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Alcohol assessment in free-living people: challenges & opportunities

Marian L Neuhouser, PhD, RD
Professor and Program Head
Cancer Prevention Program
Division of Public Health Sciences
Fred Hutchinson Cancer Center: Seattle, WA

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Disclosures for Marian Neuhouser, PhD, RD

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Exposure measurement in population studies is key to predicting whether an exposure (in this case, alcohol intake) is related to a health outcome

Ideally, we want the ‘true’ exposure… in reality we are able to measure surrogates

1. Overview of exposure measurement principles
2. Measurement of alcohol in population-based studies
3. Issues to consider in alcohol assessment
4. Is there a place for biomarker assessment of alcohol intake?

A few principles about exposure assessment

- The exposure should have a **hypothesized biological relationship** to the health outcome
  - For example, if humans could not absorb or metabolize alcohol, then alcohol would not be considered an exposure of interest
- We acknowledge that there is some error in exposure assessment
  - Nearly impossible to assess **all** alcohol exposure over the life course, so what is a meaningful measure?
- What is the **relevant time course** between the exposure (alcohol intake) and the health outcome?
  - This influences the manner in which the exposure assessment is conducted
- Duration, frequency, intensity (e.g., serving size) → dose

Measurement of Alcohol

- Alcohol falls into its own category for exposure assessment
  - **Nutritional exposure**
  - Provides kcals and some other nutrients and phytochemicals (**part of dietary assessment**)
    - 7 kcals/gram
    - Polyphenols in wine
    - Other phytochemicals in juices in some cocktails
    - Magnesium, potassium, B-vitamins
    - Added sugars in many mixed drinks/cocktails
    - Salt/sodium – rimmed glasses

Measurement of Alcohol

- Alcohol falls into its own category for exposure assessment
  - **Behavioral exposure**
  - Alcohol consumption is also a behavior or even a risky behavior (**part of behavioral assessment**)
    - Could lead to mis-reporting or underreporting
    - Reporting reliability may depend on the circumstances
      - Age
      - Life course stage (pregnancy)
      - Other personal characteristics/cultural expectations (religious practices that forbid or discourage)
  - Alcohol use disorder (AUD) – questions included in the Phen-X toolkit

Measurement of alcohol intake as part of dietary assessment

- Food frequency questionnaires (FFQs) are used in most cohort studies

- Frequency and portion size of groups of foods and beverages

- Alcohol included in the beverages section of FFQs
  - Cognitively – alongside coffee, tea, soft drinks

Alcohol assessment on FFQs (selected examples) Women's Health Initiative (WHI) FFQ. Past 12 months timeframe. Yields data on mean drinks/day, mean alcohol (g)/day, and % of kcals/d from alcohol. Can also be used in dietary pattern analyses.

BEVERAGES (Please note that the frequency headings are different.) →	HOW OFTEN DID YOU EAT THE FOOD (Mark one)									AMOUNT			
	Never or less than once per month	1-3 per month	1 per week	2-4 per week	5-6 per week	1 per day	2-3 per day	4-5 per day	6+ per day	Medium Serving Size	Your Serving Size S	M	L
Milk, all types (including canned and soy) not on cereal										8 ounce glass			
Regular soft drinks (not diet)										12 ounces or 1 can			
Beer										12 ounce can or bottle			
Wine										1 medium glass (6 ounces)			
Liquor										1 shot (1 1/2 ounces)			
Coffee or tea (all types)										8 ounce cup			

Note categories

Note serving sizes

Alcohol assessment on FFQs – Multi-ethnic cohort (MEC) FFQ. Past 12 months timeframe. Yields data on mean drinks/day, mean alcohol (g)/day, and % of kcals/d from alcohol. Can also be used in dietary pattern analyses.

