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Addressing nutrition and physical activity in substance use disorder treatment: Client reports from a wellness-oriented, tobacco-free policy intervention

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HIGHLIGHTS

- Tobacco-free policy intervention in substance use treatment focused on wellness.
- The wellness component promoted healthy nutrition and benefits of physical activity.
- Nutrition counseling receipt was higher in the post-intervention sample.
- Nutrition counseling predicted lower sugar-sweetened beverage use.
- Physical activity counseling association with physical activity stronger at post.

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ABSTRACT

Introduction: Interest in wellness interventions in substance use disorder (SUD) treatment is growing although evidence remains limited. This study evaluated nutrition, physical activity, nutrition and physical activity counseling, and relationships of counseling with wellness behavior before and after a wellness-oriented, tobacco-free policy intervention in 17 residential SUD programs.

Methods: Clients completed cross-sectional surveys reporting sugar-sweetened beverage consumption, physical activity, and receipt of nutrition and physical activity counseling before (n = 434) and after (n = 422) an 18-month intervention. Multivariable regression models assessed pre-post-intervention differences in these variables and examined associations of nutrition counseling with sugar-sweetened beverage consumption and physical activity counseling with physical activity.

Results: Post-intervention clients were 83% more likely than pre-intervention clients to report nutrition counseling (p = 0.024). There were no pre-post differences for other variables. Past week sugar-sweetened beverage consumption was 22% lower among clients reporting nutrition counseling than for those who did not (p = 0.008) and this association did not vary by time (pre/post). There was a significant interaction of physical activity counseling receipt by time on past week physical activity (p = 0.008). Pre-intervention clients reporting physical activity counseling had 22% higher physical activity than those who did not; post-intervention clients reporting physical activity counseling had 47% higher physical activity.

Conclusion: A wellness policy intervention was associated with increased nutrition counseling. Nutrition counseling predicted lower sugar-sweetened beverage consumption. Physical activity counseling predicted higher physical activity, an association that was greater post-intervention. Adding wellness components to tobacco-related interventions may promote health among SUD clients.

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1. Introduction

The high prevalence of cigarette smoking among individuals entering treatment for substance use disorder (SUD) has been well documented. Between 1987–2013, an estimated 84% of individuals in international SUD treatment samples were smokers, a rate 2–4 times higher than general population samples in their respective countries (Guydish et al., 2016). Smoking prevalence is similarly high among clients in SUD treatment in the United States (US), a robust and concerning finding demonstrated for over forty years (Berger & Schweigler, 1972; Burling & Ziff, 1988; Guydish et al., 2011; Weinberger et al., 2016). US clinical practice guidelines for addressing tobacco use in behavioral health treatment, first published in 1996, recommend tobacco-free treatment settings and provision of tobacco cessation services to clients (Fiore, 2000; Fiore et al., 1996; Fiore et al., 2008). By 2016, 35% of US SUD programs reported tobacco-free facilities and 47% reported offering tobacco cessation counseling (Marynak et al., 2018). Despite this progress, smoking prevalence among clients in SUD treatment remains high, ranging from 69% to 78% in recent samples (Campbell et al., 2019; Guydish et al., 2020). Moreover, individuals with SUDs experience poor health and excess mortality relative to the general population, health disparities that are partly attributable to co-occurring tobacco use and other health risk behaviors, including physical inactivity and poor nutrition (Callaghan et al., 2018; Gleib & Preston, 2020; Mysels & Sullivan, 2010; Walker et al., 2017).

Innovation to reduce tobacco use and improve overall health among clients in SUD treatment is needed. Targeting multiple health risk behaviors is one such innovation. A body of research has focused on multiple health behavior change (MHBC) interventions which simultaneously or sequentially address co-occurring health risk behaviors to improve outcomes for targeted behaviors, reduce disease risk, and increase overall health (Geller et al., 2017; King et al., 2015; Prochaska et al., 2008). Treating tobacco use among individuals in SUD treatment has been characterized as an MHBC intervention with some demonstrated effectiveness (Prochaska & Prochaska, 2011). Although evidence for the clustering of poor nutrition, physical inactivity, smoking, and other SUDs is emerging, there have been few reports of treatment services that address multiple risk behaviors in SUD treatment (Walker et al., 2017). A 2020 international review of English language studies found that, while 15 of 16 studies provided information about tobacco-related services in SUD treatment, only one reported services addressing nutrition or physical activity (Tremain et al., 2020). In that study of 19 treatment programs in Australia, receiving brief advice about nutrition and physical activity (PA) was reported by 24.8% and 48.8% of clients respectively, while 79.4% reported receiving advice regarding smoking (Tremain et al., 2016).

