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Ayahuasca and Public Health II: Health Status in a Large Sample of Ayahuasca-Ceremony Participants in the Netherlands

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ABSTRACT

Ayahuasca is a plant decoction in traditional Amazonian medicine. Its ritual use has been internationalized, leading to policy challenges that countries should address. This study evaluates the impact of regular ayahuasca ceremony participation on health by assessing the health status of 377 participants in ayahuasca ceremonies in the Netherlands using validated health indicators. A questionnaire was developed and administered to study participants. The questionnaire included several health indicators with public health relevance (e.g., BMI, diet, physical activity) and psychometrically validated questionnaires (ELS and COPE-easy). The data retrieved through health indicators was compared to normative Dutch data. Participants (50.1% women) were mostly Dutch (84.6%) with a mean age of 48.8 years (SD = 11.6). Compared to normative Dutch data, regular participants in ayahuasca ceremonies showed better general well-being, fewer chronic or lifestyle-related diseases, more physical activity, and a more balanced diet. Participants also used less alcohol during the COVID-19 pandemic, and although they used more illegal drugs than the general population, they did not report associated harms. Our findings suggest that regular participation in ayahuasca ceremonies is not linked to relevant health harms. This data could help drug policy-makers to develop and implement evidence-based public policies.

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Introduction

Ayahuasca is a decoction commonly made with the *Banisteriopsis caapi* vine (Schultes 1967), which contains β-carbolines (mostly harmine) that are monoamine oxidase inhibitors (MAOI), in combination with plants such as *Psychotria viridis* and *Diplopterys cabrerana* that contain *N,N*-dimethyltryptamine (DMT), which is a hallucinogenic compound (McKenna, Towers, and Abbott 1984). The recipe for the brew varies slightly among the different Indigenous, mestizo, and religious groups of South America that use it in ceremonial contexts (Luna 2011). Furthermore, ayahuasca analogues made with the β-carboline-containing *Peganum harmala* and DMT-containing *Mimosa hostilis* (jurema) are also used as alternatives to ayahuasca.

The use of ayahuasca has expanded globally (Sánchez and Bouso 2015), and its increasing use by Westerners makes it a public health concern. The scientific information gathered to date suggests that ayahuasca has a good safety and tolerability profile (Bouso et al. 2021) following acute administration in controlled settings (Riba et al. 2001; Rocha et al. 2021) and after prolonged ritual use (Barbosa et al. 2012, 2016; Bouso et al. 2012; Gable 2007; Mello et al. 2019). Observational evidence also suggests a low risk for abuse (Barbosa et al. 2012, 2016; Bouso et al. 2012; Fábregas et al. 2010; Gable 2007) and beneficial effects for substance-related disorders, mood and anxiety disorders, and improvement of general well-being (Argento et al. 2019; Bouso et al. 2012; Cruz and Nappo 2018; Gable 2007; Gonzalez et al. 2021; Grob et al. 1996; Horák, Hasíková, and Verter 2018; Lawn et al. 2017; Ona et al. 2019; Perkins et al. 2021a, 2021b; Révész et al. 2021).

Recent clinical trials showed that a single dose of ayahuasca induced beneficial effects in treatment-resistant major depressive disorder (Osório et al. 2015; Palhano-Fontes et al. 2019; Sanches et al. 2016; including reductions in suicidality: Zeifman et al. 2021), and in social anxiety disorder (Dos Santos et al. 2016, 2021). Additionally, certain components of ayahuasca have

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been studied for the treatment of neurodegenerative disorders (Goulart da Silva, Daros, and de Bitencourt 2021; Morales-Garcia et al. 2020). Hallucinogens in general have been suggested to promote positive lifestyle changes (Teixeira et al. 2021) and beneficially impact markers of physical health, including higher odds of greater self-reported overall health, lower odds of being overweight or obese, and lower odds of having diabetes and heart diseases, among others (Ona et al. 2019; Simonsson et al. 2021; Simonsson, Sexton, and Hendricks 2021).

Regarding safety, observational (Durante et al. 2020), experimental (Riba et al. 2001; Rocha et al. 2021), and clinical studies (Dos Santos et al. 2021; Osório et al. 2015; Palhano-Fontes et al. 2019; Sanches et al. 2016) have shown that the most common adverse reactions to ayahuasca are transient nausea, vomiting, gastrointestinal discomfort, and transient anxiety and confusion. Serious adverse reactions, such as prolonged psychotic reactions, are rare and were not observed in experimental settings (Dos Santos, Bouso, and Hallak 2017). In addition, most cases of life-threatening effects reported in the literature or the media cannot be directly linked to ayahuasca ingestion (Dos Santos 2013; van den Berg et al. 2020).

