Lead Article

Nutritional status and eating habits of people who use drugs and/or are undergoing treatment for recovery: a narrative review

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A comprehensive overview is presented of the nutritional issues faced by people who use drugs or are undergoing treatment for recovery. Chronic substance use affects a person's nutritional status and body composition through decreased intake, nutrient absorption, and dysregulation of hormones that alter the mechanisms of satiety and food intake. Anthropometrics alone is not the best indicator of nutritional status, because this population has hidden deficiencies and disturbed metabolic parameters. Socioeconomic factors (eg, higher education, higher income, presence of a partner, living at home) positively affect nutritional status. Scarce available data on users undergoing treatment indicate improvement in anthropometric and metabolic parameters but with micronutrient intake remaining suboptimal. Weight gain is noted especially among women who use drugs and potentially increases their risk of relapse. Finally, specific amino acids and omega-3 fatty acids are promising in decreasing relapse and improving mental health during treatment; however, additional high-quality studies are needed. Nutrition intervention for people who use drugs or are undergoing treatment for recovery is underused; comprehensive programs addressing this population's unique needs are necessary. Future research will identify which components are needed.

INTRODUCTION

Nearly 5% of the world population is currently estimated to use drugs once daily, and almost 0.6% suffer from severe drug use disorder.[1] To date, opioids are the most harmful type of used drugs, and cannabis remains the world's most widely used drug.[1]

There are various types of treatments for drug addiction, including detoxification (complete abstinence) or opioid substitution treatment (OST).[2] Drug detoxification mostly takes place initially in hospitals, followed by psychotherapy and behavioral modification in a therapeutic community or a rehabilitation center.[3] By contrast, OST is a medication-assisted program during

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which the patient receives a long-term opioid agonist (methadone or buprenorphine) to reduce the withdrawal symptoms and decrease the cravings for street opioids.[4] OST is suggested to be the more efficient method for reducing blood-borne illnesses like infection with the human immunodeficiency virus (HIV) and hepatitis.[5]

Drug use poses a cluster of harmful consequences to a person's well-being on psychological, emotional, and social levels.[6] It leads to increased risk of infectious illnesses[7] and medical issues, including mental disorders, cancer, stroke, and liver, lung, and cardiovascular diseases.[8]

Additionally, substance use can compromise the user's nutrition[2] and greatly affects their dietary habits. In general, this population has a disrupted and chaotic lifestyle, and money is usually spent on drugs rather than on food. This severely affects the user's food intake, which eventually leads to undernutrition.[9] Other factors affecting the nutritional status of drug users include the type, frequency, and duration of the drug used and the presence of infectious diseases.[10] Furthermore, the type of treatment drug users might be receiving, such as being enrolled in a detoxification program and living in a rehabilitation center vs receiving OST and living in the community, might also influence their nutritional status.[11]

In this article, the literature on the nutritional issues faced by people who use drugs (PWUD) or those undergoing treatment for recovery is reviewed, as is the effect of drug use on dietary intake and dietary habits. The effect of drugs on anthropometric indices, body composition, nutrient deficiencies, and metabolic parameters are exposed, and the effect of nutrition on substance use and the changes that occur during treatment and recovery are discussed. The term *malnutrition* describes a state of imbalance—excess or deficiency—that leads to alteration in body composition and negatively affects the health status of the individual. In this article, the term *malnutrition* is used synonymously with *undernutrition*.

We chose to conduct a narrative review because there are many different topics in this field with few studies on each and statistical combination is impossible. These data will be compiled to have a comprehensive overview and provide new insights on drug users' eating patterns for future nutritional interventions in the promotion of good health among this population.

Various databases were searched for relevant literature (namely, PubMed, Google Scholar, Science Direct, and Medline), using the following terms: "nutrition" OR "nutritional status" OR "malnutrition" OR "dietary habits" AND "illicit drug use" OR "substance abuse" OR "drug use*" OR "drug treatment." The keywords were modified according to the searched database. In addition, references of included articles were reviewed for inclusion when we thought they were relevant. Searches were restricted to English-language journals and a date range of 1990 until the present. A total of 83 studies initially were included in the review. Eight additional studies were suggested by key scholars; accordingly, the total number of studies included was 91.