Physical exercise interventions for tobacco and other substance use cessation have had short-term positive effects in decreasing substance use and smoking, although reviews describe the quality of evidence as low and call for further research (T. P. Thompson et al., 2020; Ussher et al., 2019). Interventions that address nutrition and smoking have generally focused on limiting weight gain following smoking cessation. They have been associated with higher smoking abstinence and lower weight gain for up to three months post-treatment relative to smoking cessation interventions alone, differences that tend to wane by six months (Spring et al., 2009). Several studies have reported findings of improved nutritional knowledge and eating habits following nutrition-related interventions in SUD treatment programs, but have not reported on associations with substance use or smoking outcomes (Barbadoro et al., 2011; Cowan & Devine, 2013; Sason et al., 2018). Research examining the triad of smoking cessation, dietary intake, and exercise has done so in the context of exercise interventions to prevent weight gain following smoking cessation. Findings indicate that exercise interventions may minimize weight gain after 12 months but are unlikely to improve smoking cessation rates after 6 months (Hartmann-Boyce et al., 2021; Ussher et al., 2019).

MHBC interventions, also characterized as wellness or healthy lifestyle interventions, have been developed for individuals in treatment for mental health disorders, another population with high smoking prevalence (Smith et al., 2020). Curricula disseminated in outpatient mental health programs in New Jersey (Lee et al., 2011; Williams et al., 2009), Florida (Okon et al., 2015) and North Carolina (Baker et al., 2016) focus on tobacco use cessation and making healthy lifestyle choices in areas such as eating, exercise, and stress management. They have been feasible to implement and well received by staff and clients, although outcomes for nutrition, PA and tobacco use have not been reported (Baker et al., 2016; Lee et al., 2011). We identified one study examining a wellness intervention for clients in SUD treatment. In this randomized trial, participants in an 8-session group focused on smoking, diet and PA showed a significant decrease in cigarettes smoked per day at 2 and 5 months, but no change in PA and one dietary change (variety of fruit consumption) relative to treatment as usual (Kelly et al., 2021). Despite the development of well-received curricula and one promising outcome showing smoking reductions, evidence for wellness approaches in behavioral health treatment remains limited, particularly regarding outcomes in nutrition and PA.

In 2018, the California Tobacco Control Program (CTCP) sponsored an initiative to reduce tobacco use and improve health among clients in residential SUD treatment in California. The Tobacco Free for Recovery (TFR) policy intervention, conducted by the University of California San Francisco Smoking Cessation Leadership Center (SCLC) (Schroeder et al., 2018) worked with 17 treatment programs over 18 months to implement tobacco-free grounds (TFG) and tobacco cessation client services. Programs were also contracted to develop and implement wellness policies focused on nutrition and PA. Evaluation of tobacco-related, client outcomes for the first 7 programs to complete the TFR intervention found significant reductions in client smoking prevalence (McCustian et al., 2022). Director and staff reports indicated successful implementation of TFG and increased provision of tobacco cessation services (Campbell et al., 2022). The current study focused on nutrition and PA outcomes. The study assessed changes in dietary intake, measured by sugar sweetened beverage (SSB) consumption, PA, nutrition counseling and PA counseling based on cross sectional, client surveys collected pre- and post- policy intervention in all participating programs. The study also examined relationships between nutrition counseling and PA counseling with related behavior. Study aims were to identify (1) any pre- to post-intervention decreases in SSB consumption or increases in PA; (2) any pre- to post-intervention increases in receipt of nutrition or PA counseling; and (3) whether nutrition counseling receipt was associated with lower SSB consumption during treatment, whether PA counseling receipt was associated with higher PA during treatment, and whether the associations between nutrition and PA counseling with related behaviors differed in the pre- and post- intervention samples.

2. Methods

2.1. Program recruitment

The CTCP advertised the TFR initiative through county tobacco control programs across California. Residential behavioral health programs with a minimum 20-bed capacity (later reduced to 15) were eligible to apply. Interested programs submitted letters of intent, followed by full proposals. The CTCP awarded \$36,000 contracts to support intervention implementation for an 18-month contract period. The TFR intervention was conducted between January 2019 and June 2022 with 17 programs. All participating programs were state-licensed, residential SUD treatment programs.