Despite evidence suggesting a lack of intrinsic dangers, the globalization of ayahuasca is creating challenges regarding public policies. Since the 1990s, ayahuasca has been present in European countries. In Spain and the Netherlands, religious and other ayahuasca networks appear to have grown more numerous and are relatively overt (Hanegraaff 2011; ICEERS 2020). In these countries, there is an opportunity to study the effects of regular participation in ayahuasca ceremonies outside of its place of origin on a larger scale. A study exploring the health status of regular participants in ayahuasca ceremonies in Spain (Ona et al. 2019) found that regular participants in ayahuasca ceremonies scored considerably better for various health indicators, such as cholesterol levels, blood pressure, and physical exercise, compared to the national average. Furthermore, respondents reported a lower incidence of chronic diseases and physical limitations, as well as reduced use of prescription medicines.

In the Netherlands, the Santo Daime church (originally a Brazilian religion that uses ayahuasca or *Daime* as a religious sacrament) gained the legal right to use ayahuasca as a sacrament in their religious ceremonies in 2001 (van den Plas 2011). However, this right had to be repeatedly reclaimed by the church's members due to regular seizures of the brew imported from Brazil by the customs services (van den Plas 2011). In 2018, the Amsterdam Court of Appeal ruled that the members of the Santo Daime church cannot import (and therefore use) ayahuasca due to its assumed risk to public health. Ayahuasca was considered equivalent to N, N-dimethyltryptamine (DMT), a Schedule I substance of the Opium Act, and described as risky for people with mental health problems (a predisposition to psychosis and schizophrenia); when combined with alcohol, other drugs/medicines, or certain foods; and during pregnancy and breastfeeding (Gerechtsh of Amsterdam, 2018). No reference has been made to scientific data in the court case except the information provided on the Trimbos Institute webpage (https://www.drugsinfo.nl/overige-middelen/risicos-van-ayahuasca). Although there are potential risks associated with ayahuasca, scientific evidence (Dos Santos, Bouso, and Hallak 2017; Gable 2007) shows that those risks are anecdotal compared to the number of users. Regardless, the use of ayahuasca as a sacrament by the Santo Daime church in the Netherlands was prohibited, which affected several thousand people. According to the Dutch Supreme Court records, more than 5000 people attended the church in 2017 (Hoge Raad, 2019). In the long run, this decision might have negative consequences for public health, since it is pushing the people who engage in ayahuasca ceremonies into illegal and underground activity (Drucker 1999; Martínez Oró et al. 2020; Pavarin et al. 2020; Taylor, Buchanan, and Ayres 2016).

To date, no study exists in the Netherlands that would evaluate the health risks of regular participation in ayahuasca ceremonies, which is the aim of this paper. Additionally, we assessed the coping strategies and values of the respondents to determine how they deal with stressful situations and evaluate the performance of valued life activities, respectively. Using health indicators offers relevant information about the impact of long-term exposure to ayahuasca on public health and the overall health status of the participants on one hand, and generates relevant scientific data that can be used to develop evidence-based policies on the other.

Methods

Participants

Due to the past work, our research team had access to an existing network of several dozen facilitators of ayahuasca ceremonies (religious leaders and local practitioners) in the Netherlands. We contacted the facilitators and presented the study protocol to them. We then asked them to invite all the members of their network to participate in the study. Inclusion criteria included persons of legal age (18 years or older) that had participated in ayahuasca ceremonies in the Netherlands for the first time at least

six months before the assessment. We sent an information letter and a link to the online questionnaire to respondents who met the inclusion criteria.

Measures

The questionnaire was developed from standard questionnaires and health surveys (see Supporting information 1: Questionnaire at https://doi.org/10.6084/m9.figshare.19107119.v1). The constructed questionnaire included indicators measuring several dimensions of each individual's health status: general health, mental health, physical activity, dietary habits, social support, values, coping strategies, demographics, and COVID-19-related questions that might have affected the responses (e.g., increased or decreased substance use) (see Table 1).

The items assessing general health, mental health, use of prescription medicine, substance use, physical activity, and social support were selected from the Dutch Health Survey (Gezondheidsenquête 2020 C-versie). We used items such as the subjective perception of health, the presence of chronic disease or pain, the use of hospital services, and visits to general practitioners or specialists. Items such as high or low blood pressure, cholesterol, and diabetes were included in this section. The use of medicines was surveyed together with other aspects of the use of health care services. We assessed the use of tobacco, alcohol, and controlled substances. Items on feeling happy, calm, or energetic, as well as feeling down, depressed, or nervous (in the four weeks prior to the assessment) were selected to screen mental health. Physical activity was assessed using several sub-modules (work-related, transportation, and leisure-time). Social support was assessed using items on the subjective feeling of being cared for, loved, esteemed, and valued. Another section of the questionnaire assessed dietary habits. Items were selected from the Dutch National Food Consumption Survey 2012–2016.

