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Risky Alcohol Use: The Impact on Health Service Use

Laia Miquel[a–d] Jakob Manthey[e] Jürgen Rehm[f–i] Emili Vela[j] Montserrat Bustins[k] Lidia Segura[l] Eduard Vieta[b, c, m] Joan Colom[l] Peter Anderson[n, o] Antoni Gual[a–d]

[a]Grup de Recerca en addiccions Clínic, Institut Clínic de Neurosciències, Villarroel, Barcelona, Spain; [b]Universitat de Barcelona, Casanova, Barcelona, Spain; [c]Institut d'Investigacions Biomèdiques Agustí Pi i Sunyer, IDIBAPS, Rosselló, Barcelona, Spain; [d]Spanish network of Addictive Disorders (RTA), RETICS, Sinesio Delgado, Madrid, Spain; [e]Institute of Clinical Psychology and Psychotherapy, Technische Universität Dresden, Dresden, Germany; [f]Institute for Mental Health Policy Research, Centre for Addiction and Mental Health (CAMH), Toronto, ON, Canada; [g]Dalla Lana School of Public Health, University of Toronto, Toronto, ON, Canada; [h]Department of Psychiatry, Faculty of Medicine, University of Toronto, Toronto, ON, Canada; [i]Campbell Family Mental Health Research Institute, CAMH, Toronto, ON, Canada; [j]Unitat d'Informació i Coneixement, Servei Català de la Salut, Travessera de les Corts, Barcelona, Spain; [k]Divisió d'Anàlisi de la Demanda i l'Activitat, Servei Català de la Salut, Travessera de les Corts, Barcelona, Spain; [l]Department of Health, Program on Substance Abuse, Public Health Agency of Catalonia, Government of Catalonia, Roc Boronat, Barcelona, Spain; [m]Hospital Clinic de Barcelona, Clinical Institute of Neuroscience, CIBERSAM, Villarroel, Barcelona, Spain; [n]Institute of Health and Society, Newcastle University, Baddiley-Clark Building, Richardson Road, Newcastle upon Tyne, UK; [o]Faculty of Health, Medicine and Life Sciences, Maastricht University, Maastricht, The Netherlands

Keywords
Risky drinking · Tobacco · Health service use · Inpatient · Primary health care

Abstract
Objective: To examine health services use on the basis of alcohol consumption. ***Material and Methods:*** A cross-sectional study was carried out on patients visiting the Primary Health Care (PHC) settings in Catalonia during 2011 and 2012; these patients had a history of alcohol consumption. Information about outpatient visits in the PHC setting, hospitalizations, specialists' visits and emergency room visits for the year 2013 was obtained from 2 databases (the Information System for the Development of Research in PHC and the Catalan Health Surveillance System). Risky drinkers were defined as those who consumed more than 280 g per week for men or more than 170 g per week for women, or any amount of alcohol while being involved in a high risk work activity, or taking medication that significantly interferes with alcohol or when being pregnant. Binge drinkers (>60 g in men or >50 g in women in a short amount of time more than once a month) were also considered risky drinkers. ***Results:*** A total of 606,948 patients reported consuming alcohol (of which 10.5% were risky drinkers). Risky drinkers were more likely to be admitted to hospitals or emergency departments (range of ORs 1.08–1.18) compared to light drinkers. Male risky drinkers used fewer PHC services than male light drinkers (OR 0.89, 95% CI 0.87–0.92). In general, risky alcohol users used services more and had longer hospital stays. When

E-Mail karger@karger.com
www.karger.com/ear

Laia Miquel
Grup de Recerca en addiccions Clínic
Institut Clínic de Neurosciències
Villarroel, 170, ES–08036 Barcelona (Spain)
E-Mail MIQUEL@clinic.cat

stratifying by socioeconomic level of the residential area, we found that risky drinking failed significance, while current or past cigarette smoking was associated with higher healthcare use. ***Conclusions:*** Risky drinkers use more expensive services, such as hospitals and emergency rooms, but not PHC services, which may suggest that prevention strategies and alcohol interventions should also be implemented in those settings.

Introduction

Alcohol consumption plays an important role in increased morbidity and mortality [1] and might bring about greater health service utilization [2, 3]. In order to plan preventive strategies to reduce harm attributable to alcohol consumption, it is important to know how this behaviour affects health service use.

The evidence on the relationship between alcohol consumption and health care use is not well established. Some studies have described that alcohol-dependent patients have more appointments with general practitioners and a higher rate of hospital admissions compared with alcohol abusers [4] and non-alcohol dependent patients [5, 6]. Furthermore, it has been reported that heavy drinkers with and without a diagnosis of alcohol dependence are more predominant in the emergency department and hospital services compared to abstainers [7, 8]. However, general population studies have found a negative relationship between alcohol consumption and health service use: increased alcohol consumption was associated with decreased use of health care services [9–11]. Therefore, no dose-response relationship between alcohol and health care use could be established to date [10, 12, 13]. Another important aspect that should be considered is how patterns of utilization of health resources differ by sex. In general, more women use Primary Health Care (PHC) services than men [9]. However, regarding hospital admissions, even though both sexes have a huge risk of getting hospitalized, men who drink heavy have a higher risk of getting injured [14] and, therefore, are more likely to be admitted to a hospital [12].

