11-2-2022

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ELSEVIER

Surgery for Obesity and Related Diseases ■ (2022) 1–7

SURGERY FOR OBESITY AND RELATED DISEASES

Integrated health article

# Utility of phosphatidylethanol testing as an objective measure of alcohol use during the preoperative evaluation for bariatric surgery

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Received 15 August 2022; accepted 21 October 2022

**Abstract**

**Background:** The risk of alcohol use disorder increases after bariatric surgery. Preoperative alcohol use is a risk factor, and this is evaluated during the routine preoperative psychosocial evaluation. However, it is not clear whether patients accurately report their alcohol use.

**Objective:** To determine whether an objective measure of alcohol use, phosphatidylethanol (PEth) testing, offers utility beyond self-reported alcohol use during the preoperative evaluation for bariatric surgery.

**Setting:** Single healthcare system.

**Methods:** PEth testing was included as part of the routine laboratory work for 139 patients undergoing evaluation for bariatric surgery. PEth testing results were compared with self-reported alcohol use and scores on the Alcohol Use Disorders Identification Test–Concise (AUDIT-C) questionnaire obtained during the preoperative psychosocial evaluation. PEth testing results were categorized into abstinent, light use, moderate use, or heavy use. There were 85 patients who completed both PEth testing and a preoperative psychosocial evaluation.

**Results:** There were 25 participants (29.4%) who had a positive PEth test; about half had moderate or heavy use values (15.3% of the total sample). The majority of participants with a positive PEth test (82.6%) denied recent alcohol use. Of those with PEth values indicating moderate or heavy use, 61.5% did not have an elevated AUDIT-C score.

**Conclusions:** Patients appeared to underreport their alcohol use during the preoperative psychosocial evaluation. There appears to be utility for routine PEth testing as part of the evaluation process to identify those with risky drinking patterns. Patients with preoperative risky drinking could be educated about their risk and/or referred to programs to mitigate the development of preoperative alcohol misuse. (Surg Obes Relat Dis 2022;■:1–7.) 

*Keywords:* Bariatric surgery; Alcohol use; Phosphatidylethanol testing (PEth testing); Preoperative evaluation

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https://doi.org/10.1016/j.soard.2022.10.025

Bariatric surgery is the most effective treatment for patients with severe obesity [1]. In addition to sustainable weight loss, bariatric surgery has many potential benefits for patients, including the treatment and prevention of many co-morbid medical conditions, such as diabetes mellitus, hypertension, dyslipidemia, cardiovascular disease, and sleep apnea [2,3]. It is a widely used obesity treatment, with an estimated 256,000 bariatric surgeries performed in the United States in 2019 alone [1].

Despite the success of bariatric surgery for the treatment of patients with obesity and other co-morbid medical conditions, one serious consequence is the increased risk of developing an alcohol use disorder (AUD) after surgery [4,5]. Previous studies have shown that more than half of patients consume alcohol postoperatively, of which the majority begin to use between 6 and 12 months after surgery [6]. However, the rates of alcohol use and AUDs continue to increase as patients progress from surgery [4,7]. There are multiple proposed rationales for the higher risk of developing an AUD postoperatively in bariatric populations. One proposed reason is pharmacokinetic changes that occur postoperatively that result in faster and higher increases in blood alcohol concentration and decreased elimination rates [8–10]. Additionally, individuals have reported an increased sensitivity to the effects of alcohol postoperatively, requiring fewer drinks to feel the desired effects of intoxication from alcohol than prior to surgery [11,12].

The existing literature suggests several risk factors for developing an AUD postoperatively, including male sex, younger age, tobacco and recreational drug use, and lower sense of belonging within the social community [13,14]. Most notably, individuals with a history of an AUD and recreational preoperative alcohol use are more likely to resume alcohol use postoperatively and have a postoperative AUD [4,14,15]. In addition, more than half of patients consume alcohol after surgery, and this is despite understanding that they are at an increased risk of developing an AUD [6]. Unfortunately, because most patients drink and we are not able to predict who will develop an AUD postoperatively with high specificity, many patients remain at high-risk for an AUD.