2.2. TFR policy intervention

TFR included tobacco-related and wellness components designed to

address tobacco use cessation in the positive context of health promotion. Tobacco-related intervention goals and procedures are described elsewhere (Campbell et al., 2022; McCuistian et al., 2022). For the wellness component, programs were asked to develop new or strengthen existing policies and practices focused on nutrition and physical activity. Wellness policy/practice goals were suggested but not required. Programs were encouraged to be guided by individual program needs. Suggested practices included implementing exercise activities (e.g., horse shoes, disc golf, baseball, yoga, ping pong) and healthy cooking classes for clients, as well as making environmental changes such as re-purposing smoking areas to become community gardens or exercise areas.

TFR wellness intervention procedures for each program included (a) participating in an initial, day-long training with representatives from the CTCP, the SCLC, and the evaluation study team; (b) selecting staff project leads and forming staff and client wellness groups to assist planning and implementation of wellness policies/practices; (c) meeting monthly with SCLC consultants to develop wellness-related action plans, and quarterly with other participating programs to consult with expert speakers and discuss implementation progress and challenges; and (d) collaborating with external advisors, such as the California Department of Public Health Nutrition Education Obesity Prevention Branch for technical assistance and education.

2.3. Participants

All clients currently enrolled in the participating programs and present on-site at the time of data collection were eligible to complete study surveys. Mean time between pre- and post- intervention data collection across all programs was 462 days. Treatment stays in California residential SUD programs, paid by California's Medicaid program, can extend up to 90 days. Thus, participants at each data collection period were likely to be independent, cross-sectional samples.

2.4. Survey administration procedures

Cross-sectional client surveys were completed prior to and at the end of the 18-month, TFR contract period. Pre-intervention surveys were distributed by two research staff during 1–2-day site visits in the first 8 programs. Research staff reviewed study information with small groups of approximately 10 clients and distributed iPads with unique participant IDs to each potential participant. Potential participants used the iPads to review the written study information sheet and provide consent. Participants then completed online, anonymous, self-administered, 30-minute surveys. Clients received a \$20 gift card for participation.

Procedures changed after March 19, 2020 in response to the COVID pandemic when California issued a shelter-in-place order and visitation restrictions in residential SUD programs prohibited onsite attendance by research staff. A paper version of the survey was developed for use in programs lacking capacity for online survey completion. The paper survey was shortened due to the inability to automate skip patterns, to increase ease of survey completion, and to reduce respondents' time burden. Paper surveys were distributed by program staff to potential study participants who provided consent using a check box after reading a study information sheet. Completed paper surveys were mailed to the research team. Participants in 6 programs completed short form, paper surveys at pre-intervention. Participants in 4 programs completed long form surveys online at pre-intervention under the direction of program staff. All post-intervention surveys used the short form. At post-intervention, two programs completed surveys by phone with research staff, two accessed the survey online, and 14 used the paper version distributed by program staff. The research team mailed \$20 gift cards to the programs for distribution to participants. All procedures, including COVID-19 related modifications, were approved by the University of California San Francisco institutional review board.

2.5. Measures

Thirteen survey questions, present on both the long and short versions of the survey, were used in the current study. The 13 questions administered at both pre- and post- data collection periods were identical. Survey demographic questions assessed age, gender, race/ethnicity, and education.

2.5.1. SSB consumption

Sugar-sweetened beverage consumption was selected as the sole measure of dietary intake based on (a) robust associations with poor overall diet, obesity, type II diabetes and cardiovascular disease (Luger et al., 2017; Wang et al., 2015; Yang et al., 2014); (b) accounting for almost 50% of added sugars consumed in the US (DHHS, 2015); (c) selection as a focus of dietary interventions at state (e.g., Rethink Your Drink Campaign in California), community, program, and individual levels (Hartigant et al., 2017; Hedrick et al., 2017; Richardson, 2014; von Philipsborn et al., 2019); and (d) to keep survey respondent burden low. Moreover, individuals with SUDs show both a preference for and high consumption of sugar-rich food and drink and recommendations for addressing nutrition in SUD treatment include a focus on reduced SSB consumption (Chavez & Rigg, 2020; Mahboubet al., 2021; Mysels & Sullivan, 2010; Saeland et al., 2011). SSB survey questions, adapted from the National Cancer Institute's Dietary Screener Questionnaire (NCI, 2009; Thompson et al., 2017), asked about past week consumption of non-diet soft drinks/soda/pop, sweetened fruit drinks/energy drinks, coffee or tea with added sugar, and flavored milk-type drinks. There were 9 response options ranging from 0 in past week to 6 or more times per day. Responses across the four drink categories were summed to determine the total number of sugary beverages consumed in the past week.