The literature supports the fact that alcohol consumption, for the vast majority of conditions has a linear relationship between the volume of alcohol consumed and the risk of morbidity and mortality [15–17]. Alcohol abuse and dependence are clearly associated with an increased health service use and it has been shown that alcohol reduction and abstention in this specific population reduce health service use [8, 18]. However, the impact of risky alcohol consumption on health service use is understudied despite its high importance for public health policy. The aforementioned inconclusiveness in the literature on the relationship between substances consumed and health service use is perhaps related to methodological constraints, such as lack of data, different alcohol consumption measurements, and large heterogeneity across observed settings and healthcare systems. We overcome several of these limitations in this large-scale epidemiological study on patients registered in Catalonian primary health care (PHC) settings by combining information on alcohol use from the patients' electronic health records with information on health service use gathered from administrative data. These types of studies are necessary because health policies should be based on studies that give information that is close to reality and up to date.

Given the dose-response relationship of drinking levels with several diseases and all-cause mortality [17, 19], we hypothesized that risky drinkers are more prone to use hospital and emergency room services than light drinkers. Furthermore, given the existing research findings [12], we expected to find more pronounced effects of this difference among men. Using a bottom-up approach we analysed the relationship between the patterns of alcohol consumption (risky drinking vs. light drinking) and public healthcare service use in a cohort of patients attending PHC services. Previous research has found that the magnitude of negative effects from drinking alcohol is greater among people with a lower socioeconomic level (for all-cause mortality [20]). In addition, tobacco smoking is highly prevalent among alcohol consumers, especially in risky drinkers [21] and alcohol-dependent patients [22]. Cigarette smoking increases morbidity when co-occurring with alcohol use disorder [23] and, consequently, increases health service use [9, 24]. We undertook a sensitivity analysis stratifying the sample by socioeconomic status and tobacco consumption to examine the associations between these aspects and service use in our sample.

Methods

A cohort study based on medical and administrative health records of patients registered in the Catalonian PHC settings was carried out. The Catalan Public health care system depends on the Catalan government. The major supplier of the Catalan Health System is the Catalan Health Institute (CHI). Public health care in Catalonia is universal and for free as it is paid for by taxes. The CHI owns 80% of the PHC services in Catalonia. Each year, more than

Table 1. Alcohol consumption definitions used by primary health professionals

	Men	Women
Light drinker (excluding abstainers)	<28 SDU alcohol/week	<17 SDU alcohol/week
Risky drinker	<28 SDU alcohol/week AND (– drinking alcohol while doing a high risk work activity OR – Takes medication that significantly interferes with alcohol)	<17 SDU alcohol/week AND (– Is pregnant OR – drinks while doing a high risk work activity OR – Takes medication that significantly interferes with alcohol)
	≥28 SDU alcohol/week	≥17 SDU alcohol/week
	Binge drinker (>6 SDU of pure alcohol per occasion) once a month or more frequently	Binge drinker (>5 SDU of pure alcohol per occasion) once a month or more frequently

3 million people are attending these services. Every citizen belongs to a basic heath area that has a PHC assigned. Appointments with PHC professionals like general practitioners and nurses are mainly related to medical conditions. Citizens can be referred by their doctor or nurse to hospital when necessary, but everybody can go to the hospital for an emergency. For the study, we included patients (aged 18 years or older) attending $n = 372$ PHC practices who had their pattern of alcohol consumption registered in the electronic medical record during 2011 or 2012 ($n = 1,909,359$). We restricted the analyses to currently drinking patients with information on smoking (exclusion of $n = 1,294,471$ alcohol abstainers and $n = 7,939$ cases with missing values, final sample size: $n = 606,948$).

Source of Information

Demographic, clinical and health care use information was gathered from 2 different databases that have information of all CHI services: (1) The Information System for the Development of research in Primary Care (SIDIAP) [25] provided information on alcohol and tobacco consumption, and (2) The Catalan Health Surveillance System, governed by the Catalan Health Service, provided information on health care use at the year 2013. Validity in both databases is ensured by a periodical data review, which aims to detect problems and inconsistencies in the variables. The information on health service use is used to pay healthcare providers. For more information on the validity of SIDIAP coding, see [25, 26].

Measures

Baseline information at 31st of December 2012 included demographic characteristics (age, sex and socioeconomic level) and clinical information. Socioeconomic level was defined through a regional indicator which was based on the population's income in so-called basic health areas ($n = 370$, cut-offs to define 5 socioeconomic levels (very high, high, moderate, low and very low) via percentage of the population with an annual income >100,000 and < 18,000 EUR. The majority of patients registered in a given PHC belonged to the same basic health areas, and all patients from the same PHC clinic had the same Socioeconomic level assigned. Clinical characteristics were classified following the International Statistical Classification of Diseases, 9th revision, clinical modification (ICD-9-CM) [27]. Drinking status was defined in 2 different groups (light drinker and risky drinker) following Table 1 definitions. Abstainers were not included in the analysis of the study as they are a heterogeneous group of people (including former drinkers, lifetime abstainers or lack of registration because of unknown reasons). Alcohol consumption was recorded in the clinical health record using an instrument which is based on the Systematic Interview of Alcohol Consumption [28] which records alcohol consumption in Standard Drink Units. To establish risky alcohol consumption not only the amount of alcohol consumed per week was considered, but also drinking in some conditions like pregnancy or binge drinking (Table 1). Among all patients, 7.4% of the females that drunk <170 g/week and 6.8% of the males who drunk < 280 g/week were classified as risky drinkers. Smoking status was classified into 3 groups (never smoked, current smokers and former smokers) at the moment of the appointment. Information on health services utilization at year 2013 included the number of PHC visits (including doctors, nurses and social workers), data on the number of hospital admissions (including general [acute] hospitals, skilled nursing facilities and psychiatric hospitals) and days of hospital stay, the number of admissions to an acute hospital due to an alcohol-attributable illness [17], number of emergency department visits and hospital outpatient visits. Skilled nursing facilities are welfare spaces for the continued care of people with diseases or chronic problems who have varied levels of functional dependence and degrees of clinical complexity meaning that they cannot be attended in their own homes. These inpatient services are offered through combined social-health units located in acute care hospitals or in psychiatric hospitals.