Given the increased risk of postoperative alcohol misuse and an AUD, it is recommended that clinicians thoroughly assess for alcohol use during preoperative psychosocial evaluations [16]. However, clinical interviews might miss a large portion of patients at risk for postoperative alcohol use because many patients underestimate their substance use [17,18]. Further, those undergoing a psychosocial evaluation prior to bariatric surgery may be motivated to underreport their alcohol use to obtain clearance for surgery. Given this, we may miss individuals who may be drinking at higher levels prior to surgery, and thus, those at highest risk of developing alcohol misuse or an AUD postoperatively will not be identified. A more objective measure of alcohol use may be helpful at identifying those at high risk for a postoperative AUD during the preoperative evaluation.

In other preoperative evaluations (e.g., transplant), clinicians are beginning to use phosphatidylethanol (PEth) testing as an objective measure of alcohol use. PEth testing is a blood test that measures PEth levels, which are biomarkers made only in the presence of alcohol [19,20]. PEth testing has many benefits. Because it has a direct relationship with alcohol consumption, it has high sensitivity (i.e., up to 100% for alcohol consumed in the prior week) and high specificity at rates of up to 100% [19–21]. In addition, it has benefits over other objective measures of alcohol use. Specifically, it provides information regarding alcohol use over a longer period (i.e., the previous 2–4 weeks) and also provides values that signify level of drinking (i.e., abstinent/light, moderate, and heavy use) [20,22]. Thus, it has been recommended as a more specific and sensitive measure of alcohol use in comparison with self-reports and other biological methods [18]. Use of PEth testing in bariatric surgery patients is very new, and to our knowledge, there are only 2 studies to date. Similar to the aforementioned studies, these suggest that PEth testing can identify recent alcohol use among those undergoing bariatric surgery; although they did not examine how PEth results relate to self-reported alcohol use [23,24]. Despite the use of PEth testing in preoperative evaluations for other populations, it is not used routinely as an objective measure of alcohol use among those pursuing bariatric surgery. Because PEth testing can provide an objective estimate of recent alcohol use, it could be a useful tool as part of the preoperative evaluation process (i.e., to identify those with risky preoperative alcohol use who are at high-risk for postoperative alcohol misuse). However, the utility of PEth testing has not yet been explored. There is limited research on the use of PEth testing for preoperative evaluations, and given the cost of PEth testing and laboratory analyses, further research is needed to determine whether there are benefits to PEth testing that could justify the cost. Thus, the purpose of this study was to determine the feasibility of including PEth testing as a routine part of the preoperative bariatric evaluation process and whether using routine PEth testing offers information beyond self-reported alcohol use during the preoperative psychosocial evaluation.

## Methods

### *Participants and procedure*

Retrospective chart reviews were conducted on all 139 patients who were planning to complete their preoperative evaluation and undergo bariatric surgery at a single urban Midwestern health system. The nurse coordinators of this program who order the routine preoperative laboratory work for candidates also were to include PEth testing as a

part of routine practice. To assess for feasibility, it was recorded whether the test was ordered. It also was documented whether a test was completed and, if applicable, the result. Data were also collected from the routine preoperative psychosocial evaluation note in the patients' electronic health records. Psychosocial evaluations were conducted by a licensed clinical psychologist or a psychology trainee (i.e., intern or practicum student) supervised by a licensed clinical psychologist. This included data documented from a semistructured interview and scores on brief measures. This project was approved by the healthcare system's institutional review board. Informed consent was waived due to the retrospective nature of the study.

### *Measures*

PEth test. The nurse coordinators ordered PEth testing as a part of the routine laboratory work that is conducted as a part of the preoperative evaluation process. PEth testing was conducted as a part of routine patient care, and no patients asked to opt out. As a part of this study, the cost of PEth testing was covered by a grant. PEth testing requires a blood sample (collected with the sample used for other routine preoperative laboratory work) and was run by ARUP Laboratories in Salt Lake City, Utah, using quantitative liquid chromatography/tandem mass spectrometry. It was documented whether a PEth test was completed, and if so, the test results were coded as negative (i.e., abstinent) or positive. If positive, the associated value also was recorded. PEth values indicate light use (10–19 ng/mL), moderate use (20–199 ng/mL), or heavy use (>200 ng/mL). Based on research, those with light use likely would have consumed <2 drinks per day, those with moderate use would have consumed approximately 2–3 drinks per day, and those with heavy use would have consumed at least 4 drinks per day [18,20]. Those with moderate and heavy PEth values meet the National Institute on Alcohol Abuse and Alcoholism criteria of risky drinking (i.e., >7 or >14 drinks in a week for women or men, respectively).