2.5.2. PA

Participants reported PA using a question adapted from the 2017–2018 National Health and Nutrition Examination (CDC, 2017) asking the number of days in the past week they were physically active for a total of at least 60 minutes in a way that increased their heart rate and made them breathe hard some of the time. There were 10 response options, one for each of 0–7 days, I don't know (DK), and decline to answer.

2.5.3. Nutrition and PA counseling

Participants were asked whether they had received information or counseling (referred to as counseling in this article) about making healthier nutrition choices such as drinking water instead of soft drinks, eating whole wheat instead of white bread, using olive oil instead of butter during their current treatment (Y/N/DK). Participants were also asked whether they had received information or counseling about how physical activity can support wellness and recovery during their current treatment (Y/N/DK).

2.6. Analyses

Descriptive statistics were used to summarize demographics, two wellness behavior variables (past week SSB consumption, past week PA) and two wellness counseling variables (nutrition counseling, PA counseling) using frequencies and percentages for categorical variables and means with standard deviations (SD) for continuous variables. Response options "no" and "DK" for nutrition and PA counseling were combined based on the rationale that the inability to recall whether counseling had been received suggested either that it had not or that it had minimal impact when received and was not salient to the respondent. Changes in SSB consumption, PA, nutrition counseling and PA counseling from pre- to post-intervention were assessed using Pearson's chi-square test for categorical variables and t-test for continuous variables. Comparisons significant at $p \leq 0.10$ were further evaluated with multivariable

regression models. Models adjusted for demographic variables (age, gender, race/ethnicity and education) and nesting of participants within treatment programs. Multivariable regression models also examined associations of nutrition counseling with past week SSB consumption and PA counseling with past week PA. The models assessed main effects of counseling and time period (pre/post) on SSB and PA outcomes and included a counseling by time period interaction term to assess whether associations of wellness counseling with related behavior differed in the pre- and post-intervention samples. Models also adjusted for demographic variables and nesting of participants within treatment programs. Sensitivity analyses were conducted for these models using modified nutrition and PA counseling predictor variables with the three response options (yes/no/DK). Complete case analyses were used for all tests. Missing data was generally low ($\leq 6\%$), except for the regression model evaluating the association between the PA counseling and past week PA which had a missing rate of 10%, largely due to excluding “DK” and “decline to answer” responses from the analyses. SAS version 9.4 was used to conduct the analyses.

3. Results

3.1. Participant characteristics

There were 856 participants, 434 at pre- and 422 at post-intervention (Table 1). There were no demographics differences between the pre- and post-intervention samples with the exception of gender. Both samples identified predominantly as male, although there were significantly more males at post- than at pre-intervention, 82.9% vs. 73.6%, respectively.

3.2. Pre-vs. post-intervention differences in wellness variables

There were significant pre- to post-intervention differences for both nutrition counseling receipt and PA counseling receipt (Table 2). The percentage of respondents endorsing receipt of nutrition counseling during treatment was higher at post- as compared to pre-intervention (65.4% vs. 52.0%, $p < 0.0001$). The percentage of respondents endorsing PA counseling receipt during treatment was also higher in the post-intervention sample (69.2% vs. 55.6%, $p < 0.0001$). In multivariable regression analyses (Table 3), the pre-post difference in nutrition counseling receipt remained significant. Post-intervention clients were 83% more likely than pre-intervention clients to report nutrition counseling (AOR = 1.83, 95% CI = 1.08, 3.09, $p = 0.024$). The pre-post difference in PA counseling receipt was no longer significant.