The observational research studies using SIDIAP data were approved by 2 local ethics committee. Patients' consent was not required because all data used was anonymized. Finally, the confidentiality of medical records was respected in accordance with Spanish Law (LOPD 15/1999).

Statistical Analysis

The primary analyses testing our main hypotheses required comparisons of light drinkers vs. risky drinkers for service use in different healthcare settings (primary healthcare visits, hospi-

tal inpatient admissions, hospital outpatient admissions, hospital admission due to alcohol-attributable condition, emergency department admissions). T-tests were used for quantitative variables and chi-square test for categorical variables. Multilevel logistic regressions were performed for each service use domain (any visit/admission), allowing for random intercepts for each PHC unit nested in 1 out of 9 greater regions. The sex-stratified models contained z-standardized age, and individual smoking status (never vs. former vs. current smoker) as well as the socioeconomic classification (low: very low and low, moderate, high: very high and high) as further covariates at the patient level.

In an additional sensitivity analysis, we examined if the impact of risky drinking is dependent on the socioeconomic grouping at the regional level. For this purpose, 6 multilevel logistic models were repeated for each outcome (service use domains), stratifying by socioeconomic grouping (regional level) and sex (individual level). As in the main analyses, random intercepts were allowed for each PHC unit nested within the respective region. On the individual level, we added z-standardized age, risky drinking, smoking status, as well as the interaction of risky drinking and smoking status as covariates. The results can be obtained from the online supplementary Appendix (for all online suppl. material, see www.karger.com/doi/10.1159/000493884).

In a secondary analysis, the length of inpatient stay in general hospitals, psychiatric hospitals and skilled nursing facilities were analysed. For each outcome, sex-stratified t-tests examined differences in average stay between low risk and high-risk drinkers, repeated for the total population and only for admitted patients. In order to assess whether the length of inpatient stays differed by drinking group, zero-inflated negative binomial regression models were applied, using the same Covariates as in the primary analyses. All *p* values were Bonferroni-adjusted. All analyses were conducted using R [29].

Results

In the examined sample (n = 606,948), there were n = 543,511 (89.5%) light drinkers and n = 63,437 (10.5%) risky drinkers. The mean daily pure alcohol intake was 16.3g and almost half of drinkers were non-smokers (n = 288,152, 47.5%). Drinking levels among light drinkers and risky drinkers were 10.3 and 66.6 g/day respectively.

Among risky drinkers, 83.2% were men and were on average 53.6 years old. Risky drinking patients had higher rates of current smoking (47.1%) than light drinkers (27.5%). For more details, see Table 2. Nine out of ten drinkers (88.4%) attending PHC practices in 2011 or 2012 were seen by a healthcare professional in 2013 (men: 87.7%; women: 90.1%), 51.5% had an outpatient specialized visit (men: 52%; women: 50.4%), 7.1% were admitted to hospital (men: 11.0%; women: 9.1%) and 27.4% were admitted to the emergency department at least once (men: 27.3%; women: 27.8%). Risky drinkers attending PHC settings during 2013 had a slightly lower mean number of appointments in PHC (men: 8.1; women: 7.9) than light drinkers (men: 8.2, women: 8.4). The mean number of hospital admissions among risky drinkers (men: 1.5; women: 1.4) were similar to those for light drinkers (men: 1.5; women: 1.3) and the median number of hospital admissions for both sexes and groups was 1 (Interquartile Range 1–2). The mean number of contacts with those people admitted to emergency departments was higher for risky drinkers (men/women: 2.0) as compared to light drinkers (men/women: 1.8). The mean number of contacts with specialists was slightly higher for risky drinkers (men: 4.4; women. 4.2) compared to light drinkers (men: 4.3; women: 4.1). For more details, see Table 2.

The primary analyses compared light to risky drinkers in their likelihood to use various health care services and yielded a mixed results for the observed services (for results, see Table 3). Risky drinkers were consistently more prone to be admitted as an inpatient or to emergency departments, while male risky drinkers were less likely to use PHC services (no significant effects were seen for females in the use of these services).

These results failed to show robustness when replicated in sensitivity analyses stratified by socioeconomic level and adding interaction terms of risky drinking and smoking behavior. In detail, similar effects in terms of direction and magnitude could be replicated but not in all socioeconomic strata for the 5 outcomes (PHC: low/moderate, hospital inpatient: only moderate, alcohol admissions: high/moderate, outpatient: only low, emergency: low/moderate/high). However, the effects did not remain significant after Bonferroni-correction. The model results further suggest that tobacco consumption is the most relevant factor for increased health service use both in men (current smoking for alcohol, hospital inpatient, and emergency department admissions; former smoking for PHC and hospital inpatient and outpatient admissions) and women (current smoking for alcohol, hospital inpatient and emergency department admissions; former smoking for PHC, alcohol and hospital inpatient and outpatient, and emergency department admissions). The effects of tobacco use were largely consistent across the socioeconomic strata and in the majority of models, the interaction of risky drinking and tobacco use did not prove to be significant (for detailed results, online suppl. Appendix).