Self-reported alcohol use. Data regarding self-reported alcohol use were collected from the preoperative psychosocial evaluation note written by a licensed psychologist or psychology trainee supervised by the psychologist. During the evaluation, the patients were asked to report when the last use of alcohol occurred, how often they consume alcohol, and typical number of drinks consumed per sitting. Alcohol use was coded into the following variables: (1) recent use (i.e., whether or not a patient consumed alcohol in the prior month), (2) average number of standard drinks per sitting, and (3) frequency of drinking (whether a patient consumed alcohol at least once per week or less frequently than once per week).

Alcohol Use Disorders Identification Test–Concise. Scores from the Alcohol Use Disorders Identification Test–Concise (AUDIT-C) [25] were recorded from the preoperative psychosocial evaluation note. This is a 3-item screening measure to assess for hazardous drinking over the previous year. Scores of ≥3 for women or ≥4 for men were considered to be elevated.

### *Analyses*

SPSS Software version 25 (IBM, Armonk, NY) was used to conduct analyses. Frequencies and descriptives were conducted to obtain percentages and means of variables. Chi-squared analyses, Fisher exact tests (when cells had <5 cases), and independent-samples *t* tests were used to examine whether there were differences between PEth test results and self-reported alcohol use during the semistructured interview or on the AUDIT-C. There were missing data for 13 patients (15.3%) for whether they consumed alcohol in the prior month, 11 of whom had a negative PEth test. These patients were excluded from analyses comparing PEth test results with recent alcohol use. There were missing AUDIT-C scores for 6 patients (7.1%), 1 of whom had a positive PEth test; these patients were excluded from these respective analyses.

## Results

Fig. 1 shows the flow of participants in this study. Of the 139 charts reviewed for this study, there were 107 patients (77.0%) who completed PEth testing. One patient did not have PEth testing ordered with the routine laboratory work, and the other 31 patients discontinued the program prior to having laboratory work completed. Of the 107

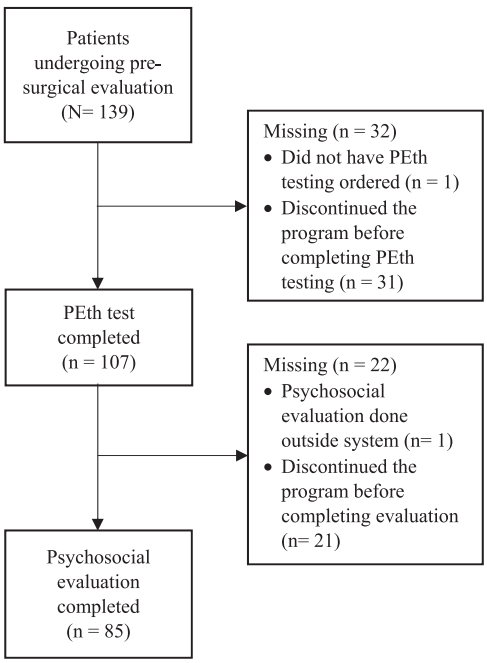


Fig. 1. Participants in the study.

Table 1
Demographics of sample (n = 85)

| Factor | Mean | Standard deviation |
|---|---|---|
| Age, yr | 44.05 | 11.41 |
| Preoperative body mass index, kg/m$^2$ | 47.9 | 7.58 |
| **Factor** | **%** | **n** |
| Sex | | |
| Female | 80 | 68 |
| Male | 20 | 17 |
| Race | | |
| White | 62.4 | 53 |
| Black | 34.1 | 29 |
| Other/multiracial | 3.5 | 3 |
| PEth test | | |
| Negative | 70.6 | 60 |
| Positive | 29.4 | 25 |
| PEth value category for positive tests (n = 25) | | |
| Light use (10–19 ng/mL) | 48 | 12 |
| Moderate use (20–199 ng/mL) | 40 | 10 |
| Heavy use (200+ ng/mL) | 12 | 3 |

PEth = phosphatidylethanol.

patients who had PEth tests, 22 patients did not complete a psychosocial evaluation. One patient had a provider outside the health system complete the psychosocial evaluation, and the other 21 patients chose not to continue in the program prior to completing the psychosocial evaluation. Thus, there were data for 85 patients who completed both a PEth test and a preoperative psychosocial evaluation. Data were missing for only 1 patient who continued to move forward in the program (PEth testing was not ordered).

