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Measuring Concurrent Polydrug Use in General Populations: A Critical Assessment

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Abstract
Background/Aims: Polydrug use is a complicated phenomenon that is measured in a wide variety of different ways. Using Finland as an example, we aimed to demonstrate how the prevalence and prevalence trends of concurrent polydrug use (CPU) varied in the general population based on the different measurements used. ***Methods:*** Population-based Drug Surveys conducted every 4 years during 1998–2014 were used. CPU was measured with different measurements: strict, medial and loose definition of CPU, which were based on different combinations of alcohol, illicit drugs, pharmaceutical drugs and cigarettes used during the last 12 months/30 days. Logistic regression was used to estimate the *p* values for assessing trends. ***Results:*** Depending on the measurements used, the prevalence of CPU in 2014 varied between 2.0 and 18.7%. Different definitions also produced contradictory trends of CPU: there was a modest increase in prevalence if it was measured with a medial ($p < 0.001$) or strict ($p = 0.054$) definition, but when measured with the loose definition (only measure that included smoking), there was a decrease in prevalence ($p < 0.001$). ***Conclusions:*** The prevalence of CPU varies greatly depending on the measurement used, as does the course of the prevalence trends. The concept of simultaneous polydrug use may capture the phenomenon better compared to the concept of CPU.

Introduction

Polydrug use gained a foothold and growing recognition among researchers several decades ago [1, 2], and currently there is an increasing body of research literature in this regard [3]. According to the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA), polydrug use has become a dominant pattern of drug use in Europe [4] and it has been brought up as a challenge in the formulation of the EU Drugs Strategy (2013–2020) [5]. Polydrug use is noted especially among problem drug users [6, 7], but it needs to be recognized among the general population too due to its serious health and social consequences [8–10]. In the present literature, it is often claimed that polydrug use has increased during the last decades [11–13]. However, as far as the authors know, only a few studies have presented research evidence about prevalence trends of polydrug use among the general population [14–16].

Polydrug use refers to the use of 2 or more different substances. Although it has been shown that polydrug use

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Table 1. Basic information about the Finnish Drug Surveys conducted in 1998–2014

	1998	2002	2006	2010	2014
Age of target population, years	15–69	15–69	15–69	15–69	15–69
Oversampling (age in years)	No	15–34	15–34	15–39	15–39
Sample size, *n*	3,250	4,053	5,500	4,250	7,000
Response rate, %	66	63	55	48	50
Number of respondents, *n*	2,143	2,541	3,029	2,023	3,485

may not always be problematic [17, 18], considerable harm can be caused by it. For example, polydrug users are at an elevated risk for developing comorbid psychiatric and other health conditions [10] and polydrug use is also significantly related to social consequences [8]. Polydrug use can be very risky due to difficulties in dosing and unpredictable effects that substantially increase the number of deaths caused by overdose and other detrimental consequences of drug use [9, 19, 20].

Apart from these consequences, polydrug use is complicated both as a phenomenon and as a term. There is no established theory, or a unified concept of polydrug use or an established practice to measure it. Indeed, as Schensul et al. [17] have argued, "existing approaches to measuring polydrug use are confusing and inconsistent." Often it is approached from the perspective of illicit drugs, where the use of 2 or more illicit drugs only [21] or illicit drugs combined with alcohol is defined as polydrug use [8]. Nonmedical use of psychoactive pharmaceutical drugs may be included as one of the substances constituting polydrug use, while sometimes cigarettes can also be included in the combination [22], especially when dealing with adolescents [23]. However, illicit drugs are not necessarily included at all, since the use of alcohol and prescription drugs may form a pattern of polydrug use [24]. Moreover, the degree of alcohol use as a part of polydrug use can vary greatly, for example, from at least one drink during the last year [8] to hazardous drinking [22], whereas the amounts of illicit drugs used are rarely taken into consideration [13].

In addition to different substances, polydrug use is measured by the timing of ingestion. "Concurrent polydrug use" (CPU) refers to the use of 2 or more different substances in a given time period, such as during the last 30 days or the last 12 months. Another measure is "simultaneous polydrug use" (SPU), which indicates the use of different substances at the same time or in temporal proximity [11]. Although occasional concurrent use of 2 or more substances, for example, during a year does not make much sense from the point of view of harms caused by the joint effects of different substances, it is more often used as a measure of polydrug use compared to the simultaneous use [11]. The lack of a separate measure for SPU in surveys may partly explain the reason for this practice.