Effect of drug use on dietary habits: food preferences, eating behaviors, and appetite regulation

Little research has been done to tackle the issues of food preferences and dietary habits of active drug users or those undergoing different treatment modalities. Cocaine drug users have irregular eating patterns and rely mainly on 1 meal taken late at night. Typically, this meal is high in refined carbohydrates and fat and low in fruits and vegetables.[12–14] People addicted to opiates replace protein and fats with meals high in sugar and alcohol, which are low in essential nutrients and, therefore, are sources of empty calories.[9] Substantial evidence supports the increased preferences for sweet taste among PWUD.[15–20]

During the early phase of detoxification, when patients are still receiving pharmacotherapy, they report a period of low food intake, and eating becomes their last priority as they experience nausea, anorexia, and gastrointestinal disturbances, all of which make eating difficult.[12,19] Between the first and sixth month of detoxification, a high preference and craving for table sugar and sweet foods, such as cakes and confectionary foods, often takes place as a replacement for the drug. However, in the later recovery phase, after 6 months, sugar cravings seem to level off with more structural food intake and improved appetite.[17,19,21]

Studies of persons receiving OST also show higher preference and intake of sugary foods[15,22–24] (eg, high consumption of tablesugar, yogurt, and soft drinks), with very little intake of fruits and vegetables.[25,26] Sugary foods appear to be the preferred foods for PWUD or those undergoing treatment. This preference may be an indication of addictive tendencies, because some studies show that heroin users have these cravings prior to using heroin more than after using it.[27]

The poor dietary habits decreasing food intake, the preference for sugary foods contributing to empty calories, the compromised liver storage and/or increased excretion of nutrients with accompanying diseases like HIV and hepatitis are major risk factors for malnutrition and hazardous health among PWUD.[28]

Nutrition knowledge seems to affect dietary choices in this population. For instance, when nutrition knowledge was offered as part of an OST program, sugary food craving was still observed but healthier foods and more meals were consumed by the participants.[18]

Effect of drug use on dietary intake: macro- and micronutrients

In the short term, opiates cause anorexia, decreased food consumption, and reduced gastrointestinal motility, all leading to malnutrition and increased risk of infections in the long term.[29] Socioeconomic factors like education and income are positively associated with nutritional indices like body mass index (BMI), hemoglobin level, and serum protein levels among PWUD. This association is in agreement with the well-documented fact that socioeconomic factors are related to the nutritional status of the individual, in addition to the high prevalence of self-reported homelessness among PWUD.[20,30] Similarly, people who use heroin and cocaine have lower energy and protein intake than nonusers.[16,31] This intake seems to decline more with higher intensity and duration of drug use.[10] The presence of disease also appears to affect food intake. HIV-positive PWUD have more energy, protein, and fat-deficient diets compared with PWUD who are HIV negative.[28] The high levels of food insecurity among this population are mainly due to the limited funds, which are usually allocated to the support of their habits rather than food; this leads to serious decrease in intake levels.

Consistent with the lower intakes of nutrient-dense foods in this population, the intake of the majority of vitamins and minerals, like thiamin, riboflavin, pyridoxine, folate, vitamin D, vitamin C, magnesium, iron, calcium, zinc, copper, and selenium is below the recommended intake.[32] The nutritional imbalance (a higher ratio of macronutrients to micronutrients) indicating higher intakes of empty calories is strongly associated with drug use.[33]

Effect of drug use on plasma nutrient deficiencies

The malnutrition of PWUD, assessed by anthropometric measurements, is not usually very severe; thus, measuring the plasma levels of macronutrients and micronutrients might reveal hidden deficiencies that reflect the decrease in the intake of these nutrients.

Essential nutrients are depleted among PWUD in general.[15] This population exhibits low selenium and potassium levels due to lower muscle mass attributed to malnutrition.[34] Iron deficiency and iron-deficiency anemia are widespread, mostly among female PWUD,[35–37] as are low plasma levels of vitamins A, C, D, and E. The latter is inversely correlated with the dose and period of addiction.[16,30,35] These deficiencies are mainly caused by restricted access to foods, in addition to the food choices previously discussed.[16,30,35] Thus, the issue of vitamin and mineral supplementation among PWUD and during treatment requires additional consideration.