Height and weight were used to calculate body mass index (BMI). Values and life fulfillment were assessed by the full Engaged Living Scale (ELS; Cronbach's alpha: .86) (Trompetter et al. 2013), which has two subscales: valued living (10 items) measuring recognition and knowledge of personal values and the capacity to undertake actions congruent with these values, and life fulfillment (6 items) measuring sense of fulfillment in life as a consequence of recognizing and living in accordance with personal values. The items are scored in a 5-point Likert scale, ranging from 1 (completely disagree) to 5 (completely agree). The higher the score, the stronger the engagement with the values.

To assess coping strategies, we employed the COPE-easy questionnaire (Cronbach's alpha: .57-.94) (Kleijn, van Heck, and van Waning 2000) in three main domains: active problem-focused coping (10 items), avoidant behavior (6 items), and support-seeking coping (6 items), as well as four health-relevant subdomains: religion (2 items), humor (2 items), acceptance (2 items), and substance use (2 items). The items are scored in a 4-point Likert scale, ranging from 1 (I haven't been doing this at all) to 4 (I've been doing this a lot).

Since the COVID-19 pandemic could have a significant influence on the measured items, we included several indicators from the Dutch Health Survey to assess its impact. We also collected demographic information and socio-economic data, such as age, gender, nationality, type of locality, type of housing and the number of household members, marital status, educational level, employment status, and household income. We also used questions relevant to ayahuasca use, such as how many ayahuasca

Table 1. Dimensions conforming to the administered questionnaire, indicators in each dimension, and sources used.

Dimensions	Indicators	Source
General health	Self-perceived health	Dutch Health Survey [Gezondheidsenquête 2020 C-versie] (RIVM)
	Mental health	
	Visits to medical professionals	
	Chronic diseases	
	Physical limitation	
	Cholesterol/blood pressure/diabetes	
	Body mass index	
	Use of prescription drugs	
	Alcohol, tobacco, and substance use	
Lifestyle	Physical activity	Dutch Health Survey [Gezondheidsenquête 2020 C-versie] (RIVM)
	Social support	
	Dietary habits	Dutch National Food Consumption Survey 2012–2016 [Voedselconsumptiepeiling 2012–2016] (RIVM)
Personal values	Complete questionnaire	Trompetter et al. (2013)
Coping strategies	Complete questionnaire	Kleijn, van Heck, and van Waning (2000)
COVID-19	Impact on general health and substance use	Dutch Health Survey [Gezondheidsenquête 2020 C-versie] (RIVM)

ceremonies the respondents attended in total, the setting of the ceremonies, and subjective effects on the individual's health.

Procedure

Data collection was conducted online due to COVID-19 restrictions. After completing the online survey, which took approximately 30 minutes, each participant received a debriefing statement and consented to the use of their data for study purposes. The study procedures were approved by the Research Ethics Committee of the Leiden University in the Netherlands.

Statistical Analyses

Descriptive statistics were used to describe the data from the indicators used. The data obtained through those indicators was compared with Dutch normative data (matched for age) retrieved from the Health Survey/Lifestyle Monitor (Gezondheidenquête/Leefstijlmonitor) conducted by the Netherlands National Institute for Public Health and the Environment (Rijksinstituut voor Volksgezondheid en Milieu [RIVM]) and Statistics Netherlands (Centraal Bureau voor de Statistiek [CBS]), the National Drug Monitor (Nationale Drug Monitor) conducted by Trimbos Institute, and the Food Consumption Survey 2012–2016 (Voedselconsumptiepeiling 2012–2016) conducted by the RIVM.

A multivariate general linear model (GLM) was developed to determine potential associations between the number of times respondents participated in ayahuasca ceremonies ("factor") and a set of 17 dependent variables. Bonferroni post-hoc analysis was used. We adjusted for age, gender, environment (urban/rural), marital status, and education level. These covariates were included given their potential differential effects on the answers. Additionally, a linear regression model was used to detect potential predictor variables (among 14 variables) of subjective health status. One-way ANCOVA was used to assess differences in the frequency of coping strategies, sub-scales of the ELS questionnaire, health status, benefits obtained with ayahuasca, presence of problems with blood pressure, cholesterol or sugar levels, adverse events associated with the use of ayahuasca, number of times participated in ayahuasca ceremonies, use of tobacco, feelings of loneliness, and the interruption of prescription medicines among those participating in distinct types of ayahuasca ceremonies (religious, Indigenous, neo-shamanic). Additionally, we assessed differences in the frequency of coping strategies and sub-scales of the ELS questionnaire among those with more or less experience participating in ayahuasca ceremonies, adjusted for age.

A p value of <.05 was considered statistically significant for all analyses. Bonferroni post-hoc analysis was carried out in the one-way ANCOVA, and we corrected for multiple comparisons (".05/30 = .001" and ".05/24 = .002"; we selected a p value of <.001 in all cases). Cohen's d effect size was reported when possible. Cohen's d was calculated through an online calculator (https://lbecker.uccs.edu/). IBM® SPSS version 22.0 software package was used.

