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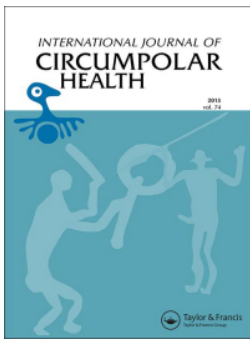
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Exploring sex-specific time trends in drinking patterns in the Greenlandic population from 1993 to 2014 – a large Arctic Indigenous population

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ABSTRACT

A drinking pattern characterised by occasional excessive drinking is a key challenge for public health in Greenland. The objective was to examine sex-specific time trends in drinking patterns among Greenland Inuit. Cross-sectional and cohort data from geographically representative health surveys in 1993, 2005–2010 and 2014 were included ($n = 4,938$). Drinking patterns were defined as abstainer, non-problematic and occasional binge drinking. Patterns were analysed by sex-specific crude proportions and logistical analyses according to age, birth cohort and calendar time, accounting for region and settlement type. More than half of the men and one-third of the women had an occasional binge drinking pattern, while 22.6% of females and 15.1% of men were abstainers. Abstention increased with increasing age, while occasional binge drinking decreased among men. Younger male birth cohorts were less likely to have an occasional binge drinking pattern, while the youngest females had the highest odds ratio. A drinking pattern characterised by occasional excessive use remains a key challenge for public health in Greenland with age as a strong predictor. A high prevalence of abstainers co-exists with a high prevalence of occasional binge drinking. The increased odds ratio for occasional binge drinking among younger females should be addressed further.

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Introduction



The consequences of alcohol consumption in Greenland

Problematic alcohol use is by far one of the most impactful public health challenges in Greenland with harmful consequences, not only for the health and well-being of those affected but also for their families and the community in terms of crime, social problems and adverse childhood experiences [1,2]. Research has shown strong associations between alcohol problems in the childhood home and exposure to sexual abuse, suicidal thoughts and a problematic alcohol use later in adult life [2]. The earliest reports of alcohol as a public health concern dates back to 1958, where repeated episodes of intoxication were described among Greenlanders, leading to social and economic problems [3]. Alcohol is not only an individual and social challenge, but also an economic burden for the healthcare system and society in Greenland [2].

Historical perspective on alcohol import and consumption patterns

After restrictions on the sale of alcohol were lifted in 1954, the import of alcohol to Greenland increased steadily until it peaked in 1987 with 22.0 litres per person aged 15+ years. Since 1987, the import decreased, at first rapidly, then more sustained [2,4]. From 1993 to 2014, which is the period covered by this study, the yearly alcohol import decreased by 33% (Figure 1). Survey data from 2014 have shown regional differences in drinking patterns with high prevalences of monthly binge drinking behaviour in East Greenland and low prevalences in the northern part of Greenland [5]. Analyses based on the same survey data found the highest prevalence of alcohol problems in childhood home in the capital Nuuk (33.1%), while 18.2% living in settlements reported such problems [1].

A harmful drinking pattern characterised by occasional excessive use has been highlighted as a key challenge in the Greenlandic society [1,2].

