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RESEARCH ARTICLE

Drug use among agriculture-related workers in Thailand

[version 1; peer review: 1 approved with reservations]Narumon Janma ¹, Manop Kanato¹, Poonrut Leyatikul²¹Department of Community Medicine, Faculty of Medicine Khon Kaen University Khon Kaen, Khon Kaen, Khon Kaen, 40002, Thailand²Department of Occupational Health, Faculty of Public Health, Vongchavalitkul University, Nakhon Ratchasima, Nakhon Ratchasima, 30000, Thailand**V1** First published: 07 Jun 2019, 8:818
<https://doi.org/10.12688/f1000research.18994.1>Latest published: 07 Jun 2019, 8:818
<https://doi.org/10.12688/f1000research.18994.1>**Abstract****Objectives:** To examine drug use prevalence and to explore the associations of cluster environment characteristics with drug use among agriculture-related workers in Thailand.**Methods:** This was a cross-sectional study involving 2936 agriculture-related workers from 10 clusters in 4 regions throughout Thailand. Trained interviewers conducted semi-structured interviews. Additionally, the drug-use patterns and behaviors of 124 current users were structurally observed. A multilevel binary logistic regression model was used to estimate the effects of the cluster environment on drug use.**Results:** The annual prevalence was 58.73%. Illicit drugs, non-prescription drugs, or over the counter medicines were widely used. Age, sex, and non-prescription behavior were associated with substance use that was statistically significant. Contextual clustering was found to significantly affect drug use among agriculture-related workers. A 1-unit increase in treatment rate predicted 12.7-times higher illicit drug use and 15.3-times higher methamphetamine use.**Conclusions:** Agricultural work facilitated the spread of drug use. The design of the surveillance system should be considered.**Keywords**

drug use, agriculture-related workers, Thailand

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Introduction

Illicit drug (ID) use has been widely recognized as a challenge to both individual health and society. According to the United Nations Office on Drugs and Crime, 5.6% of adults (15–64 years) across the globe used IDs at least once in 2016 and >10% of those drug users have suffered from drug-use disorders¹. In the Association of Southeast Asian Nations (ASEAN), the rate of drug users in 2016 who accessed treatment systems was 27.8 per 100,000 people. Over 80% of treated people were methamphetamine users². A 2016 household survey in Thailand revealed that 1.4 million Thai people aged between 12–65 years used drugs, 2.8% of the adult Thai population. The results from the last Thai national survey showed that cannabis, kratom (*Mitragyna speciosa* Korth), and methamphetamine were the three most commonly used drugs among ID users³. Government statistics reported that only 13% of these drug users were estimated to access all treatment systems in 2016⁴. Although drug use in Thailand has been lower than the global average, the problem has been a part of the national agenda since 2001⁵.

Since 1360, Thailand has been affected by the problem of illicit substance use⁶. Common indigenous plants from which IDs are sourced are opium, cannabis, and kratom. The first synthetic drug used in the population was heroin, first noticed in the early 1960s. The use of stimulants (amphetamine and methamphetamine) evolved into a major epidemic in the early 1970s. Volatile substances (benzene, lacquer, and glue) appeared in the late 1970s⁷. In the late 1990s, a new set of substances, including ecstasy, ketamine, crystalline methamphetamine, and cocaine, began to be widely used⁸. Recently, the use of non-medical pharmaceutical drugs and new psychoactive substances has become evident⁹. However, official statistics show that methamphetamine users were the biggest group of drug users who accessed treatment¹⁰. Since cannabis and kratom are less harmful than other drugs, only a few users have required treatment.

In general, people take drugs for a variety of reasons. Psychostimulants are thought to reduce fatigue and enhance activities^{11,12}. Methamphetamine, which is an amphetamine-type stimulant (ATS), has a long history of use in the Asia-Pacific region¹³. Presently, among ASEAN member states, methamphetamine is distributed in crystal, powder, and pill forms¹⁴.

In Thailand, ATSs have been known since the early 1960s and are thought to have been a major problem since the 1990s¹⁵. Recent statistics show that three quarters of ATS users are methamphetamine users¹⁰. Additionally, two-thirds of drug users who sought treatment from the government system were laborers, including agriculture-related workers. Agricultural products accounted for 8.7% of Thailand's annual GDP¹⁶. Of all workers employed in 2016, 30% were agriculture-related workers¹⁷. Recent studies have reported significant associations between substance use and agricultural activities^{18,19}.