Results

Participant characteristics

A total of 377 persons met the criteria to participate in the study. Half of the sample were women (50.1%) and the majority were Dutch nationals (84.6%). The youngest respondent was 22 years of age, and the oldest was 80 years, with a mean age of 48.8 years (SD = 11.6). More than half of the sample lived in an urban environment (52.3%) of which a quarter (24.7%) lived in cities with more than 500,000 inhabitants, such as Amsterdam and Rotterdam. Most participants lived in their own apartment or house (58.9%) and were in a relationship or married (54.1%). Most participants had a university degree (75.9%), and 82.7% were employed or self-employed, mainly in the service or sales sector (26.8%), healthcare sector (12.7%), arts and culture sector (8%), education sector (8%), or other occupational sectors (see Table 2).

Participation in ayahuasca ceremonies

The majority of the study participants (57.8%) started using ayahuasca more than five years ago, and more than half of the sample (55.2%) participated in an ayahuasca ceremony less than six months before participating in the study. In relation to frequency of attendance at ayahuasca ceremonies, 30% of the study respondents reported having participated more than 100 times in their lives. Most participants were either members of the Santo Daime church (40.3%) or attended neo-shamanic ceremonies led by local practitioners (40.6%) (see Table 3). Respondents reported mainly drinking ayahuasca made with *Banisteriopsis caapi* and *Psychotria viridis* (63.9%). Ayahuasca analogues (e.g., *jurema*) made with *Mimosa hostilis* and *Peganum harmala* (Syrian Rue) or other similar mixtures were drunk by fewer participants (6.4%). Drinking both, ayahuasca and its analogues, was reported by only 5% of the

Table 2. Sociodemographic information.

Gender		
Female	189	50.1%
Male	186	49.3%
Transgender	1	0.3%
No answer	1	0.3%
Age		
≤ 30	23	6.1%
31–40	76	20.2%
41–50	108	28.6%
51–60	108	28.6%
≥ 61	62	16.4%
Nationality		
Dutch	319	84.6%
Western	41	10.9%
Non-Western	17	4.5%
Education		
No education	1	0.3%
Low (primary school)	6	1.6%
Middle (secondary school)	84	22.3%
High (university)	286	75.9%
Employment status		
Unemployed	21	5.6%
Employed	152	40.3%
Self-employed	160	42.4%
Retired	30	8%
Unable to work	12	3.2%
Student	2	0.5%
Occupation		
Service and sales sector	101	26.8%
Healthcare sector	48	12.7%
Arts and culture sector	30	8%
Education sector	30	8%
Entrepreneur and business sector	28	7.4%
Alternative healthcare sector	22	5.8%
Social work sector	17	4.5%
Science and engineering sector	16	4.2%
Other sectors	85	22.5%
Marital status		
Single	132	35%
In a relationship	101	26.8%
Married	103	27.3%
Divorced or separated	36	9.6%
Widowed	5	1.3%
Type of housing		
Own apartment	55	14.6%
Own house	167	44.3%
Commercial rent	60	15.9%
Social rent	95	25.2%
Area		
Rural	102	27%
Suburb	78	20.7%
Urban	197	52.3%
Number of inhabitants		
0–5,000 inhabitants	70	18.6%
5,000–25,000 inhabitants	53	14.1%
25,000–50,000 inhabitants	34	9%
50,000–100,000 inhabitants	47	12.5%
100,000–500,000 inhabitants	80	21.2%
More than 500,000 inhabitants	93	24.7%
Financial difficulties due to the COVID-19 pandemic		
Yes	92	24.4%
No	285	75.6%

respondents. Some respondents did not know what brew they had drank (6.9%), and the rest (17.8%) did not respond to the question. A possibility remains that some participants (particularly those attending neo-shamanic ceremonies) reported drinking ayahuasca unaware of it being analogues.

When asked how ayahuasca influenced the individual's life, 99.8% responded very positively or positively. When asked what physical benefits (if any) they obtained from ayahuasca, 64.2% of the sample reported diverse benefits, such as improvement of general health and well-being, better pain management, feeling more physically relaxed, increased energy, being more in tune with the body, improved gastrointestinal health, and reduced or halted substance use. Also, 24.4% of the sample reported substance-related problems previous to ayahuasca use, while only 2.4% reported a current substance-related problem, and 53% reported decreased substance use. With respect to psychological benefits, 98.7% of respondents reported such benefits including becoming happier and more optimistic, gaining self-acceptance or self-awareness, feeling more peaceful and calmer, gaining confidence and self-respect, feeling more social and empathetic, and improved emotional regulation.

Adverse events were rarely experienced by respondents, with only 8.5% reporting such effects themselves or witnessing them during a ceremony. More commonly reported adverse events were panic and anxiety attacks, fainting or temporary loss of consciousness, and a generally difficult journey. Among the less reported adverse events were prolonged effects (more than 12 hours) like ataxia, vomiting and/or nausea, and injuries due to falling.