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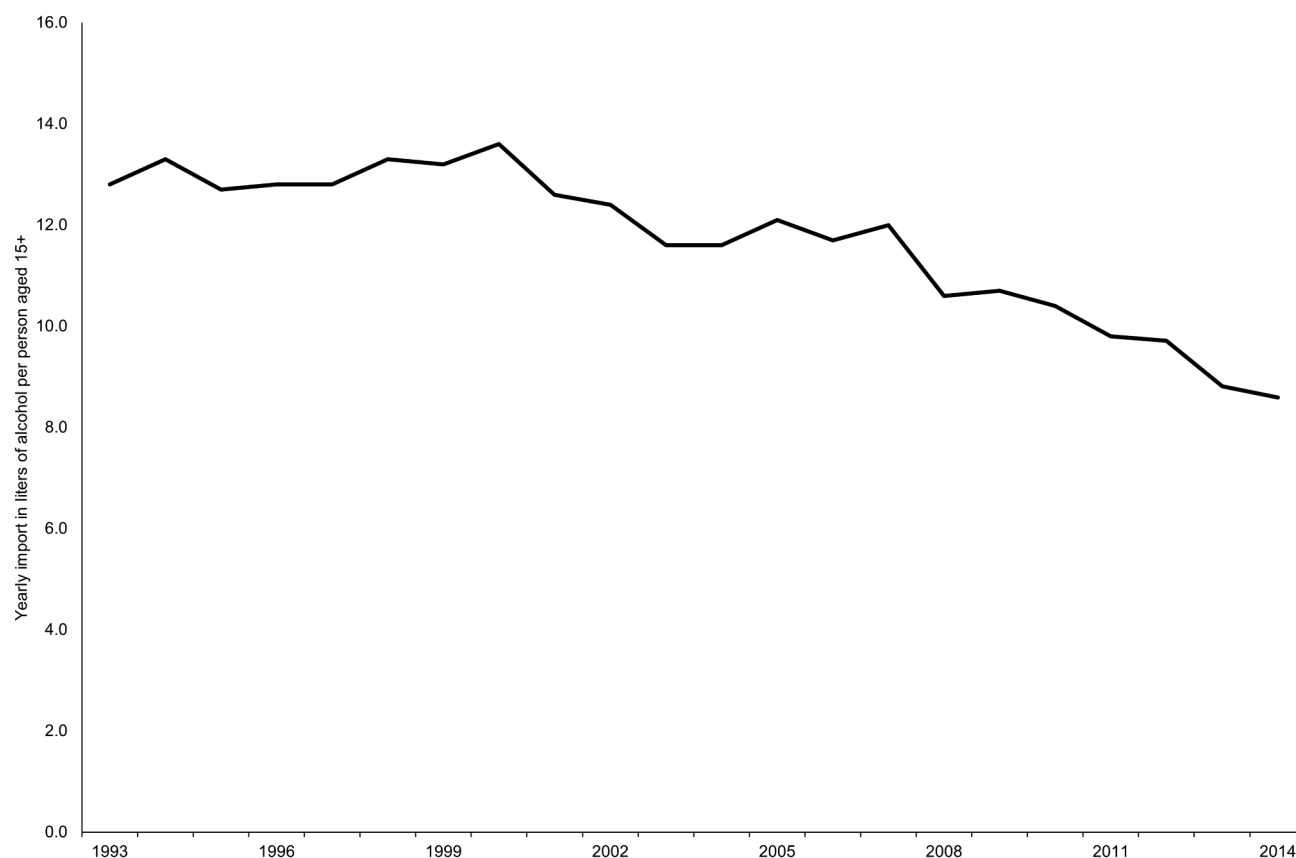


Figure 1. Yearly alcohol import in litres of alcohol in Greenland per person aged 15+ years from 1993 until 2014. Source: Statistics Greenland.

Alcohol consumption in relation to sex, time scales and geography

The decrease in alcohol import has continued since 2010, and today the consumed amount of alcohol is on par with the Nordic countries [2,6]. Globally, age is strongly associated with alcohol consumption. The association is dynamic and varies according to sex, but overall, research shows a decrease in consumption with increasing age [7,8]. However, this association may vary and can be explained by other factors such as birth cohort and calendar time effects, both of which reflect temporal trends affected by numerous factors reflected in historical events, economic (price), political (sanctions), social (norms) and cultural developments [9]. In a historical perspective, alcohol use has been more prevalent among men, but a recent systematic review and meta-regression based on 68 studies from across the world have identified that the gender gap is closing in younger cohorts, caused by an increased alcohol consumption among young women [10].

Even though use of alcohol is an important public health challenge among Indigenous Arctic populations,

little is known about how drinking patterns are related to age, cohort and calendar time. Such knowledge would inform better and more tailored preventive strategies and their potential impact on follow-up investigations.

Objective

The objective of this paper was to examine sex-specific time trends in alcohol use in the Greenlandic population from 1993 to 2014 and to explore these trends in relation to age, birth cohort and calendar time.

Materials and methods

Setting

The majority (92%) of the Greenlandic population are Greenland Inuit, Kalaallit [11]. Greenland represents a uniquely large Indigenous Inuit population of 56,000 people with self-governance, inhabiting the world's largest island of 2 million km². In Greenland, there is

Table 1. Characteristics of participants in the 1993, 2005 and 2014 health surveys.