In the secondary analyses, the duration of inpatient admissions in general hospitals, psychiatric hospitals,

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Table 2. Sociodemographic characteristics and health service use by pattern of alcohol consumption in year 2013

	Light drinkers		Risky drinkers		All drinkers		*p* value	
	female	male	female	male	female	male	female	male
Number	183,891	359,620	10,674	52,763	194,565	412,383		
Age	52.9 (52.9–53.0)	55.5 (55.5–55.6)	49.6 (49.3–49.9)	54.4 (54.2–54.5)	52.8 (52.7–52.8)	55.4 (55.3–55.4)	<0.001	<0.001
SES								
Low[a]	26.2 (26.0–26.4)	30.8 (30.7–31.0)	33.0 (32.1–33.9)	38.3 (37.9–38.7)	26.6 (26.4–26.8)	31.8 (31.6–31.9)	<0.001	<0.001
Moderate	42.3 (42.1–42.5)	42.8 (42.6–43.0)	38.6 (37.7–39.5)	40.0 (39.5–40.4)	42.1 (41.9–42.3)	42.4 (42.3–42.6)	<0.001	<0.001
High[b]	31.5 (31.3–31.7)	26.4 (26.3–26.6)	28.4 (27.5–29.3)	21.7 (21.4–22.1)	31.4 (31.2–31.6)	25.8 (25.7–26.0)	<0.001	<0.001
Alcohol consumption, g/week	50.4 (50.3–50.6)	83.7 (83.5–83.9)	326.8 (321.6–332.1)	494.8 (491.6–498.0)	65.6 (65.2–66.0)	136.3 (135.7–136.9)	<0.001	<0.001
Smoking status, %								
Non–smoker	63.1 (62.8–63.3)	42.7 (42.6–42.9)	44.3 (43.3–45.2)	26.3 (26.0–26.7)	62.0 (61.8–62.2)	40.6 (40.5–40.8)	<0.001	<0.001
Former smoker	12.4 (12.2–12.5)	28.3 (28.2–28.5)	11.7 (11.1–12.3)	26.0 (25.6–26.4)	12.3 (12.2–12.5)	28.0 (27.9–28.2)	0.025	<0.001
Smoker	24.6 (24.4–24.8)	29.0 (28.8–29.1)	44.1 (43.1–45.0)	47.7 (47.3–48.1)	25.6 (25.4–25.8)	31.4 (31.2–31.5)	<0.001	<0.001
Any primary health care, %[c]	90.2 (90.1–90.3)	87.8 (87.7–87.9)	88.8 (88.2–89.4)	86.8 (86.5–87.1)	90.1 (09.0–90.3)	87.7 (87.6–87.8)	<0.001	<0.001
Mean number of visits to primary health care [c] (95% CI)	8.2 (8.1–8.2)	8.4 (8.3–8.4)	7.9 (7.8–8.1)	8.1 (8.1–8.2)	8.1 (8.1–8.2)	8.4 (8.3–8.4)	0.019	<0.001
Median number of visits to primary health care[c] (IQR)	6 (2–11)	6 (2–11)	5 (2–10)	5 (2–11)	6 (2–11)	6 (2–11)		
Mean number of visits to primary health care of those attended (95% CI)	9.0 (9.0–9.1)	9.6 (9.5–9.6)	8.9 (8.7–9.1)	9.4 (9.3–9.4)	9.0 (9.0–9.1)	9.5 (9.5–9.6)	0.280	<0.001
Median number of visits to primary health care of those attended (IQR)	7 (3–12)	7 (3–12)	6 (3–11)	7 (3–12)	7 (3–12)	7 (3–12)		
Any inpatient hospital admission, %[d]	9.1 (8.9–9.2)	10.9 (10.8–11.0)	9.9 (9.3–10.4)	12.27 (12.0–12.6)	9.1 (9.0–9.2)	11.0 (11.0–11.1)	0.005	<0.001
Mean number of inpatient hospital admissions[d] (95% CI)	0.1 (0.1–0.1)	0.2 (0.2–0.2)	0.1 (0.1–0.1)	0.2 (0.2–0.2)	0.1 (0.1–0.1)	0.2 (0.2–0.2)	<0.001	<0.001
Median number of inpatient hospital admissions[d] (IQR)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)	0 (0–0)		
Mean number of inpatient hospital admissions of those patients admitted (95% CI)	1.3 (1.3–1.3)	1.5 (1.5–1.5)	1.4 (1.3–1.4)	1.5 (1.5–1.5)	1.3 (1.3–1.3)	1.5 (1.5–1.5)	0.025	0.020
Median number of inpatient hospital admissions of thosepatients admitted (IQR)	1 (1–1)	1 (1–2)	1 (1–1)	1 (1–2)	1 (1–1)	1 (1–2)		
Mean number of days of inpatient stay[d]	11.0 (10.5–11.5)	13.6 (13.3–14.0)	15.8 (12.6–19.0)	15.0 (14.1–15.9)	11.3 (10.7–11.8))	13.8 (13.5–14.2)	0.004	0.008
Median number of days of inpatient stay (IQR)	4 (2–8)	6 (2–12)	4 (2–11)	6 (2–14)	4 (2–8)	6 (2–13)		
Any emergency department contact, %[e]	27.5 (27.3–27.7)	26.9 (26.8–27.1)	31.6 (30.7–32.5)	30.0 (29.6–30.4)	27.8 (27.6–28.0)	27.3 (27.2–27.4)	<0.001	<0.001
Mean number of emergency department contacts [e] (95% CI)	0.5 (0.5–0.5)	0.5 (0.5–0.5)	0.6 (0.6–0.7)	0.6 (0.6–0.6)	0.5 (0.5–0.5)	0.5 (0.5–0.5)	<0.001	<0.001
Median number of emergency department contacts[e] (IQR)	0 (0–1)	0 (0–1)	0 (0–1)	0 (0–1)	0 (0–1)	0 (0–1)		
Mean number of emergency department contacts when attended (95% CI)	1.8 (1.8–1.8)	1.8 (1.8–1.9)	2.0 (1.9–2.0)	2.0 (1.9–2.0)	1.8 (1.8–1.9)	1.89 (1.8–1.9)	<0.001	<0.001
Median number of emergency department contacts when attended (IQR)	1 (1–2)	1 (1–2)	1 (1–2)	1 (1–2)	1 (1–2)	1 (1–2)		
Any alcohol admission, %[f]	1.7 (1.7–1.8)	2.7 (2.6–2.7)	2.4 (2.1–2.7)	3.4 (3.3–3.6)	1.7 (1.7–1.8)	2.8 (2.7–2.8)	<0.001	<0.001
Mean number of alcohol admissions [f] (95% CI)	0.0 (0.0–0.0)	0.0 (0.0–0.0)	0.0 (0.0–0.0)	0.1 (0.0–0.0)	0.0 (0.0–0.0)	0.0 (0.0–0.0)		
Median number of alcohol admissions[f] (IQR)	0 (0–1)	0 (0–1)	0 (0–1)	0 (0–1)	0 (0–1)	0 (0–1)	<0.001	<0.001
Mean number of alcohol admissions when attended (95% CI)	1.2 (1.2–1.2)	1.3 (1.3–1.3)	1.2 (1.1–1.3)	1.4 (1.3–1.4)	1.2 (1.2–1.2)	1.3 (1.3–1.4)	0.8	0.03
Median number of alcohol admissions when attended (IQR)	1 (1–1)	1 (1–1)	1 (1–1)	1 (1–1)	1 (1–1)	1 (1–1)		
Any outpatient specialized visit, %[g]	50.6 (50.3–50.8)	52.2 (52.0–52.4)	48.5 (47.6–49.5)	50.8 (50.4–51.2)	50.4 (50.2–50.7)	52.0 (51.9–52.2)	<0.001	<0.001
Mean number of outpatient specialized visits [g] (95% CI)	2.1 (2.1–2.1)	2.3 (2.2–2.3)	2.1 (2.0–2.1)	2.2 (2.2–2.3)	2.1 (2.1–2.1)	2.3 (2.2–2.3)	0.39	0.03