General Health

Most of our sample (94.7%) reported a good or very good perception of health. The percentage of persons with a normal BMI (within the range from 18.5 to 25 kg/m^2) was far greater among ayahuasca ceremony participants (72.6%) as compared to normative Dutch data (48.8%). The prevalence of chronic diseases, high blood pressure, cholesterol, and diabetes was lower among the sample of ayahuasca users compared to normative Dutch data. In the past year, ayahuasca ceremony participants had contact with fewer specialists compared to normative Dutch data, but more visits to physiotherapists, psychologists, and psychiatrists (see Table 4).

Ayahuasca ceremony participants also reported feeling less lonely compared to the national average. Most of our sample reported feeling happy (71.3%), calm (75.3%), and with a lot of energy (67.4%). Only a small percentage reported feeling down (9%), nervous (8.5%), and depressed (5.8%).

Table 3. Ayahuasca and substance use.

First participation in an ayahuasca ceremony		
Less than one year ago	12	3.20%
1 to 3 years ago	60	15.90%
3 to 5 years ago	87	23%
More than 5 years ago	218	57.80%
Most recent participation in an ayahuasca ceremony		
Less than half a year ago	208	55.20%
Less than one year ago	46	12.20%
1 to 3 years ago	101	26.80%
3 to 5 years ago	16	4.20%
More than 5 years ago	6	1.60%
Total number of ayahuasca ceremonies attended		
Between 3 and 10	105	27.90%
Between 10 and 20	58	15.40%
Between 20 and 50	52	13.80%
More than 50	49	13%
More than 100	113	30%
Type of ceremonies usually attended		
Religious	152	40.30%
Indigenous	42	11.10%
Local practitioners/neo-shamanic	153	40.60%
Other	30	8%
Self-perceived general influence of ayahuasca on the individual		
Very positive	314	83.30%
Positive	62	16.50%
Not influenced	1	0.30%
Negative	0	0%
Very negative	0	0%
Obtained physical benefits		
Yes	342	64.20%
No	135	35.80%
Obtained psychological benefits		
Yes	372	98.70%
No	5	1.30%
Adverse effects experienced		
Yes	32	8.50%
No	345	91.50%

Substance addiction before and after ayahuasca use

	Before		After	
Yes	92	24.40%	9	2.40%
No	285	75.60%	368	97.60%

Influence of ayahuasca on substance use	
Increased substance use	6 1.60%
Decreased substance use	200 53%
No relationship	171 45.40%

Substance use since the start of the COVID-19 pandemic

	Tobacco		Alcohol		Other substances	
More	19	5.00%	18	4.80%	20	5.30%
The same	34	9.00%	157	41.60%	136	36.10%
Less	11	2.90%	78	20.70%	47	12.50%
I've stopped since the COVID-19 pandemic	12	3.20%	2	0.50%	5	1.30%
I had already quit before the COVID-19 pandemic	48	12.70%	45	11.90%	45	11.90%
Not applicable	253	67.10%	77	20.40%	124	32.90%

Substance use compared with normative Dutch data

	Ayahuasca users		General population[a]	
Tobacco (past year)	18.30%		20.20%	
Alcohol (past year)	80.10%		77.60%	
	Past month	Past year	Past month	Past year
Cannabis	41.40%	16.20%	4.90%	7.80%
Cocaine	1.30%	4.00%	0.50%	1.60%
MDMA/ecstasy	4.80%	13.80%	0.80%	3.10%
Amphetamine	2.40%	2.40%	0.50%	1.30%
Psilocybin mushroom	21.00%	27.30%	0.10%[b]	0.40%[b]
GHB	0.80%	1.60%	0.10%	0.50%
LSD	2.60%	9.80%	0.10%[b]	0.20%[b]
Heroin	0.00%	0.00%	0.00%[b]	0.10%[b]
Laughing gas	1.90%	1.90%	0.50%	2.10%

[a]Source: Health Survey/Lifestyle Monitor (CBS in collaboration with RIVM) [Gezondheidenquête / Leefstijlmonitor CBS i.s.m. RIVM], edited by Trimbos Institute [Trimbos-instituut]. Retrieved July 25th 2021 from https://www.volksgezondheidenzorg.info and https://www.trimbos.nl/kennis/cijfers/cijfers-drugs#sub6982

[b]National Drug Monitor: Annual Report 2020 (Trimbos Institute) [Nationale Drug Monitor: Jaarbericht 2020. Trimbos-instituut]. Available data only from 2018 or 2019. Retrieved July 25th 2021 from https://www.trimbos.nl/docs/423b9c4b-a389-4bfd-aa33-0c914438f1f9.pdf

Regarding the use of medication, the ayahuasca sample used fewer prescribed medicines but more herbal remedies and other non-prescription medicines (see Table 4). Compared to normative Dutch data, ayahuasca ceremony participants differed significantly in their use of all drugs except for tobacco, alcohol, laughing gas, and heroin (see Table 3). Particularly, cannabis, psilocybin mushrooms, MDMA/ecstasy, and LSD were among the most prevalent drugs of choice. The questionnaire assessed only smoked tobacco, however, the use of tobacco snuff (rapé) is relatively common in ayahuasca ceremonies, therefore, a certain part of tobacco use might remain undetected.