On the other hand, the plasma levels of some minerals are reported to be higher in this group compared with healthy individuals. This is not due to proper nutrition but rather is attributed to factors unique to PWUD. Higher serum levels of phosphorus, sodium, and magnesium are tentatively attributed to partial dehydration.[15] Similarly, increased serum levels of copper and zinc are due to inflammation, acute fasting, and smoking.[15,34,36]

Effect of drug use on anthropometric indices and body composition

Although scarce, the majority of the literature assessing the nutritional status of PWUD mostly points toward malnutrition.[11] The relation among drug use, body weight, and BMI has been addressed in many epidemiological studies, and most of the evidence shows an inverse correlation among these variables.[28,38] On admission for detoxification, up to 70% of PWUD have BMI values below the normal range or weight values below the population mean.[10] Similarly, Ross et al[35] showed that 24% of PWUD, within a short period of admission for detoxification, exhibited mild to moderate malnutrition, based on the Subjective Global Assessment.

In general, the BMI of PWUD is lower than that of nonusers. HIV-positive persons who use cocaine have the lowest BMI, as compared with users of other drugs or with nonusers.[39] It is believed that cocaine suppresses appetite and decreases food intake, and subsequently body weight, by inhibiting dopamine transporters, decreasing reuptake of serotonin, upregulating the glucocorticoid production, and increasing the cocaine- and amphetamine-regulated transcript expression.[40,41] Cowan et al[21] supported this finding when reporting that weight was gained with the cessation of cocaine use. Ersche et al[13] challenged the assumption that cocaine leads to weight loss through appetite suppression; rather, they suggested that metabolic alteration is the cause. Their findings showed that cocaine users had lower body weight and fat mass as compared with nonusers, despite reporting higher dietary fat and carbohydrate intake.

People who smoke heroin appear to have a lower BMI and body weight than nonusers. This inverse correlation is modulated by the high frequency (>3 times/d) and the route of administration of the drug.[38] The significant negative contribution of smoked heroin to body weight and BMI may be due to faster rate of brain

Table 1 **Factors contributing to lower body weight, BMI, and body composition among drug users**

Factor	Finding
Sex	Underweight is more frequent among women than men.
Type of drug	Heroin: highest percentage of drug users in underweight categoryCocaine: decrease in weight specific to fat mass with no significant changes in BMIAmphetamines: higher risk of obesity in users as compared with morphine usersMethylamphetamines: lower BMI as compared with nonusers
Frequency and route of administration	Multiple drug use for a long duration is negatively associated with the nutritional status.Smoking has faster delivery of the drug to the brain, resulting in a lower BMI as compared with snorting or injection.
Food insecurity and poverty	Negative effect on the nutritional status by decreasing body weight, body fat, and BMI
Pathological diseases	Add to the severity of malnutrition among drug users
Treatment	Healthier dietary habits seen in detoxification and OST

Abbreviations: BMI, body mass index; OST, opioid substitution treatment.

delivery of the drug as compared with injection, snorting, or oral ingestion, leading to greater reinforcing effects. Substances like heroin may compete with food in the brain activating reward pathways and increasing dopamine receptor' availability, thus suppressing the appetite and leading to lower body weight. This is particularly noted among heroin smokers.[38,42–45]

McIlwraith et al[46] showed that heroin users are more prone to being underweight as compared with morphine and amphetamine users, whereas people who use amphetamines were at higher risk of being obese as compared with morphine users. This finding is contradictory to the appetite-suppressing effect of amphetamine, and its relevance to the general population will need to be investigated by future studies, because this increase in obesity was found only in comparison with morphine users and not with a nondrug-using control group.[46,47]

Methylamphetamine (MA), a relatively new psychostimulant (the second most widely used drug now after heroin, marijuana, and others) is associated with cardiac and hepatic pathology, neurological impairment, mood disorders, and malnutrition.[48] People dependent on MA have a lower BMI as compared with that of healthy individuals. This might be due to cognitive deficits, abnormal metabolic activity, duration of MA use, and improper oral health that affects food chewing and, thus, intake.[48,49] More frequent use of other types of drugs such as marijuana or sedatives showed a weak association with a lower BMI, although this association is statistically not significant.[39,50]

In addition, sex might influence the BMI, weight, and body composition of PWUD. Women who are heavy drug users (ie, using methadone or injection of drugs >16 times/wk) have less body fat and lower BMI as compared with PWUD moderately or infrequently, and nonusers. This difference among different levels of drug use is not present in men.[51] This study by "Cofrancesco et al.[51]" confirms the results of studies that showed a negative relation between drug use and BMI solely among women and not men.[10,52,53]

Furthermore, factors like decreased frequency of food consumption are negatively associated with body weight and BMI. Also, poverty resulting from unemployment, common among PWUD, leads to an inability to purchase nutritious foods and is associated with a low BMI. In addition, multiple drug use can lead to poorer nutritional status due to the appetite-suppressing effect of the drug.[20,28,30]