Studies have found that substance abuse behavior was affected by various social determinants, including personal characteristics and relationships with peers/family and the neighborhood^{20–22}. Some studies have focused on individual and interpersonal

factors related to substance abuse^{21,23}. Other studies have explored the extent of neighborhood factors that influence the risk of relapse^{21,24–26}. A few studies in Thailand have reported how social factors (a combination of individual, peer, and family factors) influenced substance use^{27,28}.

Although evidence has emerged showing that agriculture-related workers potentially use drugs, the prevalence of drug abuse and neighborhood cluster association was unclear. There were two objectives in this study: to explore the proportion of drug users among agriculture-related workers and to investigate the association between cluster-level factors and substance use among agriculture-related workers by using model simulation following the method described by Bronfenbrenner²⁹.

Methods

This cross-sectional study was conducted from September 2017 to July 2018.

Population and samples

In 2017, a total of 5,911,567 individuals had registered as agricultural-related workers in Thailand³⁰. Only workers who had worked for the past 3 months were eligible to participate in the survey. The prevalence of substances used from the latest national household survey in 2016 was used as a study parameter to calculate sample sizes³. The sample size calculation method for prevalence survey³¹ was employed with adjustment of design effect from multistage sampling. With an expected 10% non-response and $\pm 1\%$ error, a sample size of 3140 individuals was targeted. Stratified multistage cluster sampling was employed. Thailand was stratified into 10 geographical zones on the basis of governmental narcotic operation areas; each zone comprised 7–12 provinces. Each zone was a systematically sampled province (one zone per province). The 10 sample provinces were Chiangmai, Phitsanulok, Khon Kaen, Nakornrachasima, Samitprakarn, Chonburi, Samutsakorn, Krabi, Satun, and Bangkok. Then, the agricultural clusters of each province were mapped. Only one cluster was randomly selected from each province, which gave 10 clusters altogether. Households were systematically selected from the updated map of individual clusters. The number of households was determined on the basis of the probability proportional to size. Simple random sampling using a table was employed to obtain a sample from each household (one household per sample). Of 3140 intended samples, 2936 (93.5%) individuals agreed to participate in the survey (ages ranging from 16 to 69 years old, with an average of 36.6 years old; 61.3% (1799) were males).

After the baseline survey, 124 current methamphetamine users agreed to participate in structured observation regarding their drug use (age ranging from 18 to 58 years old, with an average of 27.4 years old; 88.7% (110) were males).

Outcome of interest

Outcomes of the study were identified as drug use prevalence. In this study, drug use was defined as the use of illicit drugs (IDs) (heroin, cannabis, methamphetamine, etc.); legal substances, such as non-prescription drugs alcohol, tobacco and

caffeine, were not included. Of all IDs, methamphetamine is hypothesized to be widely used among agricultural rated workers to accelerate productivities resulting in higher prevalence. Annual prevalence as well as past month prevalence was obtained.

Measurements

The interview questionnaire and structured observation guideline were developed by 12 experts³². The interview questionnaire comprised individual-level, interpersonal-level, and cluster-level variable sections, as well as substance use. The structured observation guideline emphasized pattern of methamphetamine use and its effects.

A total of 20 research assistants (two for each province, one male, one female) were trained to conduct field work (updating a cluster map, devising a household sampling frame, randomly selected samples, requesting consent, and interviewing the samples). The research assistants asked the intended participants to provide written informed consent, waited a couple of days to allow the participants to make their own decision, and, then, made an appointment for them to come back to be interviewed/observed. Data from the survey were gathered from September to November 2017 via private, face-to-face interviews. Interview guides are available as *Extended data*. The participants chose a convenient place and time for their interviews (e.g., the participant's household). An average of 1–1.5 hours was spent for each interview. After the interview, the research assistants requested written consent to participate in structured observation of the drug users. Only those who consented (n=124) were observed regarding their drug-use behavior—such as when and how IDs were used, and the amount and frequency used—and its effects. The research team conducted participant observations from November 2017 to July 2018 (3–5 times for each sample, 1–2 days for each observation).

The outcome variable was substance use. The current use in this study was defined as having taken drugs at least once in the past month from the interview date.