	1993 survey	2005 survey	2014 survey	Total sample
N	1,104	2,154	1,680	4,938
Women, n (%)	573 (51.9)	1147 (53.3)	1005 (59.8)	2,725 (55.2)
Age in years, mean (SD)	37.7 (13.9)	41.5 (13.4)	47.0 (14.3)	42.5 (14.3)
Range	18–91	18–84	18–88	18–91
Birth cohort year, mean (SD)	1955 (14.0)	1964 (13.6)	1966 (14.3)	1963 (14.6)
Range	1902–1975	1921–1990	1925–1996	1902–1996
Settlement type, n (%)	901 (81.6)	1,668 (77.4)	1,394 (83.0)	3,923 (80.2)
Town				
Region, n (%)				
North	426 (38.6)	629 (29.2)	511 (30.4)	1,566 (31.7)
South	231 (20.9)	457 (21.2)	225 (13.4)	913 (18.5)
Central	397 (36.0)	816 (37.9)	779 (46.4)	1,992 (40.3)
East	50 (4.5)	252 (11.7)	165 (9.8)	467 (9.5)

Individuals who participated in one, two or all three surveys are included with their separate responses across surveys. Abbreviation: SD, standard deviation.

a considerable variation in living conditions across regions and between small and large communities, including differences in educational level, job function and access to health and social services. There are around 80 communities distributed across five municipalities. These communities are either towns or villages scattered especially on the West coast. A town is historically the largest community in the former districts with access to schools and administration, health care provided by either a health centre or a hospital, and major shops. A town in Greenland is relatively small in comparison to other countries. The capital, Nuuk, counts approximately 17,000 citizens (32% of the population), while the other towns range from 550 to 6,000 citizens [4]. Villages are small communities without access to the aforementioned services and have fewer inhabitants, ranging from 10 to around 550 per village. Most of the population lives in largish towns, while 14% lives in villages [4]. Geographically, most of the population lives in the Mid-West (Central) region of Greenland, while the northernmost part and the East Coast are the least densely populated areas.

Sampling

This study is based on three population health surveys conducted in Greenland in 1993–1994 (1993 survey), 2005–2010 (2005 survey) and 2014–2015 (2014 survey), respectively [12,13,14]. The surveys collected clinical and questionnaire data about physical and mental health, diabetes, obesity, diet, physical activity, alcohol, smoking, sociodemographic information, and childhood conditions. All three surveys are geographically representative of the Greenlandic population. All three surveys included participants from communities in the following five geographical regions: the Capital, South

Greenland, Central Greenland, North Greenland, and Eastern Greenland.

Participants in the three surveys were randomly recruited among the Greenlandic population aged 18 or more. Samples were drawn from the Civil Registration System (CPR), and former participants from 1993 to 2005 were re-invited for the 2014 survey. The sample was restricted to Greenland Inuit, excluding 367 ethnic Danes from the sample. The characteristics of the surveys and the participants are shown in Table 1.

A total of 6,485 survey responses were included in the study, of which 4,795 unique persons participated. Among those, 3148 participated in one survey, 1604 in two surveys and 43 in all three surveys. Participants who did not answer the self-administered questionnaire in the surveys and those with missing information on alcohol consumption, along with 77 people who did not fit into the generated consumption groups, were excluded from the analysis (n = 1,547). In total, 4,938 survey responses were included in the analyses.

Outcome – alcohol intake and groups of alcohol consumption

Three alcohol consumption groups were constructed, based on two questions about frequency of alcohol intake and the amount of alcohol consumed on the last occasion; “How often do you drink wine, beer or spirits?” and “How much alcohol did you consume on the last occasion?”. In the frequency question, respondents could reply the following according to consumption of beer, wine or spirits: “Every day or almost every day”, “3–6 times a week”, “Once or twice a week”, “1–3 times a month”, “Less than any of the above” and “Never”. In relation to the amount consumed on the last occasion they consumed alcohol,