Thus, due to different measures and definitions, the overall impression of polydrug use among the general population remains vague and nebulous. In order to develop further actions, for example, for the prevention or harm reduction of polydrug use, we should enhance our understanding of the phenomenon [17, 25, 26] and measure it appropriately. To confirm this, we aimed to demonstrate how the prevalence of CPU varies among the general population according to different measurements by using the data of population-based, comparable Drug Surveys conducted in Finland during 1998–2014 as an example. To the best of our knowledge, this is the first study to show the effect of different measures on the prevalence of CPU by using the same data.

Methods

Data

In Finland, population-based Drug Surveys concerning drug use and drug-related opinions and attitudes have been conducted approximately every 4 years since 1992. There have been some changes and modifications in the questionnaire, and therefore, in order to ensure the comparability of the data, 1998–2014 Drug Surveys were used in this study (Table 1). Data collection conducted by Statistics Finland followed the same protocol each time: representative random samples of the population were drawn from the Finnish Population Information System, and respondents were contacted by post. The institutionalized population, those without permanent address, as well as the Åland Islands were excluded. In each survey, data was collected by self-administered anonymous postal questionnaires, which the respondents received by mail and were asked to return in a prepaid envelope. In 2010 and 2014, responding via Internet was also possible.

The age of the target population was in the range 15–69 years. Since 2002, younger age groups were oversampled in order to increase the power in the age group most actively using drugs. The size of the random samples varied between 3,250 (in 1998) and 7,000 (in 2014). The response rate for the Drug Surveys decreased from 66% in 1998 to around 50% in 2010 and 2014. Due to a de-

creasing trend in response rates, a non-respondent study was conducted in 2014. This analysis showed that the prevalence of illicit drug use was very similar both among non-respondents and respondents of the original survey [27].

Measurements of CPU

Similar to the content of previous literature, with CPU we refer to the use of 2 or more different substances during the last 12 months or 30 days without knowing the time interval in more detail. As shown in a recent review article [28], the measurements of polydrug use vary notably, indicating that there is no established practice of how polydrug use is measured. Therefore, in order to demonstrate how distinct prevalence estimates different measurements provide, 4 measures (variables) representing different degrees of strictness were formed. These measures are based on different time frames (last 30 days/last 12 months) and different combinations of

- Smoking ("Do you smoke cigarettes, cigars or pipe?"),
- Alcohol use ("How often do you drink alcoholic beverages?") or binge drinking ("How often do you drink 6 units[1] or more on one occasion [if you are a man]/4 units or more [if you are a woman[2]])?",
- Illicit drug use ("Have you during the last 12 months/30 days tried or used illicit drugs?"[3]) and
- Non-medical use of psychoactive pharmaceutical drugs ("Have you during the last 12 months/30 days used sedatives, anxiolytics or painkillers non-medically?," hereafter referred to as prescription drug misuse).

The questions used to construct these measures are all commonly applied in population-based drug surveys, and thus they are commonly used to measure CPU in other studies too.

The CPU measures in this study are as follows:

1. Strict CPU: this measure includes those who during the last 30 days reported the use of 2 different illicit drugs or at least 2 of the following – binge drinking (at least 4/6 units of alcohol per one occasion) or illicit drug use or prescription drug misuse.

2. Medial CPU (a): this is otherwise the same as Strict CPU, but the time frame is longer. Thus, this measure includes those who during the last 12 months reported the use of 2 different illicit drugs or at least 2 of the following – binge drinking (at least 4/6 units of alcohol per one occasion) or illicit drug use or prescription drug misuse.

3. Medial CPU (b): this is otherwise the same as Medial CPU (a), but the alcohol measure is not so stringent, since it does not take into account the quantity of alcohol used. Thus, this measure includes those who during the last 12 months reported the use of 2 different illicit drugs or at least 2 of the following – alcohol use (any amount) or illicit drug use or prescription drug misuse.

4. Loose CPU: this is otherwise the same as Medial CPU (b), but it also includes smoking. Thus, this measure includes those who during the last 12 months reported the use of 2 different illicit drugs or at least 2 of the following – alcohol use (any amount) or illicit drug use or prescription drug misuse or current daily smoking.

Statistical Analysis

Frequency tables were used to describe the prevalence and trends of CPU according to the different definitions. In order to estimate whether the trends observed were statistically significant, a logistic regression model was used and a p value for trend as well as ORs and their 95% CIs were calculated. When studying the trends of CPU during 1998–2014, either the Strict CPU, Medial CPU (a), Medial CPU (b), or Loose CPU was used as an outcome variable. All these were binary variables, where 0 = no CPU and 1 = CPU by each definition. The explanatory variable was the year of the survey and it was used as a continuous variable. p value <0.05 was considered statistically significant.