Demographics for this sample are located in Table 1. There were 25 patients who had a positive PEth test. PEth values ranged from 10 to 549 ng/mL. Though about half of patients with a positive PEth test had values indicative of light drinking, slightly more than half of patients had values in the moderate or heavy drinking ranges, which constituted 15.3% (n = 13) of the entire sample (Table 1).

Table 2 compares PEth test results with self-reported alcohol use. The majority of patients with a positive PEth test denied recent alcohol use, which was a similar rate to that of those with a negative PEth test. Of those with moderate or heavy PEth values, 76.9% (n = 10) denied recent alcohol use. With regard to frequency of drinking, those with a positive PEth test were more likely to endorse drinking at least once per week compared with those with a negative test (Table 2). However, of those with a positive PEth test, more than half reported drinking less than once per week. Among those in the moderate to heavy drinking categories, about half reported consuming alcohol less than weekly (46.2%; n = 6). There were no significant differences between those with a positive PEth test (mean = 2.48; standard deviation [SD] = 1.56) and a negative PEth test (mean = 2.59; SD = 3.56) for the average number of drinks per sitting reported ($t$ = .14; $P$ = .89).

Having an elevated AUDIT-C score was not significantly associated with a positive PEth test value, although those with moderate and heavy PEth values may be more likely to have an elevated AUDIT-C score (Table 2). In comparing PEth test results with the AUDIT-C scores, 76.0% (n = 19) of those with a positive PEth test did not have an elevated AUDIT-C score (Table 2). Of those in the moderate or heavy use range, 61.5% (n = 8) did not have an elevated AUDIT-C score. In addition, there were no significant differences in AUDIT-C scores between those who had PEth values in the light, moderate, and heavy drinking ranges ($F$ = 2.08; $P$ = .15).

## Discussion

Considering the high incidence of alcohol use after bariatric surgery and the increased risk that postoperative alcohol use poses, this study sought to determine whether routine PEth testing during the preoperative evaluation might offer utility beyond self-reported alcohol use. In this study, PEth testing was a highly feasible component to add to routine preoperative bariatric evaluations; all but one patient who continued on in the program had PEth testing ordered and completed. Moreover, as hypothesized, PEth testing appeared to provide valuable information regarding alcohol use that likely would have gone undetected using solely self-reported use. Specifically, about 30% of patients exhibited positive PEth test values, and of these individuals, the vast majority denied recent alcohol use. PEth testing also indicated that 15.3% of patients were engaging in risky drinking behaviors, which is double a previously noted estimate (7.6%) using AUDIT scores [5]. Additional work is needed with a larger sample size to determine whether PEth testing

Table 2
PEth test result and self-reported alcohol use

| | Denied alcohol use in prior month | | Reported alcohol use in prior month | | $\chi^2$ | *P* value |
|---|---|---|---|---|---|---|
| | % | n | % | n | | |
| PEth test | | | | | | |
| Negative | 91.8 | 45 | 8.2 | 4 | 1.35 | .25 |
| Positive | 82.6 | 19 | 17.4 | 4 | | |
| PEth value category | | | | | | |
| Abstinent | 91.8 | 45 | 8.2 | 4 | * | .30 |
| Light use | 90.0 | 9 | 10.0 | 1 | | |
| Moderate use | 80.0 | 8 | 20.0 | 2 | | |
| Heavy use | 66.7 | 2 | 33.3 | 1 | | |
| | Drink less than weekly | | Drink weekly or more | | $\chi^2$ | *P* value |
| | % | n | % | n | | |
| PEth test | | | | | | |
| Negative | 88.3 | 53 | 11.7 | 7 | 8.85 | .003 |
| Positive | 60.0 | 15 | 40.0 | 10 | | |
| PEth value category | | | | | | |
| Abstinent | 88.3 | 53 | 11.7 | 7 | * | <.001 |
| Light use | 75.0 | 9 | 25.0 | 3 | | |
| Moderate use | 60.0 | 6 | 40.0 | 4 | | |
| Heavy use | 0.0 | 0 | 100.0 | 3 | | |
| | No elevated AUDIT score | | Elevated AUDIT score | | $\chi^2$ | *P* value |
| | % | n | % | n | | |
| PEth test | | | | | | |
| Negative | 92.7 | 51 | 7.3 | 4 | 3.04 | .08 |
| Positive | 79.2 | 19 | 20.8 | 5 | | |
| PEth value category | | | | | | |
| Abstinent | 92.7 | 51 | 7.3 | 4 | * | .01 |
| Light use | 100.0 | 11 | 0.0 | 0 | | |
| Moderate use | 70.0 | 7 | 30.0 | 3 | | |
| Heavy use | 33.3 | 1 | 66.7 | 2 | | |