participants could respond “1 beer or glass of wine or spirits”, “2–5 beers or glasses of wine or spirits”, “6–10 beers or glasses of wine or spirits” and “more than 10 beers or glasses of wine or spirits”. The 2005 and 2014 surveys referred to alcohol consumption in the previous 12 months, while the 1993 survey did not refer to any specific time frame. For the 1993 survey, participants were classified as abstainers if they responded “Never” to the alcohol frequency question, and for the 2005 and 2014 survey, participants were classified as abstainers if they were lifetime abstainers or had abstained from alcohol within the previous 12 months. The three alcohol consumption groups were: *abstainers* (including both lifetime abstainers and people who had been abstainers for the past 12 months); *non-problematic alcohol use* (defined as either consuming 1 drink on the last occasion, regardless of the frequency, or consumption of 2–5 drinks on the last occasion and consumption of alcohol 1–2 days a week or less often); and *occasional binge drinking* (defined as consuming 6 drinks or more on the last occasion regardless of the frequency of alcohol consumption). The latter was constructed because the consumption of 6 drinks or more was regarded as short-term binge drinking behaviour reflecting occasional excessive alcohol consumption. Based on data on monthly binge drinking from the 2005 and 2014 surveys, 86% of the people who were occasional binge drinkers were categorised as monthly binge drinkers. Non-problematic alcohol use was constructed based on the notion that one drink per occasion is a low consumption, and that 2–5 drinks is below standard binge-drinking cut of values, which is typically 5–6 drinks or more. Participants who consumed 2–5 drinks on the last occasion and who consumed alcohol more than twice a week were excluded, since they drank too much to be categorised as non-problematic users and too little to be categorised as occasional binge drinkers ($n = 77$).

Sociodemographic indicators

Independent variables included age, birth cohort and calendar time. Age and birth cohort were categorised into 10-year intervals and calendar time had one category for each survey (1993, 2005 and 2014). All analyses were done separately for men and women. Settlement type (town/village) and region were included in order to adjust for potential geographical and residential differences.

Statistical analysis

Alcohol consumption was described by the crude proportions and logistic regression analysis for the

consumption groups according to three time scales; age, birth cohort and calendar time. Due to differences in age distribution across surveys, consumption by calendar time was standardised to the age distribution in the total sample. Abstention and occasional binge drinking were each compared to non-problematic alcohol use in two separate logistic regression analyses. Each logistic regression model accounted for repeated measures of alcohol consumption by the same person by assuming an independent correlation structure using a compound symmetry correlation structure. The influence of age was adjusted for birth cohort, while the influence of birth cohort and calendar time were adjusted for age. P-values for difference within each time scale was calculated for men and women separately with an alpha level of .05. All logistic regression models were adjusted for region and settlement type. Pearson goodness-of-fit statistics supported that the models were satisfactorily specified ($p > 0.05$). Models were fitted using PROC GENMOD in SAS version 9.4.

Ethics

All three health surveys were approved by the Greenland Committee of Research Ethics and written informed consent was given by the participants.

Results

A total of 6,485 survey responses were included in the study, of which 4,795 unique persons participated. Among those, 3148 participated in one survey, 1604 in two surveys and 43 in all three surveys. Of the 4,795 participants, a little more than half were women. Across all three surveys, living in a town was the most common settlement type, and age ranged from 18 to 91 years, with a mean age of 42.5 years ($SD = 14.3$). The corresponding mean birth cohort year was 1963 ($SD = 14.6$), ranging from 1902 to 1996 (Table 1).

Table 2 provides alcohol consumption prevalence in relation to sex, calendar time, cohort and age. Among men, 15.3% were abstainers, 30.6% had a non-problematic alcohol use and 54.3% were occasional binge drinkers. More women than men were abstainers or had a non-problematic alcohol use. Correspondingly, fewer women than men were occasional binge drinkers.