The individual-level variables included sex, age, education, monthly income, and marital status. All variables were categorized as dichotomous variables.

The interpersonal-level variables were assessed to reflect the extent to which the drug user's peers used methamphetamine or other IDs. Potential covariates were accounted for by adjusting for individual and interpersonal-level variables. These variables were selected on the basis of evidence regarding factors that affect substance abuse and the neighborhood environment^{20,21,23,25,28}.

The one cluster-level variable was the level of drug use in each of the provinces sampled in 2017. The level of drug use was defined as the proportion of the population that used drugs and was partly assessed by the number of drug users who accessed the treatment system. In this study, the treatment rate was the proportion of registered clients of governmental treatment centers in the population in a given area. The estimated rate

(per 1000 people) of ID users/methamphetamine users was determined from the survey in a given area in 2017.

Data analysis

Data double-entry was employed. SPSS for windows version 16.0 was used. Descriptive statistics were used to analyze all socioecological factors. Multilevel binary logistic regression analysis via generalized linear mixed models was used to analyze the associations among cluster-level variables, each covariate, and substance use. Level 2 comprised individuals at level 1 (individual-level variables and interpersonal-level variables) nested within clusters at level 2 (consisting of two variables). The model building process started with a null model consisting of no predictors, and a series of two-level models was developed. Model 1 fit only individual-level variables into the model. Then, in model 2, all interpersonal-level variables were entered into model 1. Finally, in model 3, all cluster-level variables were entered into model 2. The median odds ratio (mOR) and interval odds ratio (IOR) were applied to measure the variation of substance use in different clusters and the effects of cluster-level variables, respectively. The level of statistical significance was set to p-values < 0.05.

Ethics statement

This research project was approved by the Human Research Ethics Committee of Khon Kaen University and was conducted in accordance with the principles of the Declaration of Helsinki and International Conference on Harmonization Good Clinical Practice standards. Written informed consent was obtained from the participants and from the parents/guardians of minors.

Results

Demographic and ID use information

The median age of the agriculture-related workers was 36 years; 15.9% of the workers were <25 years old and 47.7% had obtained elementary education and lower (Table 1). One-third of the workers were poor (earned < per annum), 29.4% were current smokers and 19.1% were habitual smokers (>20 days in the past month), and 17.9% had smoked >1 pack daily. Regarding alcohol, 48.7% were current alcohol drinkers, 30.4% were habitual drinkers, and 24.1% had drunk >330 mL of beer or the equivalent amount of alcohol every time they drank (which resulted in a blood alcohol level >50 mg/dL). Regarding substance abuse, 57.7% (n=1695) of the participants currently used non-medical pharmaceutical drugs, mostly analgesics, codeine mixture cough syrup, sedatives, or opioids. Among the agriculture-related workers, 73.5% (2158) had used IDs at some point in their life, and 13.9% (408) were current ID users. This number is much higher than 1.99 in general population (Kanato *et al.* 2017). Current ID users were mostly regular and contracted workers also. There are a few reported histories of drug treatment for these categories of workers in the government system. All information gathered during this study is available as Underlying data³².

Drug use behavior

Among 408 illicit drug current users, 350 currently used methamphetamine. The rest used kratom, cannabis, inhalants, opiates/opioid, ecstasy, ketamine, and cocaine.

Table 1. Distribution of agriculture-related workers (individual, interpersonal, neighborhood-level) by substance abuse. Values are presented as number (%) or mean $\pm$ standard deviation.