A linear regression model was developed to detect potential predictor variables for the general subjective health status. A higher presence of long-term diseases [$F(14) = 9.59$; $p < .001$], higher use of prescribed medicines [$F(14) = 9.59$; $p = .01$], and feelings of loneliness [$F(14) = 9.59$; $p < .001$] predicted a poorer self-reported health status. Additionally, a higher score on the ELS questionnaire's life fulfillment sub-scale predicted a positive self-reported health status [$F(14) = 9.59$; $p = .003$].

Lifestyle

Almost three-quarters of our sample's ayahuasca ceremony participants (74%) complied with national exercise guidelines, performing a minimum of 150 minutes of moderate exercise per week. Concerning dietary habits, respondents consumed more vegetables, legumes, and fruits (including nuts and seeds), and fewer grains (including bread, pasta, and rice) and meat per week compared to the national average (see Table 4).

Coping strategies and personal values

According to the Bonferroni correction applied in the data analysis, only $p < .001$ are considered statistically significant. Different statistically non-significant tendencies were observed, as people who participated in more than 100 ayahuasca ceremonies tended to adopt more active problem-solving strategies than those who used ayahuasca 3–10 times [$F(4) = 4.68$; $p = .01$; Cohen's $d = .44$] and 10–20 times [$F(4) = 4.68$; $p = .005$; Cohen's $d = .57$]. Similarly, those who used ayahuasca 3–10 times tended non-significatively to use more avoidant behavioral strategies than people who participated in more than 100 ceremonies [$F(4) = 3.57$; $p = .01$; Cohen's $d = .44$]. In the valued living sub-scale, there was a non-significant tendency where people who attended more than 50 ceremonies had higher scores compared to those who attended 3–10 ceremonies [$F(4) = 6.14$; $p = .004$; Cohen's $d = .59$]. However, there was a statistically significant difference between those who participated in 3–10 ceremonies and those who attended more than 100 [$F(4) = 6.14$; $p < .001$; Cohen's $d = .60$], the latter showing a higher score on that sub-scale. There was also a non-significant tendency in the life fulfillment sub-scale where participants who participated in more than 100 ceremonies scored slightly higher than those who participated in 3–10 ceremonies [$F(4) = 3.51$; $p = .006$; Cohen's $d = .53$]. Finally, there were statistically significant differences in the ELS total score between those who participated in 3–10 ceremonies and those who participated in more than 100 ceremonies [$F(4) = 5.67$; $p < .001$; Cohen's $d = .62$], the latter scoring higher than the former. Coping strategies and values were also compared between people participating in ayahuasca ceremonies in different contexts (religious/neo-shamanic/Indigenous). Those who attended religious ceremonies showed a tendency to more frequently use active problem-solving strategies than those attending Indigenous ceremonies [$F(3) = 3.67$; $p = .009$; Cohen's $d = .49$] (see Table 5).

The impact of the COVID-19 pandemic on health and substance use

Most respondents (70.8%) reported that the pandemic did not influence them or influenced them slightly. Among those who answered that the pandemic influenced them moderately, quite a bit, or extremely (29.2%), 82.4% were affected negatively, suggesting a poorer health status associated with the pandemic. Additionally, 30.5%, 22.5%, and 33.7% of the total sample reported more stress, anxiety, or sadness, respectively, since the beginning of the pandemic. Most respondents reported no significant changes regarding use of tobacco, alcohol, and other substances due to the COVID-19 pandemic (see Table 3). The GLM showed statistically significant differences between those who participated in 3–10 ayahuasca ceremonies and those who participated in more than 100 ceremonies regarding alcohol use, with the latter group using less alcohol than the former since the beginning of the pandemic [$F(4) = 2.48$; $p = .04$; Cohen's $d = .44$]. There were no other statistically significant results nor observable tendencies in the remaining analyses.

Discussion

The findings of this study suggest that long-term participants in ayahuasca ceremonies have better general well-being, fewer chronic and lifestyle diseases, and are more physically active compared to the normative Dutch data, as well as having a more balanced diet

Table 4. Health and lifestyle of ayahuasca users compared with normative Dutch data.