PEth = phosphatidylethanol.
* Fisher exact test was conducted owing to multiple cells having <5 cases.

continues to find a higher prevalence of preoperative risky drinking than has been reported previously.

Findings from this study suggest that patients underreport their alcohol use. Furthermore, most patients who engaged in risky drinking, as identified by PEth results, did not report such use, highlighting its important utility. This is consistent with prior research that suggested that individuals in the general population tend to underestimate their alcohol use for a variety of reasons, including poor recall of past consumption, inaccuracy in estimating standard drink sizes and alcohol content, or being reluctant to report heavier use [26,27]. Interestingly, those with positive PEth tests reported drinking a similar number of drinks per sitting compared with those with negative PEth tests. Perhaps those who were currently drinking felt a greater motivation to conceal their alcohol use. Indeed, individuals with an AUD also appear to underreport their drinking; this may be a consequence of difficulty recalling use accurately, motivation by social desirability, or fear of judgment or being denied treatment [28,29].

In this study, the AUDIT-C screener appeared to detect a greater proportion of those who fell into the moderate or severe range of recent alcohol use on PEth testing compared with self-reported use during the semistructured interview. Similarly, using PEth testing in conjunction with self-reported alcohol use on the AUDIT-C enhances the ability to detect patients with co-morbid health conditions (e.g., hepatitis C infection, HIV infection) who may be at increased risk for mortality [30]. However, it appears that PEth testing outperformed both the interview and the AUDIT-C screener in detecting risky use. Specifically, two-thirds of those with a moderate or heavy PEth value (i.e., risky drinking) would not have been identified by the AUDIT-C. Thus, relying on self-reported use as assessed by a clinical interview and/or screener may fail to detect a number of high-risk patients. This also may explain why our finding of risky drinking was more than double the prior estimate based on elevated AUDIT scores [5]. The results of this study suggest that a combination of clinical interview, standardized screening (i.e., AUDIT), and objective biomarker determinations (i.e., PEth testing) would most accurately identify those engaging in risky drinking behaviors. Though the full AUDIT could be used and may be better at identifying alcohol use disorders, the AUDIT-C is briefer and performs similarly to the full-scale questionnaire at identifying heavy drinking [31]. Interviewing family members regarding the patient's alcohol use also could be considered. Because preoperative alcohol use is associated with risky postoperative drinking [5,15], preoperative identification of these individuals is critical. Incorporating PEth testing into the routine preoperative evaluation would increase the likelihood of detecting these individuals and connecting them with supportive care to mitigate the risk of problematic drinking postoperatively. For example, if patients have a high PEth value, clinicians could provide education regarding what risky drinking is and discuss options if patients are interested in resources for decreasing alcohol use. Identifying and appropriately managing problematic alcohol use prior to bariatric surgery may be associated with positive outcomes postoperatively [32]. However, additional work is needed with larger sample sizes prior to establishing guidelines around the use of PEth testing, as well as best-practice strategies for delivering patient education about high-PEth-value risky drinking.