Note categories

ALCOHOLIC AND OTHER BEVERAGES	AVERAGE USE DURING LAST YEAR									YOUR USUAL SERVING SIZE
	Never or hardly ever	Once a month	2 to 3 times a month	Once a week	2 to 3 times a week	4 to 6 times a week	Once a day	2 to 3 times a day	4 or more times a day	
Regular or Draft Beer	○	○	○	○	○	○	○	○	○	CHOOSE ONE ○ 1 can or bottle or less **OR** ○ 2 cans or bottles **OR** ○ 3 cans or bottles **OR** ○ 4 cans or bottles or more
Light Beer	○	○	○	○	○	○	○	○	○	CHOOSE ONE ○ 1 can or bottle or less **OR** ○ 2 cans or bottles **OR** ○ 3 cans or bottles **OR** ○ 4 cans or bottles or more
White or Pink Wine (includes champagne and sake)	○	○	○	○	○	○	○	○	○	CHOOSE ONE ○ 1 glass or less **OR** ○ 2 glasses **OR** ○ 3 glasses **OR** ○ 4 glasses or more
Red Wine	○	○	○	○	○	○	○	○	○	CHOOSE ONE ○ 1 glass or less **OR** ○ 2 glasses **OR** ○ 3 glasses **OR** ○ 4 glasses or more
Hard Liquor (such as bourbon, scotch, gin, vodka, tequila, rum, cocktails)	○	○	○	○	○	○	○	○	○	CHOOSE ONE ○ 1 drink or less **OR** ○ 2 drinks **OR** ○ 3 drinks **OR** ○ 4 drinks or more

Note serving sizes

NHANES alcohol assessment; Lifetime habits and recent number of days of drinking. No data on g/d

How old were you when you had your first drink of alcohol?

During your life, on how many days have you had at least one drink of alcohol?

6 response options ranging from 1-2 day to > 100 days

During the past 30 days, on how many days did you drink alcohol?

During the past 30 days, did you have 5 or more drinks in a row (within a few hours)?

Issues to consider in standard alcohol assessment: Alcohol types/content

FFQ line items give 3-4 groupings of alcohol drinks

- **Beer: Most FFQs will list beer as a single line item**

- ‘standard’ beer: 14 grams of alcohol, 5-6% alcohol,150 kcals/12 ounces
- ‘craft’ beer: 170-350 kcals/12 ounces
- ‘light’ beer (e.g. ‘Bud Light’): 4% alcohol, 100 kcals/12 ounces
- ‘very light’ or ‘zero carb’ beer: 2-3% alcohol, 60 kcals/12 ounces

- Other variations: dark beer, lager, malt beverages, hard ciders

Not clear where to group some of these

Do these variations on beer type matter in population assessment?

It will depend on the consumption patterns of the population being studied

Issues to consider in standard alcohol assessment: Alcohol types/content

FFQ line items give 3-4 groupings of alcohol drinks

- **Wine: Most FFQs have one line item, some will split into red and white wine. have about 12% alcohol/5 ounce serving. 14 grams of alcohol**
- Red wine: polyphenols will vary between red and white wine
- White wine
- Rose
- Fortified wine
- Wine beverages such as sangria
- ‘Sparkling’ wine such as Champagne, Prosecco
- Dessert or sweet wines – some alcohol content may be higher

Do these variations on wine type matter in population assessment?

It will depend on the consumption patterns of the population being studied

Do study participants ‘see’ their wine type in a single line item?

Issues to consider in standard alcohol assessment: Alcohol types/content

FFQ line items give 3-4 groupings of alcohol drinks

- **Spirits or liquor: Most FFQs have one line item for spirits or liquor. Some will give examples (gin, brandy, vodka, scotch, 'cocktails'). 1.5 ounces of distilled spirits is about 40% alcohol and 14 grams of alcohol**

- Challenge to group cocktails and 'shots' together
- Many cocktails have added sugars or syrups or salt in rimmed glasses
- Some mixed drinks may be made with diet soft drinks (rum and 'diet coke')
- 'Doubles' or double shots may not be considered
- Some higher proof distilled liquors may have higher kcal content

Do these variations in 'spirits' or liquor type matter in population assessment?

It will depend on the consumption patterns of the population being studied

Do study participants 'see' their mixed drink or spirits type in a single line item?

