ-9 = Patient Health Questionnaire; MOS = Medical Outcomes Study; CDRS = Conner-Davidson Resilience Scale; WHO-DAS = World Health Organization Disability Assessment Schedule II. Ref. = reference.

p* ≤ .01; *p* ≤ .001.

consequences following from diagnostic drinking in young adulthood would diminish over time if drinking was minimal, and would result in normal health in late life. Current results did not support this expectation. Seven of nine outcomes remained robustly significant, and an eighth trended toward significance (Table 2, Test 2). Thus, even after three decades of successful remission, a significant residual impact on late-life health was evident: there were an increased number of medical conditions, lower general physical and mental health, increased disability, increased depression, and

lower resilience. The only exception was that, given midlife remission, mortality rates significantly decreased. Overall, the means for the Remitted drinkers group were remarkably similar to the Chronic drinkers group for these late-life outcomes regardless of the cessation of symptomatic drinking throughout midlife (see Table 2, means for Groups 2 vs. 3).

At first glance, this appears inconsistent with the literature showing that stable remission has important benefits. It may be that there are positive proximal benefits that follow from recovery from a debilitating alcohol disorder such as im-

TABLE 3. Post hoc univariate tests (with covariates) differentiating short and longer duration of young-adult diagnostic drinking; cases with duration of ≤ 4 years are compared with those with duration of ≥ 5 years of diagnostic drinking under age 30

	Group 1a: Chronic Young adult 1–4 years of diagnostic drinking Low persistence (<i>n</i> = 55) <i>M</i> (<i>SD</i>)	Group 1b: Chronic Young adult 5–17 years of diagnostic drinking High persistence (<i>n</i> = 267) <i>M</i> (<i>SD</i>)	Group 3: Minimal (reference) No diagnostic drinking (no AD symptoms) (<i>n</i> = 368) <i>M</i> (<i>SD</i>)
Chronic drinkers, <i>p</i> values			
Current number of health conditions	2.6 (3.7)	3.2*** (3.4)	2.0 (2.4)
Current physical health score: VR-36	75.5 (14.8)	65.5*** (22.5)	77.3 (19.6)
Current mental health score: VR-36	71.8 (16.2)	66.7*** (20.9)	78.8 (16.2)
Current overall health score: VR-36	74.3 (14.0)	66.2*** (20.3)	78.0 (16.8)
Depression (current) by PHQ-9	3.9 (4.8)	5.7*** (5.7)	2.5 (4.0)
Social support (current) by MOS	57.4 (19.4)	49.1*** (19.7)	61.0 (17.6)
Resilience (current) by CDRS	73.4* (16.4)	68.0*** (19.7)	80.7 (17.6)
Disability by WHO-DAS	13.6 (13.9)	20.2*** (17.4)	9.2 (13.1)
Mortality by state death certificates	0.09 (0.29)	0.12* (0.33)	0.06 (0.23)

Notes: Linear (or logistic) regression models adjusted for covariates (age, education, employment, marital status, and income) were used to test for group differences as indicated. AD = alcohol dependence; VR-36 = Veteran RAND 36-item health assessment; PHQ-9 = Patient Health Questionnaire; MOS = Medical Outcomes Study; CDRS = Conner-Davidson Resilience Scale; WHO-DAS = World Health Organization Disability Assessment Schedule II.

* $p \leq .05$; *** $p \leq .001$.

proved physical condition, better work performance, closer family relationships, and greater social support (Dawson et al., 2005; Finney et al., 1999; Humphreys, 2004; Moos & Moos, 2007). However, it may be necessary to distinguish between these immediate benefits and other critical factors determining risk in late life (Finney & Moos, 1991; Timko et al., 2000).

The third analysis directly contrasted the Chronic drinkers group with the Remitted group. Recall that both groups involved diagnostic-level drinking in young adulthood and differed only in midlife diagnostic-level drinking. The results—shown in Table 2, Test 3—were unequivocal: Late-life health outcomes did not differ as a function of diagnostic-level drinking in midlife. This finding underscored the conclusion that negative late-life health was primarily a residual effect associated with young-adult diagnostic-level drinking.

Both the second and third tests were counterintuitive. Test 2 identified young-adult diagnostic drinking as the key predictor of late-life health outcomes. Test 3 found that midlife drinking did not significantly affect late-life health outcomes. Thus, a question about persistence became important: At what level of young adult diagnostic drinking did negative late-life health outcomes become evident? The results, seen in Table 3, indicated that those with 4 or fewer years of diagnostic drinking in young adulthood did not experience negative late-life health outcomes. However, those with a history of 5 or more years of diagnostic drinking under age 30 were highly likely to report negative health outcomes in late life (compared with the reference group). Thus, it was persistent (≥ 5 years) young-adult diagnostic drinking that accounted for the observed elevation in negative late-life

health outcomes. These findings underscored the conclusion that it is the duration or persistence of diagnostic levels of alcohol use during young adulthood that is the crucial factor in predicting negative health outcomes in late life.

These findings make sense in the context of the greater addiction literature. For example, smoking often begins in adolescence/young adulthood and, if extended, can result in a permanent increase in risk due to injury. This is not a felt injury, but tar does not dissipate—rather, it accumulates in the lungs over time. Cumulative tar exposure has been found to be a reliable measure of the relative risk of Kreyberg type 1 and 2 lung cancer (Zang & Wynder, 1992), which more commonly emerges in late life. In a similar way, persistent alcohol exposure may injure key body systems, of note the prefrontal cortex and anterior cingulate cortex of the brain (Crews & Boettiger, 2009; Crews & Nixon, 2009; De Bellis et al., 2005) and thus create a permanent increase in risk. In this way, repeated diagnostic-level exposures to alcohol before age 30 may have a cumulative, negative impact that results in increasing, unseen injury that, over time, results in the currently observed negative late-life health outcomes. Replication of this study in other samples, and additional biomedical and neuropsychological inquiries, will be needed before the relationship between young-adult drinking risk and late-life health outcomes is well understood.

Limitations

This study did not rule out all confounding factors. It is possible that those who remitted from problem drinking compensated with smoking or other drug use or, alterna-

tively, became ill and stopped drinking [the “sick-quitter effect” (Shaper et al., 1988)], or perhaps resumed problem drinking between 2003 and 2012. Our quick review of the data did not support such notions but, rather, the opposite. The data showed a decline in smoking, alcohol, and other drug use in these later years. Further, sickness onset was not correlated with drinking offset. Even so, these risks could not be eliminated. Most important, the LDH is a retrospective interview, and, as such, these data cannot make a strong case for causal effects across decades of time. Prospective tests will be needed. Even so, the findings are robust and have important implications, and these results are valuable if interpreted cautiously.

Conclusions

This study found that 5 or more years of diagnostic-level drinking in young adulthood is associated with increased health difficulties in late life. This finding was consistent even for those who never experienced another alcohol dependence symptom after age 30. These findings point to a distal, but surprisingly strong, link between diagnostic-level young-adult alcohol use and subsequent morbidity and mortality in late life. Future studies should examine the possibility that a permanent alcohol-related injury (probably to the developing brain) results from persistent diagnostic drinking during adolescence and young adulthood that, in turn, results in negative late-life health consequences. Because late life is associated with declining physical strength and resilience, it may be that this injury in young adulthood is most consequential at this later stage of life. These findings shed light on an important personal, familial, and public health concern that warrants additional study.

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