This study is not without its limitations. The study collected data through a retrospective chart review and thus was subject to missing data. For example, we did not have the date of last alcohol use and AUDIT-C scores for

all patients. However, the clinicians conducting the psychosocial clinical interviews would have been likely to document significant alcohol use had it been reported. In addition, some of the PEth tests were conducted outside the 4 weeks of the psychological evaluation. It is possible that some of those with elevated PEth tests may have stopped drinking prior to self-reporting use; though it still appears that frequency and amount may have been underreported, and recent moderate or heavy use is still a risk factor for postoperative misuse. Future studies also could benefit from more structured data collection. By documenting specific time frames and amounts of alcohol use, future researchers may be better able to determine how well self-reports align with PEth test values. For example, 4 patients with a negative PEth test endorsed alcohol use in the prior month; this could have been due to a low amount of drinking more remote from the testing. In addition, 4 patients had elevated AUDIT-C scores but a negative PEth test. This was likely due to differing time frames; AUDIT-C asks about alcohol use over the previous year, whereas PEth testing is measured over the prior month. It is possible that those patients discontinued their alcohol use in preparation for surgery. Finally, the current sample size was relatively small. Although a similar investigation should be repeated with a larger sample, the present pilot findings are promising in supporting the use of PEth testing as an objective measure of alcohol use during preoperative evaluations for bariatric surgery.

## Conclusion

PEth testing provides an objective measure of alcohol use that may offer utility beyond self-reported alcohol use and assist in the identification of individuals who may be at greater risk for postoperative AUDs. Identifying at-risk individuals and guiding them to effective treatments prior to surgery may decrease the incidence of postoperative AUDs. Future work could evaluate the predictive validity of preoperative PEth testing for postoperative AUDs.

## Disclosures

*This project was funded by the Fund for Henry Ford Health. The authors have no commercial associations that might be a conflict of interest in relation to this article.*

## References

[1] American Society for Metabolic and Bariatric Surgery. Estimate of bariatric surgery numbers, 2011–2019. https://asmbs.org/resources/estimate-of-bariatric-surgery-numbers. Accessed March 30, 2022.

[2] Chang S-H, Stoll CRT, Song J, Varela JE, Eagon CJ, Colditz GA. The effectiveness and risks of bariatric surgery: an updated systematic review and meta-analysis, 2003–2012. JAMA Surg 2014;149(3):275–87.

[3] Arterburn DE, Telem DA, Kushner RF, Courcoulas AP. Benefits and risks of bariatric surgery in adults: a review. JAMA 2020;324(9):879–87.

[4] King WC, Chen J-Y, Courcoulas AP, et al. Alcohol and other substance use after bariatric surgery: prospective evidence from a US multicenter cohort study. Surg Obes Relat Dis 2017;13(8):1392–402.

[5] King WC, Chen J-Y, Mitchell JE, et al. Prevalence of alcohol use disorders before and after bariatric surgery. JAMA 2012;307(23):2516–25.

[6] Miller-Matero LR, Coleman JP, LaLonde L, Martens KM, Hamann A, Carlin AM. Patient recall of receiving education about the risks of alcohol use following bariatric surgery. Obes Surg 2019;29(8):2707–10.

[7] Miller-Matero LR, Orlovskaia J, Hecht L, et al. Hazardous alcohol use in the four years following bariatric surgery. Psychol Health Med 2022;27(9):1884–90.

[8] Acevedo MB, Eagon JC, Bartholow BD, Klein S, Bucholz KK, Pepino MY. Sleeve gastrectomy surgery: when 2 alcoholic drinks are converted to 4. Surg Obes Relat Dis 2018;14(3):277–83.

[9] Pepino MY, Okunade AL, Eagon JC, Bartholow BD, Bucholz K, Klein S. Effect of Roux-en-Y gastric bypass surgery: converting 2 alcoholic drinks to 4. JAMA Surg 2015;150(11):1096–8.

[10] Steffen KJ, Engel SG, Pollert GA, Cao L, Mitchell JE. Blood alcohol concentrations rise rapidly and dramatically following roux-en-Y gastric bypass. Surg Obes Relat Dis 2013;9(3):470–3.

[11] Smith KE, Engel SG, Steffen KJ, et al. Problematic alcohol use and associated characteristics following bariatric surgery. Obes Surg 2018;28(5):1248–54.

[12] Acevedo MB, Teran-Garcia M, Bucholz KK, et al. Alcohol sensitivity in women after undergoing bariatric surgery: a cross-sectional study. Surg Obes Relat Dis 2020;16(4):536–44.

[13] Ivezaj V, Benoit SC, Davis J, et al. Changes in alcohol use after metabolic and bariatric surgery: predictors and mechanisms. Curr Psychiatry Rep 2019;21(9):85.