Interestingly, Richardson et al[54] showed that BMI alone may not be the best indicator to assess PWUD because there was no association between BMI and the nutritional risk level of PWUD when screened. Using other tools to assess appetite, diet quality, and biochemical parameters better identified nutritional deficiencies to be addressed.[35]

Throughout treatment processes, whether by OST or detoxification, PWUD start to consume healthier foods and more structured meals.[19,21,26] Better dietary habits are seen among those in residential homes where meals are provided, or later in recovery when food preparation becomes a more sociable and satisfying activity as compared with PWUD who have severe addiction and for whom eating is given little consideration.[19] Table 1 summarizes the factors contributing to changes in anthropometric indices and body composition among PWUD.

Effect of drug use on plasma metabolic parameters

The effect of drug use on plasma parameters has also been studied with emphasis on lipid profile, glucose and hemoglobin levels, and hematocrit. In general, plasma total cholesterol has an inverse relation with drug use. Persons addicted to opium, heroin, and MA have a significant decrease in serum cholesterol level as compared with nonusers but with no change in triglyceride levels.[49,55–58] By contrast, comparing HIV-positive and HIV-negative injecting drug users with a control group, total cholesterol levels were lower and triglyceride levels were significantly higher in the HIV-positive drug users, indicating the possible effect of the disease itself and not the drug use.[28] These findings were supported by Maccari et al,[59] who found that heroin users had significantly lower serum cholesterol and high-density lipoprotein levels, and higher triglyceride levels than nonusers. The aforementioned decrease in serum lipid levels could be mainly attributed to malnutrition and weight loss, specifically the loss of abdominal fat, in addition to the presence of liver diseases or HIV that are common among heroin users.

Decreased plasma cholesterol levels have been associated with many negative psychological behaviors, including aggression, depression, and suicide[60]; however, this remains controversial. Low plasma cholesterol levels can alter tissue concentration of polyunsaturated fatty acids, the depletion of which has important consequences on modulating the serotonergic and dopaminergic functions that play key roles in the aforementioned behaviors. Yet, to date, a causal relationship has not been shown.[58,61–63] Persons addicted to cocaine who relapsed after detoxification had lower plasma cholesterol values (<160 mg/dL) than those who did not, suggesting an increased vulnerability to the development of behavioral and psychological disorders with low cholesterol levels.[55] Whether these diminished levels are associated with drug craving still needs to be investigated.

Glucose is another parameter that was studied in PWUD and remains not well understood. In a study by Zhang et al,[48] the fasting blood glucose levels of persons addicted to MA were lower than those of control participants. This finding runs in parallel with studies done on animals that reported a direct effect of MA on the pancreas, leading to insulin secretion and induced hypoglycemia.[64] On the other hand, non-insulin dependent persons with diabetes who used opium had higher glycosylated hemoglobin values than did nonusers, thereby indicating elevated blood glucose levels in the former for the previous 3 months.[65] The effect of morphine on glucose has been demonstrated in animals, with several mechanisms suggested, like an increase in hormone levels including adrenalin, noradrenalin, corticosterone, and glucagon; these, in turn, increase blood glucose levels.[66,67] Among the very few studies on humans, Carey et al[68] showed that morphine can induce a reduction in the plasma counterregulatory epinephrine response, thus causing hypoglycemia symptoms in healthy individuals without diabetes. More studies are needed to confirm if behavioral factors play a role in the effect of drugs on plasma glucose levels.

Hemoglobin and hematocrit levels are lower in PWUD than in nonusers, with the lowest levels seen among multiple-drug users and those with longer duration of addiction.[30] This finding was related to malnutrition and decreased micronutrient intakes, especially iron.[69] The decrease in hemoglobin levels and hematocrit among PWUD is specifically noted among women. This might be because men are institutionalized for a longer period than women and that, in turn, correlates with better nutritional status.[32,35]

Nutritional changes during recovery (detoxification or OST)

In addition to being an effective method for reducing harm, OST or methadone maintenance treatment (MMT) also improves the nutritional status of PWUD, whereby the BMI and weight of users starting treatment significantly increase.[70,71] The increased weight and BMI are mostly seen in patients with higher education and income, suggesting a positive role of social factors on the nutritional status of PWUD.[20,30,70,72] From the patients' point of view, MMT has a positive impact on their physical health, sleep, and weight gain.[73] They report better appetite, change in taste, and more desire to eat.