Variable	Total (n=2936)	Not drug user (n=1207)	ID only (n=34)	ID + Non-P (n=374)	Non-P only (n=1321)
<i>Sex</i>					
Male	1817 (61.9)	807 (66.9)	30 (88.2)	211 (56.4)	769 (58.2)
Female	1119 (38.1)	400 (33.1)	4 (11.8)	163 (43.6)	552 (41.8)
<i>Age</i>					
≤ 24 (years)	467 (15.9)	220 (18.2)	7 (20.6)	61 (16.3)	179 (13.6)
≥ 25 (years)	2469 (84.1)	987 (81.8)	27 (79.4)	313 (83.7)	1142 (86.4)
<i>Monthly income</i>					
$\leq$ US\$300	2026 (69.0)	873 (72.3)	23 (67.7)	316 (84.5)	814 (61.6)
$\geq$ US\$301	910 (31.0)	334 (27.7)	11 (32.3)	58 (15.5)	507 (38.4)
<i>Education</i>					
Elementary and lower	1400 (47.7)	644 (53.4)	14 (41.2)	185 (49.5)	557 (42.2)
Secondary and upper	1536 (52.3)	563 (46.6)	20 (58.8)	189 (50.5)	764 (57.8)
<i>Marital status</i>					
Single	1136 (38.7)	505 (41.8)	16 (47.1)	165 (44.1)	450 (34.1)
Couple	1800 (61.3)	702 (58.2)	18 (52.9)	209 (55.9)	871 (65.9)
Peer ID users	8.1 $\pm$ 26.2	6.5 $\pm$ 21.0	14.9 $\pm$ 31.7	5.9 $\pm$ 19.4	10.1 $\pm$ 31.3
Meth network	0.3 $\pm$ 9.4	0.1 $\pm$ 0.7	0.1 $\pm$ 0.5	0.2 $\pm$ 1.4	0.5 $\pm$ 14.0
Treatment Rate (in 1000 population)	2.8 $\pm$ 0.6	2.7 $\pm$ 0.5	2.7 $\pm$ 0.4	3.5 $\pm$ 0.5	2.7 $\pm$ 0.5
ID estimation (per 1000 people)	18.4 $\pm$ 29.4	20.7 $\pm$ 33.2	11.4 $\pm$ 8.5	15.2 $\pm$ 12.6	17.6 $\pm$ 29.3
Meth users estimation (per 1000 people)	5.5 $\pm$ 5.3	5.8 $\pm$ 5.6	4.0 $\pm$ 4.7	5.6 $\pm$ 2.5	5.3 $\pm$ 5.6

IDs, illicit drugs; Non-P, non-prescription drugs.

Users used methamphetamine 1–3 times daily (1–6 pills each time), around 30 minutes before work for first intake and every 5–6 hours booster. Mostly, users smoked methamphetamine (put 1 pill on foil then used lighter to burn and applied straw to take it). A few put 1–2 pills into drinking water. They recognized the effect of the drug (energetic, painless etc.) 1–2 minutes after smoking, or around 10 minutes after drinking. There are few reports of drug treatment for these categories of workers in the government system.

Bivariate models

Concerning both the ID use (Table 2) and methamphetamine use (Table 3), the treatment rate showed a statistically significant association with decreased substance use. Regarding ID estimation, only ID use (Table 2) was significantly associated with increased substance use; however, the effect was extremely small.

The respondents who were single, had low incomes, and currently used non-medical pharmaceutical drugs were more likely to use IDs and methamphetamine (Table 2 and Table 3).

Multilevel models

The mOR in all models was >1 , which indicated that the between-cluster variation in substance use was greater than the within-cluster-level variation; all of the IOR-80% intervals contained 1, which confirmed this finding further (Table 2 and Table 3).

Table 2 presents the results of the multilevel binary logistic regression models for ID use. In model 1, the analysis of the association of the individual-level variables with substance use showed that a higher likelihood of ID use was associated with males, older age, and non-prescription drug use. In model 2, drug use among peers was not associated. In the final model (model 3), 2 cluster-level variables (i.e., treatment rate and ID estimation variables) were added to the model, and each 1-unit score increase in treatment rate was associated with a significant 12-fold increase in the likelihood of ID use.

We hypothesized that methamphetamines were used to accelerate the productivity of agriculture-related workers. A series of similar models was used to estimate the odds ratio of methamphetamine use, as shown in Table 3. In models 1 and 2 of this category,

Table 2. Odds ratios (ORs) and 95% confidence interval (CIs) from the multilevel binary logistic regression for illicit drug (ID) use.