Table 2 (continued)

	Light drinkers		Risky drinkers		All drinkers		*p* value	
	female	male	female	male	female	male	female	male
Median number of outpatient specialized visits [g] (IQR)	1 (0–3)	1 (0–3)	0 (0–3)	1 (0–3)	1 (0–3)	1 (0–3)		
Mean number of outpatient specialized visits when attended (95% CI)	4.1 (4.1–4.2)	4.3 (4.3–4.3)	4.2 (4.1–4.4)	4.4 (4.3–4.4)	4.1 (4.1–4.2)	4.3 (4.3–4.4)	0.08	0.17
Median number of outpatient specialized visits when attended (IQR)	3 (1–5)	3 (1–5)	3 (1–5)	3 (1–5)	3 (1–5)	3 (1–5)		

[a] low = socioeconomic (SES) status very low or low.
[b] High = socioeconomic status very high or high.
[c] Comprises any visit to a doctor nurse or social worker.
[d] Comprises any inpatient admission to a general or psychiatric hospital or to a skilled nursing facility.
[e] Comprises any contact with the emergency department.
[f] Comprises any alcohol-attributable admission (for acute or chronic conditions entirely or partly attributable to alcohol use).
[g] Comprises any visit to outpatient mental health department or hospital specialists.
IQR, interquartile range for median only.

and skilled nursing facilities have been examined (descriptive tabulations of all patients and admitted patients by drinking risk status can be found in Table 4). Very few admissions were recorded in psychiatric hospitals for both light and risky drinkers. Zero-inflated negative binomial models were performed to examine the effects on the length of inpatient stays. The results indicate differences in the stay duration for general hospitals and skilled nursing facilities. In general but not in psychiatric hospitals, risky drinkers were found to stay longer (mean difference among all admitted patients: 1.3 days) than light drinkers. In skilled nursing facilities, a contrasting effect on length of stay was observed. Among females, risky drinkers stayed longer than light drinkers (almost 1 month), while the opposite was true for their male counterparts. The results further suggest that the length of inpatient admissions is associated with smoking behavior as well. For general hospitals and skilled nursing facilities, the effects of current and former smoking largely parallel those of risky drinking. In addition, current smoking has been found to be positively associated with the length of stay in psychiatric hospitals (all results presented in Table 5).