Table 1

Demographic characteristics of clients in California residential SUD programs at pre- and post- wellness policy intervention.

| | Mean (SD) or n (%) | | p values |
|------------------------|---------------------------|----------------------------|--------------|
| | Pre-intervention (N= 434) | Post-intervention (N= 422) | |
| Age | 38.1 (11.6) | 38.6 (11.5) | 0.495 |
| Gender | | | 0.003 |
| Male | 318 (73.6%) | 348 (82.9%) | |
| Female | 110 (25.5%) | 68 (16.2%) | |
| Other | 4 (0.9%) | 4 (1.0%) | |
| Race/ethnicity | | | 0.693 |
| Hispanic | 191 (44.1%) | 193 (45.8%) | |
| Black/African American | 70 (16.2%) | 71 (16.9%) | |
| White | 126 (29.1%) | 114 (27.1%) | |
| American Indian/Alaska | 10 (2.3%) | 5 (1.2%) | |
| Asian/Pacific Islander | 11 (2.5%) | 8 (1.9%) | |
| Other | 25 (5.8%) | 30 (7.1%) | |
| Education level | | | 0.111 |
| <HS | 116 (26.7%) | 139 (33.3%) | |
| HS/GED | 156 (35.9%) | 140 (33.5%) | |
| >HS | 162 (37.3%) | 139 (33.3%) | |

Table 2

Nutrition and physical activity behaviors and counseling receipt pre- and post-wellness policy intervention in California residential SUD programs.

| | n (%) / Mean (SD) | | p value |
|--|--------------------------|---------------------------|-------------------|
| | Pre-intervention (N=434) | Post-intervention (N=422) | |
| Sugar-sweetened beverages-servings/week | 14.1 (20.4) | 15.0 (18.8) | 0.509 |
| Nutrition counseling receipt | | | <0.0001 |
| Yes | 223 (52.0%) | 259 (65.4%) | |
| No/ Don't know | 206 (48.0%) | 137 (34.6%) | |
| Days of physical activity per week | 3.8 (2.5) | 3.8 (2.5) | 0.885 |
| Physical activity counseling receipt | | | <0.0001 |
| Yes | 240 (55.6%) | 285 (69.2%) | |
| No/Don't know | 192 (44.4%) | 127 (30.8%) | |

3.3. Associations of nutrition counseling and PA counseling with related behavior

Multivariable regression models testing associations of wellness counseling receipt with related behavior including the interaction of counseling receipt with time period are shown in Table 4. Nutrition counseling receipt was significantly associated with past week SSB consumption ($p = 0.008$). Clients reporting nutrition counseling had 22% lower past week SSB consumption than clients who did not endorse counseling receipt (Adjusted mean ratio (AMR)= 0.78, 95%CI: 0.65, 0.94). SSB consumption did not significantly differ by time period (pre vs. post), nor was there a significant interaction effect of counseling with time period.

There was a significant interaction effect of PA counseling receipt with time period on past week PA ($p = 0.008$). In the pre-intervention sample, past week PA was 22% higher among clients endorsing PA counseling receipt than among clients who did not endorse PA counseling receipt (AMR=1.22, 95%CI: 1.11, 1.34, $p < 0.0001$). This ratio was higher in the post-intervention sample as shown in Fig. 1 (AMR=1.47, 95%CI: 1.28, 1.68, $p < 0.0001$). There was no significant effect of time period on past week PA regardless of PA counseling receipt.

To conduct sensitivity analyses, multivariable regression models shown in Table 4 were repeated with modified (yes/no/DK) nutrition and PA counseling predictor variables for both outcomes, past week SSB consumption and past week PA. There were no differences in significance from results shown in Table 4.

4. Discussion

A wellness-oriented, tobacco-free policy intervention implemented in residential SUD programs in California addressed tobacco use, nutrition, and PA to promote overall health. There were no pre- post-intervention changes observed in SSB consumption. Weekly average SSB intake of 14–15 sugary drinks remained above the American Heart Association’s recommendation of no more than 3 sugary drinks weekly (Lloyd-Jones et al., 2010). However, clients in the post-intervention

Table 3

Regression models of changes in nutrition and physical activity counseling receipt pre- and post- wellness policy intervention in California residential SUD programs.

| | Post intervention vs. pre intervention ¹ | |
|---|---|--------------|
| | OR (95%CI) | p value |
| Nutrition counseling receipt | 1.83 (1.08, 3.09) | 0.024 |
| Physical activity counseling receipt | 1.75 (0.86, 3.54) | 0.121 |

¹ Adjusted for demographics (age, gender, race/ethnicity, education) and controlled for nesting of participants within clinics.