Variable	Bivariate OR (95%CI)	Model 1 aOR (95%CI)	Model 2 aOR (95%CI)	Model 3 aOR (95%CI)
Sex, male (ref: female)	0.87 (0.70, 1.08)	5.36 (2.23, 12.89) ^{***}	5.37 (2.29, 12.60) ^{***}	5.40 (2.36, 12.37) ^{***}
Age >25 years (ref: <25 year)	1.07 (0.81, 1.41)	1.73 (1.19, 2.54) ^{**}	1.73 (1.19, 2.51) ^{**}	1.74 (1.20, 2.53) ^{**}
Monthly Income <US\$300 (ref: >US\$301)	2.45 (1.87, 3.21) ^{***}	0.94 (0.70, 1.26)	0.94 (0.73, 1.20)	0.94 (0.74, 1.20)
Education, primary (ref: secondary and above)	1.05 (0.85, 1.30)	0.96 (0.73, 1.26)	0.96 (0.73, 1.26)	0.95 (0.72, 1.26)
Marital status, single (ref: married)	1.37 (1.10, 1.69) [*]	1.40 (0.93, 2.10)	1.39 (0.95, 2.03)	1.39 (0.95, 2.03)
Non-prescription (ref: no)	10.05 (7.02, 14.40) ^{***}	4.30 (2.03, 9.11) ^{***}	4.32 (1.95, 9.54) ^{***}	4.32 (1.96, 9.50) ^{***}
<i>Interpersonal level</i>				
Peer ID users	1.004 (0.998, 1.009)		0.999 (0.981, 1.017)	0.999 (0.981, 1.017)
<i>Level 2</i>				
<i>Cluster level</i>				
Treatment rate	0.034 (0.025, 0.045) ^{***}			12.74 (1.85, 87.97) [*]
ID estimation	1.007 (1.002, 1.012) [*]			0.993 (0.984, 1.001)
<i>Random effects</i>				
Level 1 ¹		1	1	1
Level 2 ²		4.24 (2.11) [*]	4.23 (2.10) [*]	2.31 (1.37)
Median OR (mOR)		7.13	7.11	4.26
IOR-80% for treatment				0.8108, 200.275
IOR-80% for estimation				0.063, 15.606

¹Variance at level 1 was constrained to 1. ²Estimated standard error. *p < 0.05, **p < 0.01, ***p < 0.001.

OR, odds ratio; aOR, adjusted OR; CI, confidence interval; ref, reference group; IOR, interval OR. ID, illicit drug.

older respondents were more likely to use methamphetamines than were younger respondents. Males and non-prescription drug use were significantly associated with an increase in the likelihood of methamphetamine use. Finally, in model 3, the results showed similar associations between individual and interpersonal-level variables with substance use, as in model 2. In the final model (model 3), 2 cluster-level variables, i.e., treatment rate and ID estimation variables, were again added to the model, and each 1-unit increase in treatment rate was associated with a significant 15-fold increase in the likelihood of methamphetamine use.

Discussion

With the objective of exploring the prevalence of drug use among agriculture-related workers, this study found that the past month's prevalence was much higher than the prevalence in the general Thai population, particularly for use of methamphetamine^{3,9}. This difference in prevalence indicated that agriculture-related

workers use stimulant drugs to increase their productivity, which may give them more income. Recent investigations have shown that use of IDs has spread to regular and contracted workers, indicating that IDs have become more easily accessible and affordable. Thus, functional use of drugs is acceptable by workers.

The results showed that neighborhood problems, such as health problems (treatment accessibility rate), were associated with ID use, particularly methamphetamine, consistent with other research findings^{22,33,34}. A possible explanation for this finding is neighborhoods/clusters with a high prevalence of drug use reflect drug availability and accessibility, which could be enabling factors for workers throughout the community. Methamphetamine is an ID popularly used by drug users in Thailand. Covariates, such as sex, age, and non-prescription drug use, were related to both ID use and methamphetamine use. This finding is consistent with other research findings^{20,35–37}.

Table 3. Odds ratios (ORs) and 95% confidence intervals (CIs) from the multilevel binary logistic regression for methamphetamine use.