Discussion

In the present study, we aimed to find differences in health service use between light alcohol drinkers compared to risky drinkers. On the one hand, we found that risky drinking patients attending PHC are more prone to admission to hospitals or emergency departments, and their inpatient stays are longer. On the other hand, risky drinking men use less PHC or outpatient services than light drinkers. No significant differences in PHC use were found between light drinking and risky drinking women. When stratifying by SES and tobacco use, we found that the impact of risky drinking was less consistent than the impact that cigarette smoking has on health service use. Being a past or current cigarette smoker is associated with an increase in health service use, especially among men.

One strength of the study is that it gives unusually reliable information at an individual level not only on alcohol consumption but also on health service use. Given that in Catalonia, the information on health service use is systematically gathered from hospitals and PHC settings, it is noteworthy that this information is used by the Catalan government to pay health providers. We were

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Table 3. Results from multilevel logistic regression on combined service use categories. ORs with 95% CIs

Variable	Any primary health care[a]		Any hospital inpatient admission[b]		Any alcohol admission[c]		Any outpatient specialized visit[d]		Any emergency department visit	
Gender	female	male	female	male	female	male	female	male	female	male
Number	194,565	412,382	194,389	411,828	194,565	412,382	194,389	412,382	194,389	411,828
Intercept	17.84 (15.18–20.95)**	10.07 (9.11–11.14)**	0.07 (0.06–0.08)**	0.05 (0.05–0.06)**	0.01 (0.01–0.01)**	0.02 (0.01–0.02)**	1.31 (1.18–1.45)**	0.95 (0.85–1.06)	0.39 (0.33–0.46)**	0.33 (0.28–0.39)**
z-standardized age	2.08 (2.04–2.11)**	2.51 (2.48–2.54) **	1.45 (1.42–1.48)**	2.35 (2.31–2.38)**	2.50 (2.39–2.61)**	2.33 (2.28–2.39)**	1.53 (1.51–1.54)**	1.93 (1.91–1.94)**	0.97 (0.96–0.98)**	1.11 (1.11–1.12)**
SES[e]										
Very low (reference)	/	/	/	/	/	/	/	/	/	/
Low	0.94 (0.85–1.05)	0.98 (0.91–1.04)	0.9 (0.82–0.98)	0.94 (0.89–1)	1.07 (0.92–1.25)	1 (0.93–1.08)	0.89 (0.82–0.97)*	0.99 (0.93–1.06)	0.91 (0.83–1)	0.92 (0.86–0.98)
Moderate	0.82 (0.74–0.91)**	0.93 (0.87–0.99)	0.86 (0.8–0.93)*	0.91 (0.87–0.96)**	1.03 (0.9–1.18)	0.97 (0.91–1.04)	0.83 (0.77–0.9)**	0.96 (0.9–1.03)	0.84 (0.77–0.92)**	0.89 (0.83–0.95)**
High	0.69 (0.62–0.77)**	0.85 (0.79–0.91)**	0.76 (0.7–0.83)**	0.86 (0.81–0.92)**	0.91 (0.78–1.05)	0.93 (0.86–1.01)	0.72 (0.66–0.79)**	0.89 (0.83–0.95)*	0.77 (0.7–0.85)**	0.84 (0.78–0.91)**
Very high	0.60 (0.53–0.69)**	0.80 (0.73–0.88)**	0.64 (0.57–0.72)**	0.75 (0.69–0.82)**	0.83 (0.69–1.01)	0.80 (0.71–0.89)**	0.59 (0.52–0.66)**	0.75 (0.68–0.83)**	0.61 (0.54–0.69)**	0.65 (0.59–0.72)**
Risky vs. light drinker	0.98 (0.92–1.05)	0.89 (0.87–0.92)**	1.18 (1.09–1.28)**	1.22 (1.18–1.26)**	1.65 (1.45–1.89)**	1.35 (1.28–1.42)**	0.98 (0.94–1.02)	0.97 (0.95–0.99)	1.13 (1.08–1.18)**	1.11 (1.09–1.14)**
Smoker										
Non–smoker (reference)	/	/	/	/	/	/	/	/	/	/
Former smoker	1.18 (1.12–1.24) **	1.57 (1.53–1.62) **	1.13 (1.06–1.2) **	1.41 (1.37–1.45)**	1.12 (1–1.25)	1.34 (1.28–1.4)**	1.18 (1.14–1.21)**	1.36 (1.34–1.38)**	1.06 (1.02–1.09)*	1.18 (1.16–1.2)**
Smoker	0.94 (0.91–0.97) *	1 (0.98–1.02)	1.15 (1.09–1.21) **	1.57 (1.52–1.62)**	1.34 (1.21–1.48)**	1.59 (1.51–1.67)**	1 (0.97–1.02)	1.03 (1.02–1.05)**	1.19 (1.16–1.22)**	1.23 (1.21–1.25)**

Results obtained from multilevel logistic regression with individuals clustered in GP clinics (n = 373), nested in overarching regions (n = 9).
[a] Comprises any visit to a medical doctor, nurse or social worker.
[b] Comprises any inpatient admission to a general or psychiatric hospital or to a skilled nursing facility.
[c] Comprises any alcohol-attributable admission (for acute or chronic conditions entirely or partly attributable to alcohol use).
[d] Comprises any visit to outpatient mental health department or hospital specialists.
[e] SES, socioeconomic status.
* Bonferroni-corrected $p < 0.01$ ($p = 0.01/5 = 0.002$).
** Bonferroni-corrected $p < 0.001$ ($p = 0.001/5 = 0.0002$).