Issues to consider in standard alcohol assessment

Frequency

Standard frequencies ask for frequency of consumption ranging from “never or less than once/month” to 6 or more times per day

8-9 response options

BEVERAGES (Please note that the frequency headings are different.) →	HOW OFTEN DID YOU EAT THE FOOD (Mark one)								
	Never or less than once per month	1-3 per month	1 per week	2-4 per week	5-6 per week	1 per day	2-3 per day	4-5 per day	6+ per day

These frequency of consumption categories assume relatively consistent intake over the FFQ reference time period (past 12 month, 6 months, 1 month etc)

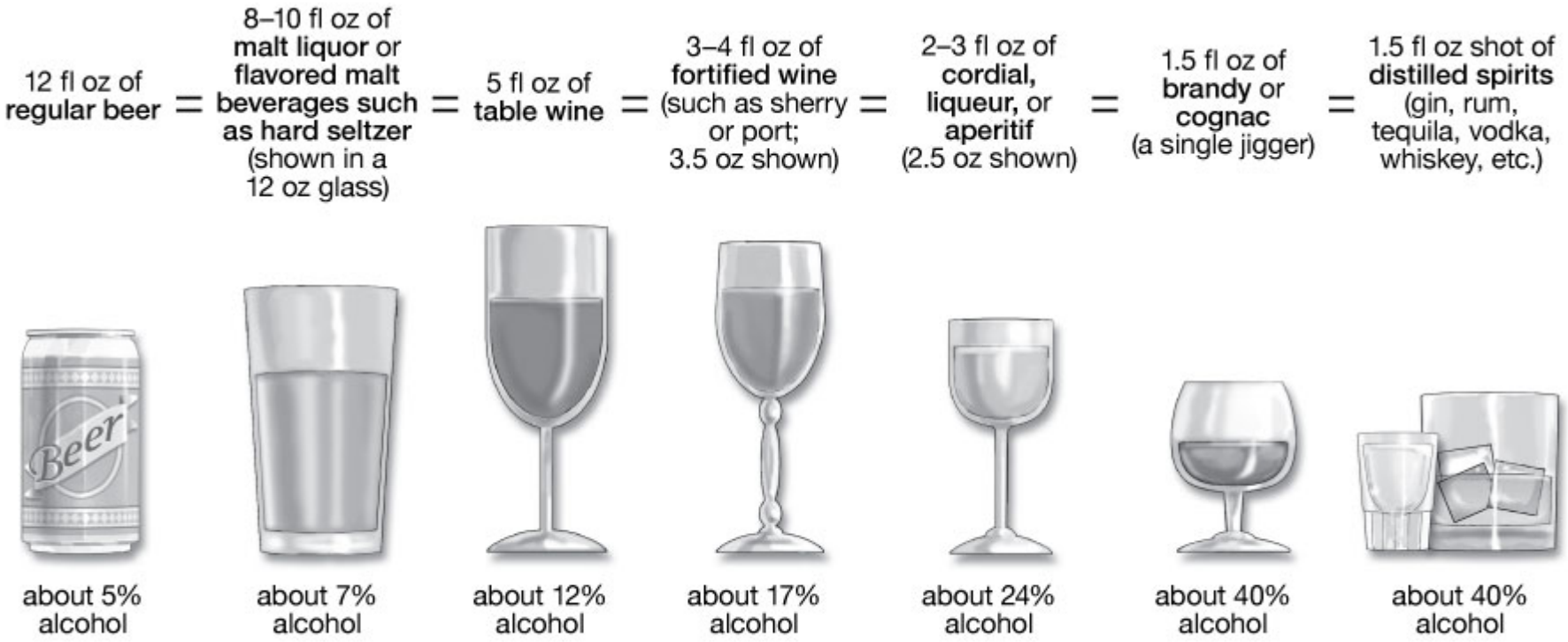
Is that always the case?

Holidays, ‘dry’ January, special events (sporting events, super bowl) where consumption may vary

For many people, alcohol is an episodically consumed beverage, but the total intake averaged over the year may be an important exposure

Issues to consider in standard alcohol assessment

Portion size: FDA defined portion sizes



Each drink shown above represents one U.S. standard drink and has an equivalent amount (0.6 fluid ounces) of "pure" ethanol.

Issues to consider in alcohol assessment: portion size

Portion size on FFQs, which aligns with FDA portion sizes, may not be ‘actual’ portion sizes consumed.