PWUD starting MMT show a decreased intake in the majority of the nutrients (ie, fats, cholesterol, fibers, and some minerals and vitamins) 2 months after beginning treatment, followed by an increase after 9 months.[74] Sex might modulate the effect of MMT on weight gain. W hereas studies show an increase in dietary intake, body weight, BMI, and skin fat folds among men, as compared with a modest weight loss in women,[74] other studies show the opposite, with women having a much greater increase in BMI and weight than men.[75] The reason underlying this significant difference between sexes does not seem to be related to the duration of the treatment and needs additional investigation. The increase in weight and BMI may not be due to the shift toward a healthier eating pattern but might be related to the pharmacological aspect of the treatment itself.[23,75,76] Detoxification also results in increased weight and food intake,[77–79] which vary at different recovery stages. In the early stages, binge eating is observed as a result of the replacement of drugs with food. Binging may be related to changes in the eating behaviors of PWUD after periods of food restriction caused by drugs. In later stages of their recovery, PWUD developed more structured and less frequent overeating habits.[21]

The studies regarding the effect of MMT on some metabolic parameters are limited. After 6 months of MMT, persons addicted to opioids show an increase in serum levels of leptin, total cholesterol, high-density lipoprotein , and low-density lipoprotein, compared with serum levels before initiation of the treatment.[70,80] A positive correlation has been shown between leptin,

Table 2 **Effect of drug use and treatment methods on the nutritional status**

	Drug use	OST	Detoxification
Food preferences	Consumption of 1 meal/d with higher preference for sugars and fats and lower intakes of fruits and vegetables	Better appetite and increased number of mealsHigh consumption of sugars, yogurt, and soft drinks with low intakes of fruits and vegetables	Binging on sweets in early phases of treatment with more structured food intakes in later recovery stages
Macro- and micronutrient intake	Deficits in energy and proteinMajority of vitamins and minerals below RI	Higher energy, proteins, and carbohydrates after initiation of treatments, with a decrease in later stages	Higher energy, proteins, and carbohydrates after initiation of treatments, with a decrease in later stages.
Plasma nutrients	Low levels of Se, K, Fe, vitamins A, D, C, and EHigh levels of Mg, Na, and Ph attributed to dehydration	Majority of micronutrient levels stayed below the recommended levels.	Majority of micronutrient levels stayed below the recommended levels.
Anthropometrics	Decrease in BMI and weight with variations based on the type of drug	Significant increase in BMI and weight, with more significance in women, placing them in the overweight category.	Increase in weight and food intake in early stages of recovery
Metabolic parameters	Low levels of total and HDL-cholesterol, leptin, FBS, Hct, and Hb	Increase in total and HDL-cholesterol and leptin levels	

Abbreviations: BMI, body mass index; FBS, fasting blood sugar; Fe, iron; Hb, hemoglobin; Hct, hematocrit; HDL, high-density lipoprotein; K, potassium; Mg, magnesium; Na, sodium; OST, opioid substitution treatment; Ph, phosphorus; RI, recommended intake; Se, selenium.

BMI, and serum lipid levels, with greater effect among women; this is attributed to the difference in percent body fat mass.

As for micro- and macronutrient intake during MMT or detoxification, an increase in the overall intake of energy, proteins, and carbohydrates occurs with both modalities after initiation of the treatment. Yet, this is followed by a decrease in later stages of recovery, when the food intake starts to become more structured. Interestingly, intake of the majority of the minerals remains below the recommended levels, especially in patients with HIV; this could be related to the increased intake of energy-dense foods rather than nutrient-dense ones.[24,81]

Personal and environmental factors like decreased physical activity and the purchase of high-fat, less-expensive foods play a role in the weight gain seen among patients in recovery from drug use, thereby highlighting the need to incorporate exercise and nutrition information as part of the treatment.[82] Exercise reduces stress, anxiety, depression, and drug use in individuals recovering from substance use.[83]

Better nutrition knowledge and healthier eating habits are seen among PWUD in MMT after receiving nutrition lectures as part of the treatment program, although no effect on BMI and weight gain is seen. This could be because the intervention program emphasized the healthier eating habits and did not specifically target weight reduction.[84]