Table 4

Regression models of associations of wellness counseling, pre-post-time period, and counseling by time period interactions with wellness behaviors of clients in California residential SUD programs.

| | Pre-intervention (LS Mean, 95%CI) | | Post-intervention (LS Mean, 95%CI) | | p value ¹ | | |
|--|-----------------------------------|----------------------------|------------------------------------|----------------------------|---------------------------------|-------|---|
| | Received counseling ² | No/Don't know ² | Received counseling ² | No/Don't know ² | Counseling receipt ² | Time | Counseling receipt by time ² |
| Sugar-sweetened beverages ³ | 17.6 (14.1, 22.0) | 21.7 (18.1, 25.9) | 18.5 (13.8, 24.8) | 24.6 (20.4, 29.6) | 0.008⁴ | 0.434 | 0.509 |
| Days of physical activity ⁵ | 3.7 (3.1, 4.5) | 3.1 (2.5, 3.8) | 3.9 (3.3, 4.7) | 2.7 (2.2, 3.2) | <0.0001 | 0.464 | 0.008 |

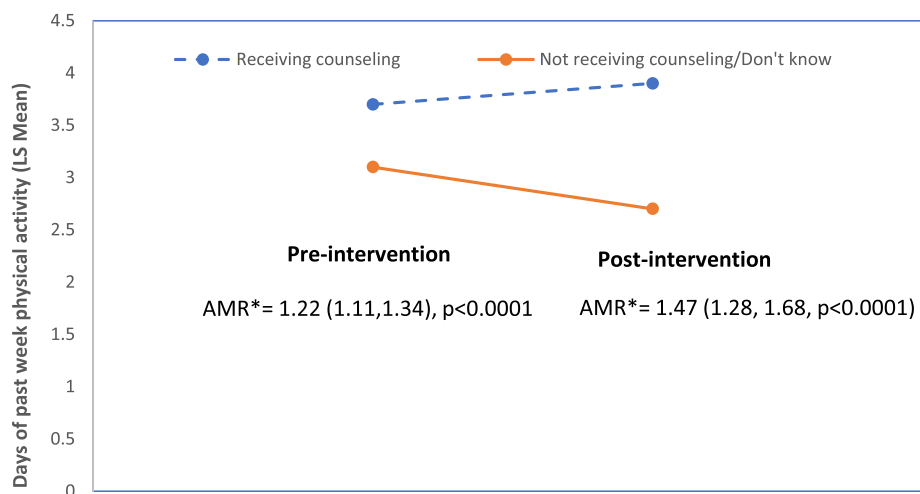
¹ Adjusted for demographics (age, gender, race/ethnicity, education) and controlled for nesting of participants within clinics.

² Receipt of nutrition counseling for sugar-sweetened beverages model and receipt of physical activity counseling for days of physical activity model.

³ n = 426 for pre- and n=377 for post- intervention group

⁴ Adjusted mean ratio (AMR) = 0.78, 95%CI: 0.65, 0.94

⁵ n = 411 for pre- and n=360 for post- intervention group



$$*AMR = \frac{LS\ Mean\ of\ past\ week\ PA\ among\ clients\ received\ PA\ counseling}{LS\ Mean\ of\ past\ week\ PA\ among\ clients\ who\ didn't\ receive\ or\ didn't\ know\ if\ receiving\ counseling}$$

Fig. 1. Interaction of time by PA counseling receipt for past week PA.

sample were significantly more likely to report nutrition counseling and counseling receipt was associated with lower SSB consumption, suggesting a positive impact of such counseling whether it was reported pre- or post-intervention. These findings suggest that counselors incorporated counseling about healthy nutrition into clinical services to clients in association with the policy intervention and that such information was associated with healthier dietary intake. Conducting nutrition counseling in SUD treatment to improve health is a common-sense intervention given evidence of poor nutrition among those with SUDs (Saeland et al., 2011). It may be particularly important for clients who are also managing cigarette smoking cessation during residential treatment since most of the weight gain associated with smoking cessation occurs within three months of quitting (Aubin, Farley, Lycett, Lahmek, & Aveyard, 2012). Information-based interventions in SUD treatment have led to improvements in nutritional knowledge and healthier eating (Kelly et al., 2021; Sason et al., 2018). These and current findings provide impetus for further empirical investigation of nutrition counseling in SUD treatment, particularly conducting trials of specific nutrition interventions, assessing broader nutrition outcomes beyond SSB, and examining their impact on tobacco use cessation, a primary component of wellness interventions in SUD treatment.