A few examples:

- A ‘pint’ of beer is 1.3 times a standard 12 oz serving of beer
- Pitchers of beer
- Restaurant servings of wine are 6-9 ounces
- Restaurant size giant margaritas/pitchers of margaritas

Biomarkers of Alcohol Intake: recent research

The Journal of Nutrition
Nutritional Epidemiology

See corresponding commentary on page 2077.

Urinary Ethyl Glucuronide Can Be Used as a Biomarker of Habitual Alcohol Consumption in the General Population

Inge AT van de Luitgaarden,[1,2] Joline WJ Beulens,[1,3] Ilse C Schrieks,[1,2] Lyanne M Kieneker,[4] Daan J Touw,[5] Adriana J van Ballegooijen,[3,6] Sabine van Oort,[3] Diederick E Grobbee,[1,2] and Stephan JL Bakker[4]

[1]Julius Center for Health Sciences and Primary Care of the University Medical Center Utrecht, Utrecht, Netherlands; [2]Julius Clinical, Zeist, Netherlands; [3]Department of Epidemiology and Biostatistics, Amsterdam Cardiovascular Sciences Research Institute, Amsterdam University Medical Center, location VUmc, Amsterdam, Netherlands; [4]Department of Internal Medicine, Division of Nephrology, University Medical Center Groningen, University of Groningen, Groningen, Netherlands; [5]Department of Pharmaceutical Analysis, Groningen Research Institute of Pharmacy, University of Groningen, Groningen, Netherlands; and [6]Department of Nephrology, Amsterdam Cardiovascular Sciences Research Institute, Amsterdam University Medical Center, location VUmc, Amsterdam, Netherlands

ABSTRACT

Background: Alcohol consumption is a frequently studied risk factor for chronic diseases, but many studies are hampered by self-report of alcohol consumption. The urinary metabolite ethyl glucuronide (EtG), reflecting alcohol consumption during the past 72 h, is a promising objective marker, but population data are lacking

Potential biomarker of alcohol consumption

TABLE 4 Associations between alcohol consumption categories and EtG concentrations in PREVEND participants with detectable EtG concentrations ($n = 3219$)[1]

	Alcohol consumption category					
	Abstention (reference) ($n = 119$)	Light drinkers ($n = 319$)	Light–moderate drinkers ($n = 1268$)	Moderate drinkers ($n = 1265$)	Heavy drinkers ($n = 248$)	*P*-trend
Model 1[2]	620 (470, 820)	1068 (583, 1955)	2343 (1326, 4138)	5497 (3109, 9711)	15,139 (8168, 28,057)	<0.001
Model 2[3]	670 (409, 1097)	1064 (467, 2426)	2109 (935, 4755)	4346 (1850, 10,209)	10,467 (4081, 26,849)	<0.001

[1] All values are geometric means (95% CIs) of linear regression analyses and were found to be statistically significant, $P < 0.001$. eGFR, estimated glomerular filtration rate; EtG, ethyl glucuronide; PREVEND, Prevention of Renal and Vascular End-Stage Disease.
[2] Crude analysis.
[3] Adjusted for age (y), sex, and eGFR [mL/(min · 1.73 m^2)].

The biomarker seems to perform well at higher levels of intake; performs less well at low to moderate levels of intake. Overall sensitivity was 66.3% but increased to 93% at higher alcohol intake levels.

Potential biomarkers of alcohol intake

The Journal of Nutrition
Genomics, Proteomics, and Metabolomics

Plasma MicroRNA Signature of Alcohol Consumption: The Rotterdam Study

Irma Karabegović,[1] Yasir Abozaid,[1] Silvana CE Maas,[1,2] Jeremy Labrecque,[1] Daniel Bos,[1,3] Robert J De Knegt,[4] M Arfan Ikram,[1] Trudy Voortman,[1,5] and Mohsen Ghanbari[1]

[1]Department of Epidemiology, Erasmus MC University Medical Center, Rotterdam, The Netherlands; [2]Vall d'Hebron Institute of Oncology (VHIO), Barcelona, Spain; [3]Department of Radiology and Nuclear Medicine, Erasmus MC University Medical Center, Rotterdam, The Netherlands; [4]Department of Gastroenterology, Erasmus MC University Medical Center, Rotterdam, The Netherlands; and [5]Division of Human Nutrition and Health, Wageningen University & Research, Wageningen, The Netherlands