Variable	Bivariate, OR (95%CI)	Model 1, aOR (95%CI)	Model 2, aOR (95%CI)	Model 3, aOR (95%CI)
Sex, male (ref: female)	0.71 (0.57, 0.89)**	5.26 (1.87, 14.77)**	5.28 (1.87, 14.93)**	5.34 (1.96, 14.50)**
Age >25 years (ref: <25 years)	1.06 (0.78, 1.43)	1.96 (1.13, 3.42)*	1.96 (1.13, 3.40)*	1.98 (1.14, 3.49)*
Monthly income <10,000 (ref: >10,000)	3.41 (2.47, 4.71)***	1.10 (0.72, 1.68)	1.11 (0.72, 1.69)	1.10 (0.73, 1.67)
Education, primary (ref: secondary and above)	1.19 (0.95, 1.48)	1.11 (0.83, 1.49)	1.11 (0.83, 1.49)	1.11 (0.83, 1.50)
Marital status single (ref: married)	1.27 (1.01, 1.60)*	1.20 (0.67, 2.14)	1.20 (0.67, 2.14)	1.20 (0.67, 2.14)
Non-prescription (ref: no)	12.66 (8.24, 19.46)***	4.33 (1.64, 11.40)**	4.33 (1.64, 11.39)**	4.33 (1.65, 11.34)**
<i>Interpersonal level</i>				
Meth Network	1.001 (0.986, 1.016)		1.003 (0.996, 1.009)	1.003 (0.997, 1.009)
<i>Level 2</i>				
<i>Cluster level</i>				
Treatment rate	0.01 (0.01, 0.02)***			15.34 (1.24, 190.32)*
Meth users estimation	0.99 (0.97, 1.01)			0.99 (0.80, 1.24)
<i>Random effects</i>				
Level 1 ¹		1	1	1
Level 2 ²		4.98 (2.49)*	4.98 (2.49)*	3.05 (1.85)
Median OR (mOR)		8.4	8.4	5.29
IOR-80% for treatment				0.647, 363.333
IOR-80% for estimation				0.0421, 23.673

¹Variance at level 1 was constrained to 1. ²Estimated standard error. *p < 0.05, **p < 0.01, ***p < 0.001.

OR, odds ratio; aOR, adjusted OR; CI, confidence interval; ref, reference group; IOR, interval OR.

Strengths and limitations of the study

This study used data from a cross-sectional survey; therefore, it cannot establish a temporal relationship or causality. However, the study strengths are the use of treatment rate as a cluster-level factor (enables an objective assessment), providing more reliability than that of previous subjective assessments^{38,39}. Another study strength is it controlled for a wide range of covariates and used a large sample size and a nationally representative sample, meaning that the findings can be generally applied to the larger Thai population. Not only did this study provide further insights into cluster-level affects on substance use, but also describes associated factors adjusted for cluster environment among agricultural at national scale. However, prospective studies to further investigate may be required.

This study was successful in collecting data with a high response rate. The findings of the present study can also be applied to other similar contexts. The authors suggest further qualitative study on the beliefs of among agricultural regarding drug use

for working. However, patterns of drug use may be better measured using open-ended questions, where among agricultural are asked to provide information freely without being influenced.

Conclusions

This study demonstrated association of personal characteristics of agricultural related workers and substance use particularly methamphetamine. In addition, cluster-level factors (treatment rate and ID estimation) were also significantly associated. Thus, the development of prevention measure on substance use should be taking into account the area based socioeconomic environment to pursue the more effective demand reduction.

Data availability

Underlying data

Open Science Framework: Drug use among agriculture-related workers in Thailand.

<https://doi.org/10.17605/OSF.IO/DWV9G>³².

This project contains the following underlying data:

- Data_Narumon.csv (demographic and questionnaire response data).
- Data Dictionary_Narumon .csv (data dictionary for Data_Narumon.csv).
- Correct Responses_Narumon.csv (scoring system for questionnaire responses in Data_Narumon.csv).

Extended data

Open Science Framework: Drug use among agriculture-related workers in Thailand. <https://doi.org/10.17605/OSF.IO/DWV9G>³².

This project contains the following extended data:

- Drug_use_QN1.jpg–Drug_use_QN5.jpg (questionnaire used in this study)

Data are available under the terms of the [Creative Commons Attribution CC 1.0 International license](#) (CC0 1.0 Universal).

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Version 1

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The present study, conducted from September 2017 to July 2018, considers prevalence of illicit drug use among agriculture-related workers in Thailand. The study moves past its introduction without defining the term 'agriculture-related worker' – how is this defined? Are these individuals working on family parcels? Do they work year-round or seasonally? Do they accept work for any crop(s) (suggesting irregular employment in fields/orchards/vineyard/etc.) or specialize in one or more crops? Do these individuals hire-out as day-labor workers? Do they work in packing and/or distribution?