[14] Briegleb M, Hanak C. Gastric bypass and alcohol use: a literature review. Psychiatr Danub 2020;32:176–9.

[15] Miller-Matero LR, Hamann A, LaLonde L, et al. Predictors of alcohol use after bariatric surgery. J Clin Psychol Med Settings 2021;28(3):596–602.

[16] Sogg S, Lauretti J, West-Smith L. Recommendations for the presurgical psychosocial evaluation of bariatric surgery patients. Surg Obes Relat Dis 2016;12(4):731–49.

[17] Allen JP, Wurst FM, Thon N, Litten RZ. Assessing the drinking status of liver transplant patients with alcoholic liver disease. Liver Transplant 2013;19(4):369–76.

[18] Kechagias S, Dernroth DN, Blomgren A, et al. Phosphatidylethanol compared with other blood tests as a biomarker of moderate alcohol consumption in healthy volunteers: a prospective randomized study. Alcohol Alcoholism 2015;50(4):399–406.

[19] Nguyen VL, Haber PS, Seth D. Applications and challenges for the use of phosphatidylethanol testing in liver disease patients (mini review). Alcohol Clin Exp Res 2018;42(2):238–43.

[20] Ulwelling W, Smith K. The PEth blood test in the security environment: what it is; why it is important; and interpretative guidelines. J Forens Sci 2018;63(6):1634–40.

[21] Andresen-Streichert H, Müller A, Glahn A, Skopp G, Sterneck M. Alcohol biomarkers in clinical and forensic contexts. Dtsch Arztebl Int 2018;115(18):309–15.

[22] Isaksson A, Walther L, Hansson T, Andersson A, Alling C. Phosphatidylethanol in blood (B-PEth): a marker for alcohol use and abuse. Drug Test Anal 2011;3(4):195–200.

[23] Siikaluoma L, Stenberg E, Raoof M. Prevalence of and risk factors associated with alcohol overconsumption at 2 years after bariatric surgery. Obes Surg 2022;32(7):1–6.

[24] Walther L, Brodén C-M, Isaksson A, Hedenbro JL. Alcohol consumption in obese patients before and after gastric bypass as assessed with the alcohol marker phosphatidylethanol (PEth). Obes Surg 2018;28(8):2354–60.

[25] Bradley KA, DeBenedetti AF, Volk RJ, Williams EC, Frank D, Kivlahan DR. AUDIT-C as a brief screen for alcohol misuse in primary care. Alcohol Clin Exp Res 2007;31:1208–17.

[26] Stockwell T, Donath S, Cooper-Stanbury M, Chikritzhs T, Catalano P, Mateo C. Under-reporting of alcohol consumption in household surveys: a comparison of quantity–frequency, graduated–frequency and recent recall. Addiction 2004;99:1024–33.

[27] Stockwell T, Zhao J, Sherk A, Rehm J, Shield K, Naimi T. Underestimation of alcohol consumption in cohort studies and implications for alcohol's contribution to the global burden of disease. Addiction 2018;113:2245–9.

[28] Nielsen DG, Andersen K, Nielsen AS, Juhl C, Mellentin A. Consistency between self-reported alcohol consumption and biological markers among patients with alcohol use disorder–a systematic review. Neurosci Biobehav Rev 2021;124:370–85.

[29] Raggio GA, Psaros C, Fatch R, et al. High rates of biomarker-confirmed alcohol use among pregnant women living with HIV in South Africa and Uganda. J Acquir Immune Defic Syndr 2019;82(5):443–51.

[30] Eyawo O, McGinnis KA, Justice AC, et al. Alcohol and mortality: combining self-reported (AUDIT-C) and biomarker detected (PEth) alcohol measures among HIV infected and uninfected. J Acquire Immune Defic Syndr 2018;77:135.

[31] Bush K, Kivlahan DR, McDonell MB, Fihn SD, Bradley KA. The AUDIT alcohol consumption questions (AUDIT-C): an effective brief screening test for problem drinking. Arch Intern Med 1998;158:1789–95.

[32] Clark MM, Balsiger BM, Sletten CD, et al. Psychosocial factors and 2-year outcome following bariatric surgery for weight loss. Obes Surg 2003;13:739–45.