Table 4. Description of the length of inpatient stay at year 2013 by pattern of alcohol consumption

	General hospital		Psychiatric hospital		Skilled nursing facility	
	light drinkers	risky drinkers	light drinkers	risky drinkers	light drinkers	risky drinkers
All patients						
n	542,894	63,323	542,894	63,323	543,511	63,437
Mean (95% CI)	0.6 (0.6–0.6)	0.8 (0.8–0.9)**	0.0 (0–0.0)	0.0 (0.0–0.0)**	0.3 (0.3–0.3)	0.4 (0.4–0.5)**
All admitted patients						
n	37,110	5,157	201	93	2,971	427
Mean (95% CI)	8.8 (8.7–9.0)	10.1 (9.7–10.5)**	17 (14.2–19.8)	16.6 (13.0–20.1)	52.5 (50.1–54.8)	61.9 (54.3–69.5)
All female admitted patients						
n	10,295	654	76	21	775	59
Mean (95% CI)	7.0 (6.8–7.2)	8.3 (7.3–9.4)	18.1 (12.6–23.6)	20.6 (9.5–31.8)	54.3 (50.0–58.7)	83.3 (57.0–109.7)
All male admitted patients						
n	26,815	4,503	125	72	2,196	368
Mean (95% CI)	9.5 (9.4–9.7)	10.4 (9.9–10.8)*	16.3 (13.2–19.5)	15.4 (12.0–18.7)	51.8 (49.0–54.6)	58.5 (50.7–66.2)

Comparisons between light and risky drinkers
* $p < 0.01$ (bonferroni corrected $p = 0.001/9 = 0.0011$).
** $p < 0.001$ (bonferroni corrected $p = 0.001/9 = 0.00011$).

Table 5. Results from zero-inflated negative binomial regression on length of inpatient stay

Variable	General hospital		Psychiatric hospital		Skilled nursing facility	
Gender	female	male	female	male	female	male
Number	194,389	411,828	194,389	411,828	194,565	412,382
Count model						
Intercept	1.31 (1.21 to 1.41)**	1.42 (1.36 to 1.48)**	–7.12 (–8.8 to 5.45)**	–4.24 (–5.48 to 3)**	3.68 (3.36 to 4)**	–1.37 (–1.7 to 1.05)**
z-standardized age	0.4 (0.37 to 0.42)**	0.33 (0.31 to 0.35)**	–0.11 (–0.66 to 0.44)	0.44 (0.11 to 0.77)	0.07 (–0.07 to 0.21)	1.25 (1.11 to 1.39)**
SES						
Very low (reference)	/	/	/	/	/	/
Low	–0.05 (–0.15 to 0.06)	–0.05 (–0.11 to 0.01)	1.69 (–0.12 to 3.5)	0.59 (–0.43 to 1.6)	0.35 (0.06 to 0.65)	0.05 (–0.27 to 0.37)
Moderate	–0.11 (–0.2 to 0.01)	–0.1 (–0.16 to 0.05)**	1.35 (–0.35 to 3.06)	0.86 (–0.07 to 1.79)	0.22 (–0.05 to 0.48)	–0.01 (–0.3 to 0.27)
High	–0.17 (–0.27 to 0.06)*	–0.11 (–0.17 to 0.05)*	2.01 (0.26 to 3.75)	0.52 (–0.51 to 1.54)	0.09 (–0.19 to 0.38)	–0.13 (–0.46 to 0.19)
Very high	–0.2 (–0.34 to 0.07)*	–0.09 (–0.17 to 0)	2.38 (0.37 to 4.39)	1.2 (–0.28 to 2.68)	0.33 (–0.01 to 0.68)	–0.5 (–0.96 to 0.05)
Risky vs. light drinker	0.26 (0.14 to 0.38)**	0.12 (0.07 to 0.17)**	1.6 (–0.2 to 3.41)	–0.21 (–0.92 to 0.5)	0.49 (0.22 to 0.77)*	–0.81 (–1.01 to 0.6)**
Smoker						
Non-smoker (reference)	/	/	/	/	/	/
Former smoker	0.11 (0.03 to 0.2)	0.28 (0.24 to 0.32)**	0.57 (–0.67 to 1.82)	0.69 (–0.14 to 1.53)	0.05 (–0.21 to 0.31)	0.32 (0.11 to 0.53)*
Smoker	0.22 (0.14 to 0.29)**	0.42 (0.37 to 0.46)**	1.27 (0.11 to 2.43)	1.44 (0.77 to 2.12)**	–0.23 (–0.51 to 0.05)	0.96 (0.72 to 1.2)**
Zero-inflation model						
Intercept	2.25 (2.2 to 2.3)**	2.28 (2.24 to 2.31)**	–26.14§	2.42 (1.52 to 3.32)**	7.06 (6.89 to 7.23)**	2.48 (2.31 to 2.66)**
z-standardized age	–0.25 (–0.27 to 0.23)**	–0.79 (–0.8 to 0.77)**	–6.65§	0.99 (0.68 to 1.31)**	–2.1 (–2.21 to 1.99)**	–2.73 (–2.91 to 2.55)**
Risky vs. light drinker	–0.1 (–0.19 to 0.01)	–0.24 (–0.28 to 0.2)**	–4.58§	–1.93 (–2.55 to 1.31)**	–0.71 (–0.98 to 0.44)**	–26.47§

Results obtained from zero-inflated negative binomial regression.
§ Standard error could not be estimated.
* Bonferroni-corrected $p < 0.01$ ($p = 0.01/3 = 0.0033$).
** Bonferroni-corrected $p < 0.001$ ($p = 0.001/3 = 0.00033$)

thus able to avoid memory bias in obtaining the information on individual health service use. Furthermore, the sample analysed is very large and closely representative of the region.