Are they paid by hour/by week, or do they receive wages based on piece rate (quantity they harvest)? Do they return home at the end of each day or return home at the end of short-term on-the-season employment? Do these workers live with family, do they live in dormitory barracks, do they rent living space in nearby communities, or do they live on farm premises? Defining these workers and living arrangements is important, owing to diverse types of work/employment in agriculture throughout the world. Readers outside Thailand, and agricultural labor researchers, will find valuable information in this study. In particular, how wages are determined may be related to expendable cash, utilized for drug purchase(s).

Data from the home survey was collected by private face-to-face interviews from September to November 2017. Each interview lasted approximately one to 1.5 hours. Were all interviewees interviewed in the same language (for the reader, name the language)? The remaining months from November 2017 to July 2018 were spent in "structured observations." What was the purpose of these observations?

Research design was "stratified multi-stage cluster sampling" on governmental narcotic operation zones. These appear to be the provinces of Thailand. How many provinces are there in Thailand? Total sample for the survey was 2,936 persons, among whom 124 methamphetamine users participated in a structured observation (purpose?). Meth users were common among those who accessed drug treatment systems, where 80% of those treated were methamphetamine users. Also, annual prevalence was 58.73%. What types of illicit drugs are included in percentage?

Page 3, first column, first paragraph: The acronym “ID use” is defined as illicit drug use, yet some readers may recognize or confuse this with ‘intravenous drug’ use. In some countries, **IDU** is ‘intravenous drug use.’ Usually an intravenous drug, heroin is included among identified drugs (page 3, second column, sixth paragraph) – although alternative modes of administration exist for heroin and the other drugs that are identified.

Page 3, first column, second paragraph: What is meaning of “Since 1360...”?

Page 3, first column, fourth paragraph: What is meaning of acronym “GDP” which refers to Thailand’s agricultural products?

Page 3, second column, fourth paragraph: The total number of 5,911,567 individuals registered as agriculture-related workers – what proportion is this of the national population?

Page 4, first column, third paragraph: The concept or method of “structured observation” needs description, including where this took place, what is meant by “3-5 times for each sample, 1-2 days for each observation.” Were these observations over this time, continuous? How many persons in total were observed? Importantly, what was the purpose of these observations?

Page 4, second column, fifth paragraph: Drugs identified for current users differ slightly from those earlier named – including the absence of heroin (page 3, second column, sixth paragraph). “Cannabis” is the only drug named in both places – this drug also has more than one mode of administration.

Page 4, Table 1: Sample size earlier identified N=2936 becomes something different, when the second column identifies n=1207 persons (807 men, 400 women), who were “not drug user.” How is this explained?

Also, why is there an age threshold (roughly 24/25 years)? This is particularly interesting, considering that “older respondents were more likely to use methamphetamines than were younger respondents” (page 6, first column, first paragraph). Were men or women more often in one or the other category of “older” and “younger,” and/or among those who use methamphetamines? Is the threshold age distinction correlated to discontinuation of drugs used earlier, which were replaced by others? For how many respondents was methamphetamine the first drug ever used? Discontinued drug(s) identified in the research, did any users return to these?

Page 5, first column, first paragraph: The concept of “booster” needs to be defined, and “applied straw to take it,” needs to be described. Is this referring to oral intake, literally, OR inhalation into nostrils (nose) by means of the straw?

Does the “lighter to burn” refer to melting or generating a vapor for inhalation? “Drinking water” – how much: half a glass, or a full glass, or some irregular amount, based on the individual users? This information would be available from observations. Term “energetic” refers to what? Term “painless” refers to what? Is this removal and/or generating an analgesic effect that eliminates pain or a numbing predisposition for pain? Does this refer to any place within the body, or specific body sites? Most importantly, do agriculture-related workers use drugs at their work-site: field, orchard, packing plant, loading platforms, and so on?

Final sentence is unclear. Does this mean agriculture-related workers rarely seek drug treatment? Information in the final sentence does not close-out this paragraph that describes methods of use.

Page 5, second column, third paragraph: A hypothesis is given, which should have been introduced earlier. Later in the manuscript, findings can be elaborated to describe whether the hypothesis was demonstrated.

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

I cannot comment. A qualified statistician is required.

Are all the source data underlying the results available to ensure full reproducibility?

Partly

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Medical/cultural/social anthropology; public health; immigration; alcohol/drug use among populations that experience health disparities.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

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