The current study did not find pre- post-intervention differences in PA. Given a mean of almost 4 days past week PA in the pre-intervention sample, it is possible that potential increases associated with the intervention faced a ceiling effect. There were also no pre-post- intervention differences in PA counseling receipt after adjusting for demographics

and program nesting. However, there were significant associations between reporting PA counseling and higher levels of PA, an association that was stronger in the post-intervention sample. The findings suggest that interventions as simple as providing counseling about the benefits of PA may increase clients PA levels while in treatment. Other studies have shown exercise interventions to have positive, if short-term, effects on substance use, including smoking (Santos et al., 2021; Thompson et al., 2020). Such findings lend support for the inclusion of physical activity in wellness-oriented services in residential SUD treatment. They call for further empirical investigation to examine whether specific PA interventions increase PA, facilitate smoking cessation, limit weight gain and weight gain concerns following smoking cessation, and improve general health among clients in residential SUD treatment.

4.1. Limitations

The current study's cross-sectional design precludes causal interpretations of findings, such as the finding of pre-post increases in nutrition counseling receipt. Additionally, the current study reported on pre-post- differences in wellness variables in the absence of measures of programmatic implementation of wellness interventions. We are unable to determine either the "dose" or the components of wellness policies or practice changes. Client-reported nutrition and PA counseling receipt provide some information about wellness services, but the nature and extent of counseling are unknown since the provision of wellness counseling was not a prescribed policy intervention component. Varying

data collection procedures due to COVID-related disruptions may have impacted participants' survey responses. The survey was shortened in response to required procedural changes which resulted in limited measures of both nutrition and PA. We were unable to assess the potential impacts of COVID-related disruptions on wellness counseling and on related client behavior. Challenges associated with mandated health protocols (e.g., quarantining, masking, social distancing), as well as staffing disruptions due to COVID illness, may have negatively affected implementation of nutrition or PA components during the intervention period. Associated changes in client SSB consumption and PA may also have been impacted. For example, social distancing, masking, and limited staffing could have decreased opportunities to implement exercise classes in indoor settings. The current study did not assess relationships among SSB consumption, PA and smoking cessation. Thus, the important question of whether improving nutrition and PA during SUD treatment can facilitate smoking cessation requires further examination. Generalizability of our findings may be limited. The total study sample was over 75% male. Moreover, the study was conducted with California residential SUD programs who applied and were selected to participate in the TFR intervention, creating a study sample that could differ in numerous ways from other residential SUD programs including interest, motivation, and perceived ability to successfully implement tobacco-free, wellness programs. Results may also have been affected by historical, external factors associated with the COVID pandemic, such as changes to treatment service delivery, to intervention implementation, and to clients' health concerns (Pagano et al., 2021).

4.2. Conclusion

Over the past decade, wellness curricula have been implemented in SUD and behavioral health programs despite a limited evidence base. Results of the current study contribute to developing evidence. Post-intervention survey respondents reported more receipt of nutrition counseling than pre-intervention respondents and nutrition counseling was associated with lower SSB at both pre- and post-intervention. PA counseling was associated with higher levels of PA with a stronger association post-intervention. These findings suggest that counselors can incorporate wellness interventions in SUD treatment to improve nutrition and increase PA. Further studies should seek to identify specific nutrition and PA intervention components that improve targeted behaviors and examine whether they benefit overall health, whether they have reciprocal impacts on diet and exercise, and whether they mediate change in smoking outcomes. If wellness-oriented interventions are found to be efficacious, implementation research should examine barriers and supports, such as the perceived burden of addressing multiple life domains during treatment versus increased motivation to improve health and quality of life. Future research should also determine the extent to which health and wellness changes are meaningful to persons in recovery. Doing so would expand the scope of patient-centered, recovery outcomes and improve quality of care.

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CRedit authorship contribution statement

Barbara K. Campbell: Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Thao Le:** Methodology, Formal analysis, Data curation, Writing – review & editing. **Anna**

Pagano: Conceptualization, Writing – review & editing. **Caravella McCuistian:** Conceptualization, Writing – review & editing. **Gail Woodward-Lopez:** Conceptualization, Methodology, Writing – review & editing. **Catherine Bonniot:** Conceptualization, Project administration, Writing – review & editing. **Joseph Guldish:** Conceptualization, Writing – review & editing, Supervision, Project administration, Funding acquisition.

Declaration of Competing Interest

None.

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