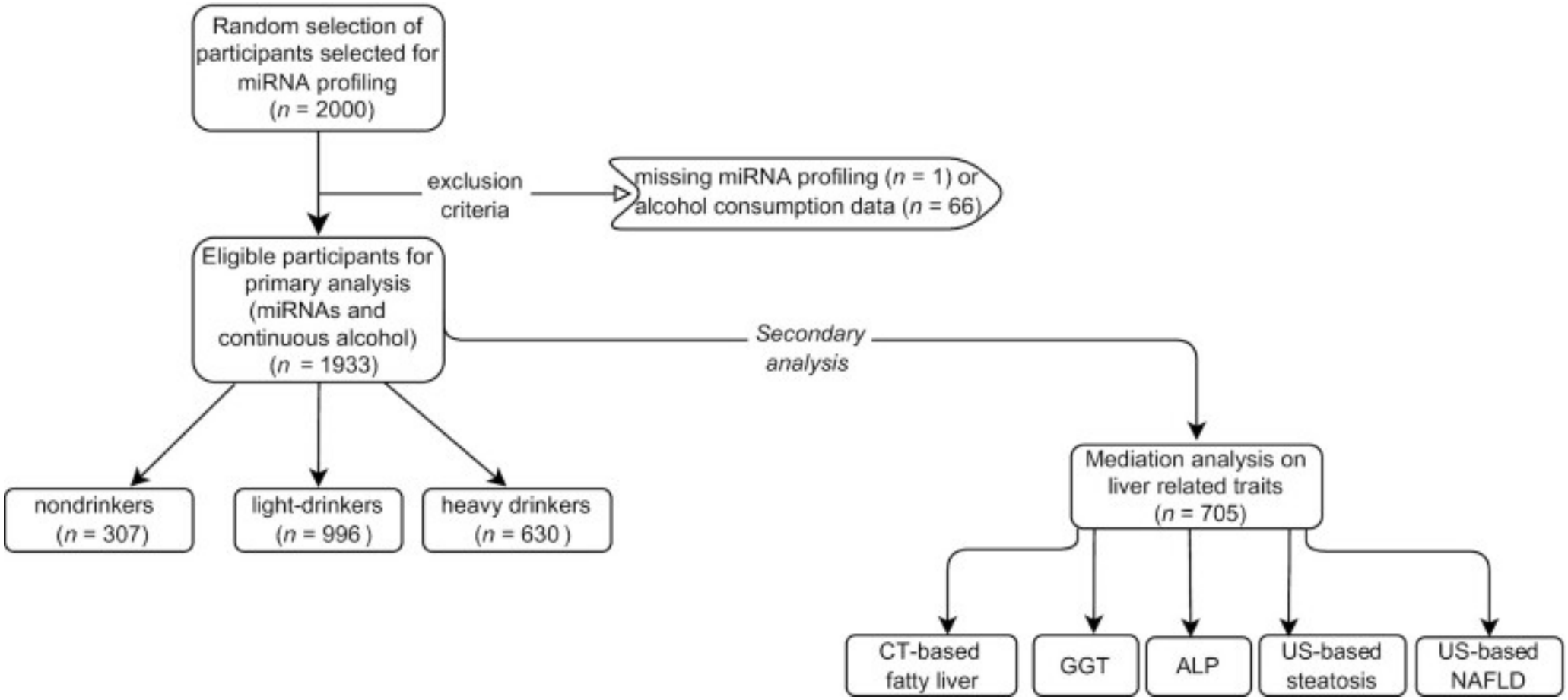
ABSTRACT

Background: MicroRNAs (miRNAs) represent a class of noncoding RNAs that regulate gene expression and are implicated in the pathogenesis of different diseases. Alcohol consumption might affect the expression of miRNAs, which in turn could play a role in risk of diseases.