Health indicators	Ayahuasca users	General population
Self-perceived health (good/very good)	94.70%	78.10%[a]
Normal BMI (from 18,5 to 25,0 kg/m2)	72.60%	48.80%[b]
Chronic disease	27.30%	35.70%[a]
Diabetes	0.50%	6.00%[a]
High blood pressure	10.10%	17.20%[a]
Cholesterol	3.70%	8.50%[e]
Feeling lonely	35.30%	46.60%[b]
Use of prescription medicine	18.60%	45.30%[a]
Use of non-prescription medicine (herbal remedies)	70.30%	42.00%[a]
Contact with a specialist	31.80%	39.40%[a]
Contact with a physiotherapist	35.80%	29.00%[a]
Contact with a psychologist or psychiatrist	14.10%	9.90%[a]
Contact with alternative medicine healer	44.80%	/
Physical activity: At least 150 minutes per week of moderate-intensity exercise	74.00%	52.90%[c]

Dietary habits	days/week (mean)	g/day (median)	days/week[d]	g/day[d]
Vegetables (excluding potatoes)	7	150	6	131
Legumes	1–3	20	once in 3 weeks	5
Fruits, nuts and seeds	7	100	4	130
Grain, bread, rice and pasta	4–6	100	7	194
Meat	<1	50	6	98
Fish	<1	50	/	16

[a]Source: Health and health care use 2020; 18 years or older (CBS) [Gezondheid en zorggebruik; persoonskenmerken 2020, 18 jaar of ouder (CBS)]. Retrieved July 25th 2021 from https://opendata.cbs.nl/statline/#/CBS/nl/dataset/83005NED/table?ts=1627223551312

[b]Source: Health Survey 2020; 18 years or older (RIVM) [Gezondheidsmonitor 2020; bevolking 18 jaar of ouder (RIVM)]. Retrieved July 25th 2021 from https://statline.rivm.nl/#/RIVM/nl/dataset/50083NED/table?ts=1627217367353

[c]Source: Health Survey/Lifestyle Monitor (CBS in collaboration with RIVM) [Gezondheidenquête/Leefstijlmonitor (CBS i.s.m. RIVM)]. Retrieved July 25th 2021 from https://www.volksgezondheidenzorg.info/onderwerp/bewegen/cijfers-context/huidige-situatie#!node-beweegrichtlijnen-volwassenen

[d]Source: Food Consumption Survey 2012–2016 (RIVM) [Voedselconsumptiepeiling 2012–2016 (RIVM)]. Retrieved July 25th 2021 from https://www.wateetnederland.nl/resultaten/voedingsmiddelen/consumptie

[e]Source: Primary Care Registrations (RIVM) [Nivel Zorgregistraties eerste lijn (RIVM)]. Retrieved July 25th 2021 from https://www.volksgezondheidenzorg.info/onderwerp/cholesterol/cijfers-context/huidige-situatie

(according to national dietary guidelines; Health Council of the Netherlands 2015). Other studies that investigated the health of ayahuasca ceremony participants similarly reported differences in lifestyle, well-being, nutrition, and physical activity (Kaasik and Kreegipuu 2020; Ona et al. 2019).

It had been suggested that hallucinogens may promote healthful behaviors and may reduce the risk of developing "lifestyle diseases" such as diabetes, high cholesterol and blood pressure, which contribute to personal suffering, premature mortality, and public health costs (Teixeira et al. 2021). Two recent studies report an association between classic hallucinogens and lower odds of being overweight or obese, and lower odds of having diabetes, cardiometabolic diseases, and/or cancer (Simonsson et al. 2021; Simonsson, Sexton, and Hendricks 2021). In addition, observational studies reported improvements of indicators of mental health and overall well-being among ayahuasca ceremony participants (Gonzalez et al. 2021; Kaasik and Kreegipuu 2020; Maia, Daldegan-Bueno, and Tófoli 2020).

Our sample used approximately the same amount of alcohol, tobacco, and heroin compared with normative Dutch data, but used substances such as cannabis, MDMA, LSD, and psilocybin mushrooms or truffles more, which corresponds with previously published studies (Kaasik and Kreegipuu 2020; Ona et al. 2019). Furthermore, studies have shown that users of hallucinogens tend to expose themselves to distinct drugs within this class twice or three times per year (Aixalá et al. 2020; Johnson et al. 2019). Our sample also used other drugs of different classes more frequently, like cocaine and amphetamines. It is challenging to interpret the data, since the health indicators used in this study did not show differences in drug-related harms as compared to the general population. Naturalistic studies have found that it is common for drug users to stop or reduce drug misuse after experiencing hallucinogenic drugs (Garcia-Romeu et al. 2020).

In the linear regression model, a higher presence of long-standing diseases and a higher use of prescribed medications predicted a poorer self-reported health status. Notably, higher scores for the life fulfillment subscale of the ELS questionnaire predicted a better health status. This is in line with the findings from the study involving Spanish ayahuasca ceremony participants, in which personal values also predicted better mental health as measured by the GHQ-12 questionnaire (Ona et al. 2019). Additionally, feelings of loneliness were also associated with a poorer health status. Social isolation

Table 5. ANCOVA's analyses assessing coping strategies and values between experienced/less experienced ayahuasca users and participants in different kinds of ceremony settings. The letters "a" and "b" refer to differences between pairs of scores within each scale.