The results found are in accordance with those studies that found that heavy drinkers or alcohol dependent patients are more prone to be admitted to hospitals [9, 30] and to emergency departments [5, 6, 8, 18] than light or

non- drinkers. The pattern of health service use described in our study may be due to the fact that risky drinkers have more health problems than light drinkers that imply using more specialized and expensive services. Risky drinkers, in order to avoid being stigmatized and classified as alcohol dependent, may elude going to a health care professional with whom a relationship of trust should be established, only asking for help when an illness is severe and emergency care it is required. Our results point in the same direction as those studies that found that higher amounts of alcohol consumed correlates with higher health services use, and the divergences between our results and those reported by Rice and colleagues [10] may be due to the type of coverage that the Catalan public health system offers, that is, universal health coverage and free of charge.

Results of the primary analyses suggest that socioeconomic level and cigarette smoking have an impact on health service use. The sensitivity analyses performed considering these 2 factors show that the association between risky drinking and health care use is not consistent across socioeconomic strata. It has been described elsewhere that alcohol consumption has a greater impact on people with a lower socioeconomic status in terms of harm. However, this relationship still requires better characterization, according to Jones and colleagues [31]. On the other hand, the sensitivity analyses found a robust relationship between cigarette smoking and an increased health service use. Consistent findings have been previously reported describing former and current cigarette smokers using more the health services compared to those who have never smoked [24]. Smoking status has been strongly associated with an increased number of hospitalizations, longer hospital stays [12, 32] and a higher number of emergency, in- and outpatient visits [9] among cigarette smokers; as well as being even higher among former-smokers [9]. Given that the socioeconomic level was defined using aggregate data, conclusions cannot be drawn at the individual level. Other determinants related to the classification of socioeconomic level for municipalities, such as density of health care services, may also impact health care utilization and should be considered in future analyses on this subject.

Our findings support the idea that sex differences in the pattern of health service use should be considered when planning health care policies for the general population [33]. In general, women use more PHC services [3] and this trend is in accordance with our results. In this sense, preventive interventions in PHC would benefit women.

In the last few years, a great deal of effort has been made to increase preventive strategies to reduce alcohol consumption in PHC settings. However, from our study results, it seems that risky drinkers, who would benefit most from those strategies, are using more inpatient services and emergency departments. It has been proposed that preventive strategies on alcohol consumption should focus on hospital settings, such as those being implemented for smoking [34]. Thus, screening and brief interventions in emergency departments and during hospital admissions could be adequate means to reach a meaningful proportion of risky drinkers. Furthermore, brief Interventions have been found useful and promising in the emergency department [35, 36].

This study has some limitations that should be taken into consideration. First, it has to be considered that the information on alcohol and cigarette smoking was self-reported and may be subject to underreporting bias. Second, we should bear in mind that alcohol consumption may be under-recorded in PHC medical records, as has been described previously in a study of 9 European general hospitals [37]. From the total sample of patients with information on alcohol consumption registered in the electronic medical record, it was recorded that only 32% were considered drinkers, which is clearly below the national prevalence figures [38]. As the group of patients classified as abstainers may include a very heterogeneous group and some of them might be misdiagnosed, we decided not to include them in the analysis. Third, it has to also be considered that in the sample studied, the group of risky drinkers might be underrepresented, given that only people attended in a PHC setting were selected. Information on individuals that only use the emergency department is lacking, for example, healthy young people who are impacted by an alcoholic intoxication, or people living in a situation of social exclusion, such as homeless people. Fourth, alcohol consumption first started being registered in Catalan electronic medical records in January 2011, so information on the duration and pattern of alcohol consumption of each patient prior to this date was lacking. However, it has been indicated that the impact of changes in alcohol consumption on hospitalization rates has no substantial time lag [39]. Also, we did not include several variables that are potentially associated with the pattern of healthcare use, such as ethnicity, physical activity, nutrition or other dietary factors. Furthermore, patients in high-income areas could incur less public health care use as they may be covered by a

private health insurance and use public healthcare less often. The Catalan Health Department has estimated that private health insurance costs represent 25% of the total public healthcare costs. Finally, it has to be considered that the large sample size may result in small, negligible group differences becoming significant even with Bonferroni corrected *p* values.

A different pattern of health service use has been observed depending on alcohol and tobacco consumption. Risky drinking and cigarette smoking are associated with higher inpatient admissions and emergency department visits. Those services are more expensive than outpatient visits and PHC. Furthermore, gender differences in health service use in this population should be considered. As PHC services are less frequently used by risky drinkers, interventions in emergency departments and acute hospitals, particularly for women, may be appropriate means to reach this population.

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