Concerns about weight gain among women drug users in recovery is a potential risk factor for relapse. In a study of 297 women of different ethnicities who were recruited from 7 different treatment facilities, Warren et al[79] reported that 70% were concerned about weight gain during recovery, and 45% were concerned about relapse because of this gain. One-third of the sample indicated that weight loss was a reason to initiate drug use to start with. Similarly, drug use was positively associated with overweight among female adolescents.[85] Data revealing drug users' perceptions about the kind of intervention programs for tackling the weight gain they face during treatment are scarce. Most of the research suggests similarities between women and men in terms of drug-use behaviors; however, significant differences exist that may indicate a need for more sex-specific research on prevention and treatment strategies.[85] On the basis of these findings, giving individualized behavioral recommendations must be considered, because all intervention research shows its efficiency. Table 2 summarizes the effect of drug use and treatment on different aspects of the nutritional status of PWUD.

Effect of nutrition on substance use

The high prevalence of PWUD with mood disorders like depression and anxiety has been confirmed by numerous, large epidemiological studies[86–88] and these disorders, in turn, may have a negative impact on users' recovery, which will lead to relapse.[15,89] Essential micronutrients play an important role in mood regulation by the brain,[33] and deficiencies or insufficient intakes of these nutrients, in addition to food deprivation, correlate with poor mental health, especially depression.[90,91] Serotonin plays a role in the modulation of many behaviors, including violence, aggression, mood, sleep, and appetite.[92,93] The synthesis of serotonin starts with the amino acid tryptophan. Increasing dietary intake of tryptophan can increase serotonin levels, thus modulating the aforementioned behaviors. Data in the literature concerning the positive effect of tryptophan supplementation on depression are inconsistent; consensus has not yet been reached regarding the effectiveness in the treatment of drug use.[93–95] Tyrosine and phenylalanine are also involved in the synthesis of dopamine and catecholamines that influence behavioral performance, with limited and inconsistent evidence that their supplementation is beneficial in the treatment of PWUD.[15,95,96] When patients dependent on heroin or opiates are given a combination of amino acids (namely, phenylalanine, tryptophan, tyrosine, and glutamine) while undergoing detoxification, they show a significant reduction in the craving for opiates.[97] This might be an important tool in the treatment of drug use that warrants additional study.

The provision of micronutrients is required as a cofactor for the synthesis of serotonin, dopamine, and catecholamines.[98,99] Deficiencies of copper, selenium, manganese, magnesium, folate, and B-complex vitamins are linked to depression,[98,100–102] which might hinder the treatment process of drug users. Vitamin and mineral supplementation should be considered, not only for the management of malnutrition but also as a preventive measure of relapse.

Furthermore, fatty acids are also involved in regulating the aforementioned behaviors.[103,104] Elevated levels of corticotropin-releasing hormone, which is associated with defensive and violent behaviors, decrease with supplementation of a combination of omega-3 fatty acid docosahexaenoic and eicosapentaenoic acids.[105] Patients undergoing detoxification from drug use have a decrease in anger score upon supplementation with docosahexaenoic acid, whereas lower anxiety scores are associated with supplementation with eicosapentaenoic acid.[106]

Supplementation could have a positive effect on the psychological behaviors that might prevent relapse. The intake of specific nutrients like amino acids and omega-3 fatty acids are promising in decreasing relapse and improving mental health during treatment, but additional high-quality studies are needed to provide evidence that such supplementation can increase the efficacy of the treatment of PWUD.

CONCLUSION

PWUD are a vulnerable population, and most of the research exploring their nutritional status points to malnutrition. Substance use affects the nutritional status and body composition through decreased food intake and nutrient absorption, altered metabolism, and use of multiple drugs, in addition to the dysregulation of hormones altering the mechanism of satiety and food intake. Anthropometric measurements alone are not the best indicators of assessment in this patient population, because active users and those seeking treatment have many hidden deficiencies and disturbed metabolic parameters. Socioeconomic factors like education, income, presence of a partner, and living in a residential home where meals are provided have a positive impact and should be considered.

Scarce available data indicate improvements in the anthropometric and metabolic parameters of PWUD when they initiate treatment, but micronutrient levels remain below recommended intake values. Yet, an increase in weight is noted, which might pose negative health implications.

All of these factors draw attention to the importance of proper, comprehensive nutrition care being provided for drug users and in treatment centers. Simple nutrition education about healthy eating habits improves the quality of the nutritional intake of PWUD but does not seem to be solely effective in treating the problems faced by users and those undergoing treatment and improving their outcomes. This indicates the need for an individualized and comprehensive nutritional intervention. The components of this intervention still need to be determined by future studies.

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