Table 3 shows no clear trend between calendar time and odds ratios (OR) for abstention in men and women. Among men, there was a decrease in the OR of occasional binge drinking in 2005 compared to 1993 ($P = 0.02$). Abstention and occasional binge

Table 2. Alcohol consumption prevalence in relation to sex, calendar time, cohort and age.

	n (%)	Abstention		Non-problematic alcohol use		Occasional binge drinking	
		Male	Female	Male	Female	Male	Female
		334 (15.1) %	615 (22.6) %	678 (30.6) %	1,199 (44.0) %	1,201 (54.3) %	911 (33.4) %
Calendar time ^a							
1993	1,104	13.4	27.8	28.3	44.2	58.3	28.0
2005	2,154	14.7	22.0	31.4	44.5	54.0	33.6
2014	1,680	14.2	24.4	32.1	42.4	53.8	33.2
Cohort							
–1944	507	26.4	49.8	38.4	35.8	35.3	14.4
1945–1954	728	22.3	34.1	30.3	43.4	47.5	22.5
1955–64	1,453	12.5	18.2	27.4	47.6	60.1	34.3
1965–1974	1,243	13.5	18.4	29.6	44.3	56.9	37.3
1975–1984	587	4.4	17.6	32.3	47.8	63.3	34.6
1985–	420	8.6	16.7	31.5	34.5	59.9	48.8
Age							
18–29	1,121	7.5	17.5	30.4	40.8	62.1	41.8
30–39	974	11.1	16.6	29.2	48.7	59.8	34.7
40–49	1,261	12.6	18.1	29.2	45.3	58.2	36.6
50–59	936	18.8	27.5	27.0	45.5	54.2	27.1
60–69	488	24.6	42.9	39.0	39.7	36.4	17.4
70–91	158	41.4	64.8	41.4	28.2	17.2	7.0

Individuals who participated in one, two or all three surveys are included with their separate responses across surveys.

^aProportions for calendar time were age standardised according to the age distribution in the total sample.

drinking do not seem to be associated with a clear trend with regard to birth cohorts, but the results suggest that younger male birth cohorts are less likely to occasionally binge drink, while the youngest females have the highest OR across the female birth cohorts (1.4, 95% CI = 0.9–2.1). Age was a statistically significant predictor of abstinence, showing increasing OR with increasing age in both men and women ($P = 0.02$ and $P = 0.0003$). Conversely, increasing age was associated with decreasing odds of occasional binge drinking; however, this was only statistically significant in men ($P < 0.0001$).

Discussion

The main finding of the present study is that trends in drinking patterns were most consistent in relation to age, while the trends for cohort and calendar time varied among men and women. Another important finding was a high OR of women occasionally binge drinking in the youngest birth cohort, while the OR decreased with younger birth cohorts in men. Increasing age was associated with a higher proportion of abstainers and a decrease in the proportion of occasional binge drinking. The results of the association between drinking pattern and age were in accordance with the literature [2,7,15].

Due to the high alcohol import, we expected a higher tendency to occasional binge drinking among people who consumed alcohol in the 1980s compared to later birth cohorts. This seems to apply to men with the highest

OR among people born before 1965 and decreasing OR in birth cohorts after 1974. We further hypothesised that drinking patterns would reflect the decrease in alcohol import during the study period. The overall trend with stable drinking patterns from 1993 until 2014 is in discordance with the decrease in alcohol import, apart from a decrease in the OR of occasional binge drinking among men. This discrepancy could be related to the timing of the survey. The earliest survey included in this study was carried out in the early 1990s, where the alcohol import had already changed after being at a high level for many years. Following this line of thought, a decline in consumption may have been clearer with an older survey exhibiting a drinking pattern unaffected by the decreasing import, with a high OR of occasional binge drinking and a low OR of abstinence. The stability in drinking patterns may also represent a tendency in which those with the highest consumption are consuming increasingly more alcohol. According to a recent study, the 20% with the lowest and the highest consumption consumed 0.8% and 50%, respectively, in 1956. In 2018, the corresponding distribution of consumed alcohol in the two groups were 0.1% and 74% [2].

The high proportion of occasional binge drinkers among younger age groups suggests a need for a particular focus on monitoring and prevention among youth. The findings are in accordance with the literature, and occasional binge drinking has been found to coincide with alcohol-related problems, stressing the need for youth-oriented prevention [16]. In the present study, the only group with a very limited alcohol intake were persons aged 60 or above, which supports general findings within alcohol research [2,7,8].

Table 3. Odds ratios of abstinence and occasional binge drinking compared to non-problematic alcohol use in relation to sex, age, cohort and calendar time.