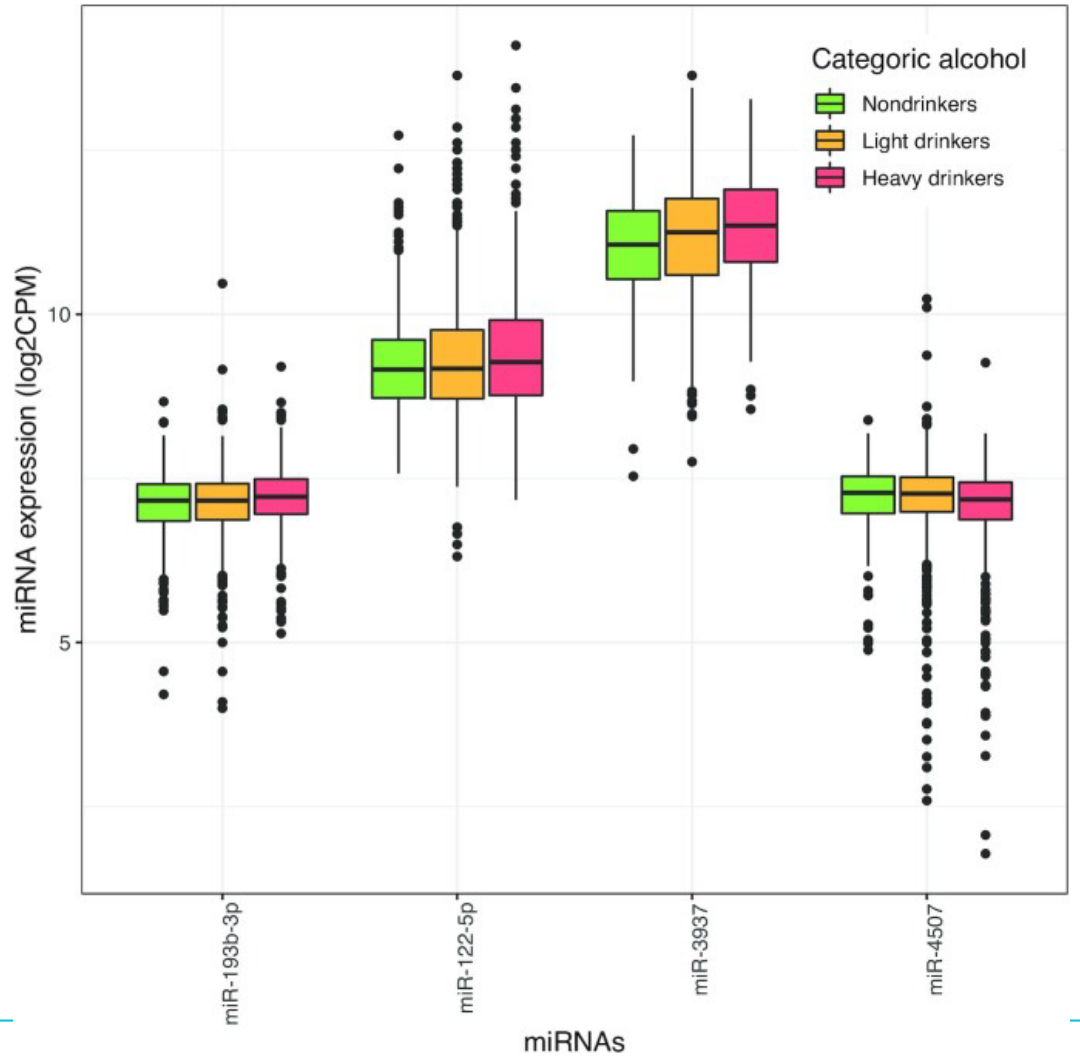
Objectives: We investigated whether plasma concentrations of miRNAs are altered by alcohol consumption. Given the existing evidence showing the link between alcohol and liver diseases, we further explored the extent to which these associations are mediated by miRNAs.

Methods: Profiling of plasma miRNAs was conducted using the HTG EdgeSeq miRNA Whole Transcriptome Assay in 1933 participants of the Rotterdam Study. Linear regression was implemented to explore the link between alcohol

Potential biomarkers of alcohol intake



Potential biomarkers of alcohol intake



Conclusions

Alcohol assessment in free living people is challenging

Frequency, portion size and type of alcohol may each be mis-measured

For many people, alcohol is episodically consumed

Potential for biomarkers for alcohol assessment, but still early days

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Thank you