	Coping (COPE-easy questionnaire) Mean; SD			Values (ELS questionnaire) Mean; SD		
Experience with ayahuasca	Active problem solving	Avoidant behavior	Support seeking	Valued living	Life fulfillment	ELS total score
3–10 ceremonies	2.76; 0.43[a]	1.72; 0.41[a]	2.63; 0.54	39; 6.3[a/b]	20.3; 4.7[a]	59.4; 10.2[a/b]
10–20 ceremonies	2.71; 0.40	1.63; 0.33	2.58; 0.56	40.6; 8.1	20.7; 5.6	61.4; 12.5
+20 ceremonies	2.73; 0.49	1.51; 0.42	2.52; 0.54	42.3; 6.1	21.5; 4.8	63.8; 10.1
+50 ceremonies	2.74; 0.37	1.61; 0.42	2.51; 0.52	43; 6.8[a]	22.1; 6	65.2; 11.6[a]
+100 ceremonies	2.95; 0.39[a]	1.53; 0.35[a]	2.67; 0.05	43.1; 5.4[b]	22.8; 4.5[a]	66; 9.1[b]
ANCOVA (F; p)	4.68; p = .01	3.57; p = .01	-	6.14; p = .004 6.14; p < .001	3.51; p = .006	5.67; p = .01 5.67; p < .001
Type of ceremony	Coping (COPE-easy questionnaire) Mean; SD			Values (ELS questionnaire) Mean; SD		
Religious	2.87; 0.42[a]	1.57; 0.37	2.60; 0.50	42.5; 5.3	22.1; 4.8	64.6; 9.3
Indigenous	2.63; 0.42[a]	1.58; 0.41	2.51; 0.55	40.4; 9.5	21.9; 5.8	62.3; 14.2
Local practitioners	2.78; 0.41	1.67; 0.40	2.67; 0.53	40.5; 6.6	20.6; 5.1	61.2; 10.7
ANCOVA (F; p)	3.67; p = .009	-	-	-	-	-

[a]No significant differences but observed tendencies.
[b]Statistically significant differences.

and loss of community bonds is being increasingly highlighted as a primary risk factor for mental disorders (Wang et al. 2018). This result is relevant not only for mental health issues but also for health in general (National Academies of Sciences, Engineering, and Medicine 2020).

The results also showed differences between those who had more experience with ayahuasca and those less experienced. More experienced users tended to be more engaged in active problem-solving coping strategies, while the latter engaged more frequently in avoidant behavior. Regarding values, those who attended more than 100 ayahuasca ceremonies scored higher in the valued living sub-scale and the total scale of the ELS questionnaire than those who attended 3–10 ceremonies. These findings are consistent with the findings of previous studies (Ona et al. 2019). Participants with more experience with ayahuasca showed a higher mean age, so that could affect their responses in terms of values, since it is well established that as people get older their personal values become stronger and better defined (Borg, Hertel, and Hermann 2017; Heckhausen, Wrosch, and Schulz 2010). However, this analysis was adjusted for age. We suggest that either the continued practice of attending ayahuasca ceremonies creates engagement with the values shared by the community or some extraneous variables, like personality traits, are affecting the results.

Our results corroborate prior findings, but we must consider the limitations of this research. First, our sample included volunteers with positive attitudes toward ayahuasca. The absence of negative responses may be explained by the lack of individuals in the sample who discontinued use due to negative experiences. Second, the study could not evaluate dose- and substance-specific relationships between ayahuasca use and health markers. Third, religion might be associated with positive health outcomes and act as a confounding factor in the results (Koenig and Cohen 2002). Fourth, our study was observational and retrospective, precluding conclusions regarding the causal role of ayahuasca in the observed results.

While there may be biological (e.g., neurogenesis) (Morales-Garcia et al. 2020), neurocognitive (e.g., modulating the activity and connectivity of the default mode network) (Palhano-Fontes et al. 2015), and psychological effects (e.g., antidepressant effect) (Palhano-Fontes et al. 2019) that explain differences in health measures, our intention is not to establish a causal relationship between participation in ayahuasca ceremonies and the better health status reported by participants in this survey. Health is a complex construct affected by a plethora of factors. The most appropriate interpretation of these findings is that people who usually attend ayahuasca ceremonies are also engaging in other practices and self-care strategies, or ways of dealing with stress that produce the ultimate outcome of a better health status.

Scientific evidence suggests a good safety and tolerability profile of ayahuasca, low risk for abuse, and potential benefits for the individual's health, particularly if used in a controlled ceremonial setting. However, the Amsterdam Court of Appeals denied the right to use ayahuasca due to its supposed threat to public health, which pushed people who engage in ayahuasca ceremonies into illegal and underground activity that could produce harms for the individuals and society. This contradiction between policy and evidence illustrates how science and the law sometimes diverge inexplicably.

We encourage policy makers and stakeholders to rely on scientific evidence when developing and implementing public health policies.

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Data availability statement

Raw data supporting the findings of this study are available from the corresponding author (jcbouso@iceers.org) on request.

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