	Abstinence compared to non-problematic alcohol use				Occasional binge drinking compared to non-problematic alcohol use			
	Male		Female		Male		Female	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Calendar time ^a								
1993	1.0	Ref	1.0	Ref	1.0	Ref	1.0	Ref
2005	1.1	0.7–1.5	0.8	0.6–1.1	0.7	0.6–0.9	1.1	0.8–1.4
2014	1.1	0.7–1.6	1.0	0.8–1.4	0.7	0.5–1.0	1.2	1.0–1.6
P-value	0.9		0.1		0.02		0.2	
Cohort ^a								
–1944	0.7	0.4–1.4	1.4	0.8–2.4	1.3	0.8–2.1	0.7	0.4–1.3
1945–1954	1.1	0.6–1.9	1.0	0.7–1.6	1.3	0.8–1.9	0.7	0.5–1.1
1955–64	0.8	0.5–1.2	0.7	0.5–1.0	1.4	1.0–1.9	0.9	0.7–1.2
1965–1974	1.0	Ref	1.0	Ref	1.0	Ref	1.0	Ref
1975–1984	0.3	0.1–0.7	0.8	0.6–1.3	0.9	0.6–1.3	0.8	0.6–1.0
1985–	0.6	0.3–1.4	1.3	0.8–2.1	0.7	0.5–1.2	1.4	0.9–2.1
P-value	0.02		0.08		0.3		0.05	
Age ^b								
18–29	0.8	0.4–1.6	0.9	0.6–1.3	1.4	0.9–2.0	1.1	0.8–1.5
30–39	1.0	0.6–1.6	0.8	0.6–1.2	1.1	0.8–1.5	0.9	0.7–1.1
40–49	1.0	Ref	1.0	Ref	1.0	Ref	1.0	Ref
50–59	1.7	1.1–2.6	1.6	1.2–2.1	1.0	0.7–1.3	0.8	0.6–1.1
60–69	1.4	0.9–2.4	2.2	1.5–3.4	0.4	0.3–0.7	0.7	0.4–1.1
70–91	2.8	1.4–5.4	3.7	1.9–7.2	0.2	0.1–0.4	0.4	0.2–1.3
P-value	0.02		0.0003		<0.0001		0.3	

All models are adjusted for region (North, South, Central and East Greenland) and settlement type (town and village). The statistical models account for repeated measurements.

^aRegression models of cohort and calendar time are also adjusted for age.

^bRegression models of age are also adjusted for cohort.

Comparing trends in alcohol consumption in Greenland to other Western countries may be less optimal due to historical consequences of being a former colony, including acculturation and marginalisation, which have caused psychological trauma and intergenerational trauma leading to higher alcohol consumption and alcohol-related problems [17–19]. Despite differences in historical events, more comparable indigenous populations are the Inuit in Canada and Alaska, who have a similar colonial and cultural background. Unfortunately, research on time trends in alcohol consumption in Inuit populations is sparse, and only one study was identified. A study of Inuit from Northern Québec in Canada investigating temporal trends in alcohol and drug use found an increase in alcohol consumption from 1992 to 2004. The alcohol pattern was characterised by an increasing frequency in alcohol consumption and an increase in the proportion of at least one episode of heavy drinking within the last year. The study found a high proportion of abstainers, which matches our findings [20]. The overall increase in alcohol consumption measured in the Canadian study was in discordance with the decrease in alcohol import in Greenland during the same period.

Strengths and limitations

The main strength of the present study is that it is unique in being based on cross-sectional data from three geographical representative health surveys with high

response rates varying between 57% and 63%. The civil registration numbers allowed us to adjust for duplicates in our analysis. Included measures of alcohol consumption were based on two largely identical questions, ensuring that the results are referring to consistent measurements. Problems with small sample sizes are prevalent in research on Indigenous population, which poses challenges with statistical power. However, this study represents a large sample within the field.

Another strength of the present study was the investigation of drinking patterns according to age, birth cohort and calendar time, accounting for different time-related effects on alcohol consumption. The absence of clear trends in drinking patterns may reflect selection bias in that those who have the highest consumption may not be able to or willing to participate in the health surveys, resulting in an underestimation of the proportion of people with an occasional binge-drinking pattern. Since we know the underreporting of alcohol consumption in Greenland is between 40% and 50% of the imported amount, depending on consumption pattern, this selection is expected to have affected the results [21]. Furthermore, the lack of change over time may indicate that the measuring of occasional binge drinking was not an optimal proxy measure for usual consumption volume. A general weakness of studying alcohol patterns is reporter bias. The consumption groups were based on

a measure of amount of consumed alcohol on the last occasion, which may not reflect the average drinking pattern or volume. Since this study was investigating drinking patterns, it would have been valuable to include a measure for binge drinking, as this would potentially have strengthened the ability to reflect average drinking habits. However, this was not possible, because binge drinking was not measured in the 1993 survey. The construction of the occasional binge-drinking group was defined to create a short-term binge measure, which was the closest construct to binge behaviour that could be generated across all three surveys. Since occasional excessive alcohol use is defined as a key public health challenge in Greenland, this measure provided valuable information. Comparison with binge drinking data from the 2005 and 2014 surveys indicated that occasional binge drinking could, to some extent, reflect an average consumption. Problems with healthy selection and under-reporting points towards the use of alcohol import as a useful measure of the consumed volume of alcohol. In line with the high level of underreporting in Greenlandic health surveys, surveys are perhaps better suited to investigate the *frequency* of alcohol consumption rather than the *volume*. The ability to benchmark the findings of the present study against import statistics was an important indication of their validity. Differences in the length of survey sampling may have affected the results, since the 2005 survey was conducted from 2005 until 2010, while the other two surveys were conducted across a two-year period. Between 2005 and 2010, the alcohol import decreased, potentially leading to an overestimation of the odds of abstention and an underestimation of the odds of occasional binge drinking.

Implications for the future

Understanding the patterns of alcohol use and how these patterns might have varied over time is important for future public health policy planning and can be used to target alcohol prevention and health promotion in Greenland.

The present study has identified important implications for future research to focus on alcohol consumption measures. Based on the results, it is recommended to carry out more studies of binge drinking behaviour in Greenland, along with studies using more robust measures on consumption volume and average consumption. The high proportion of occasional binge drinkers in the present study suggests that the preventive strategies in Greenland should have a specific focus on a lower consumption

per drinking occasion, especially among young people. A high prevalence of occasional binge drinking with large consequences at both the family and the community level is an equal challenge in other Arctic regions, such as Alaska and Canada [19,22–24]. In the same regions there are examples of preventive strategies targeted at mental health and problem drinking in communities based on culturally relevant measures developed by the community as a part of a community-based participatory research approach. One example of this is the work of the *Qasgiq Model*, an Indigenous model based on Alaska Native culture and context focusing on protective factors to reduce suicide and alcohol abuse among youth [25]. However, research with a focus on interventions and prevention building on strengths in Inuit cultures, where a particular focus on culture and community is important, is still sparse [19,26]. Culturally defined and community-led models for the prevention of problematic alcohol use have not yet been a part of the Greenlandic approach to prevention but represent a promising practice that should be taken into consideration in future public health strategies in Greenland.

Conclusion

Based on a large Indigenous sample among the Greenlandic Inuit, we found that a drinking pattern characterised by occasional excessive use remains a key challenge for public health in Greenland. Both abstention and occasional binge drinking are prevalent in Greenland among the participants from the population surveys from 1993, 2005 and 2014. Age is the strongest predictor of drinking pattern with a decrease in occasional binge drinking and increase of abstention with increasing age among both men and women, while the trends for cohort and calendar time varied according to sex. The high prevalence of occasional binge drinking among young age groups calls for further attention and prevention. There is a need to investigate the potentially beneficial effects of community-led prevention models targeted at both the general population and young people. Although the import of alcohol in Greenland has decreased significantly since the late 1980s, this is not reflected in our findings, which measure self-reported drinking patterns across age, birth cohorts and calendar time. This discrepancy may reflect both healthy responder selection and that the included measures of drinking patterns do not capture the actual volume consumed, indicating a need for better measuring tools.

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Disclosure statement

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