Due to the differences in response activity and the oversampling of younger age groups, weighting coefficients were used in all the analyses to restore the population representation. The weighting coefficients were calculated by Statistics Finland and they were based on age, gender, education and level of urbanization. SPSS Statistics software version 22 was used to analyze the data.

Research Ethics

The study protocol was approved by the Ethical Review Board of the National Institute for Health and Welfare.

Results

As shown in Figure 1, the prevalence of CPU varied notably among the general Finnish population. During 1998–2014 from one fourth to one fifth of Finns were defined as polydrug users according to the loosest measure, whereas with Strict CPU the proportion of polydrug users was only 1–2%. Thus, the wider the time frame the higher the prevalence. Similarly, the substances included had an impact on the prevalence of CPU. The measure including current daily smoking (Loose CPU) produced the highest prevalence and the difference with the other measures was considerable. The amount of alcohol used, however, did not seem to have an impact on the prevalence (Medial CPU [a] vs. Medial CPU [b]).

Different definitions also produced different and even contradictory trends for CPU in Finland during 1998–2014 (Fig. 1). According to Medial CPU and Strict CPU, CPU has somewhat increased, although the observed increase was statistically significant only in Medial CPU (a: from 3.7 to 6.5%, p for trend <0.001, OR 1.1, 95% CI 1.1–1.2; b: from 4.0 to 6.7%, p for trend <0.001, OR 1.1, 95% CI 1.1–1.2), but not in Strict CPU (from 1.2 to 2.0%, p for

[1] One unit refers to 12 g of ethanol. The respondents were instructed by several illustrated examples how to calculate alcohol units that they had used.
[2] In 1998 and 2002, it was 6 units even for women.
[3] Due to emerging illicit drugs, the list of substances has changed over the time of the drug survey series. In 1998, the list included hashish/marijuana, amphetamine, heroin/morphine, cocaine/crack, LSD, ecstasy and magic mushrooms, whereas in 2014, it covered in addition methamphetamine, buprenorphine or methadone (other than in substitution treatment), other opioids illegally, GHB/GBL, synthetic cathinones, synthetic cannabinoids and mephedrone.

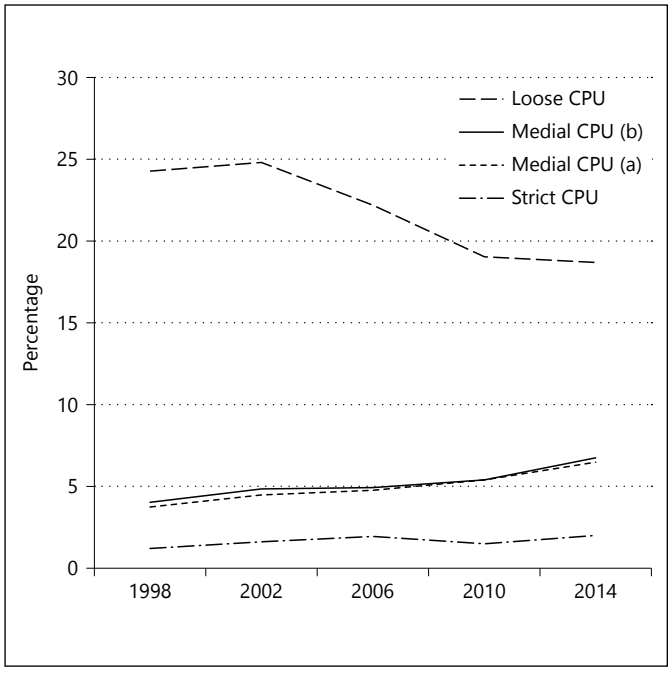

Fig. 1. The trends of concurrent polydrug use (CPU) based on different measurements among the Finnish general population during the period 1998–2014.

trend = 0.054, OR 1.1, 95% CI 1.0–1.2). However, if measured with Loose CPU, the trend was in the opposite direction: the prevalence seemed to be decreasing throughout the 2000s, and the trend was statistically significant (from 24.3 to 18.7%, *p* for trend <0.001, OR 0.9, 95% CI 0.88–0.93).

Discussion

Main Findings and Their Interpretation

We used a series of Finnish population-based Drug Surveys to demonstrate the effect of different measurements to the prevalence estimates of CPU among the general population. It was no surprise to find out that different measurements provided significant variation in the prevalence figures, but the level of difference is worth noting. More importantly, different measurements had an impact on the course of prevalence trends.

In our study, where different measures were tested with the same data, the prevalence of CPU was notably spread across a wide range: according to the strictest definition only 1–2% of Finns are polydrug users, but with the loosest definition, almost as much as one fifth to one fourth of the population are classified as polydrug users. Given this, what can be concluded from the results of previous studies where the prevalence of CPU varies between 3.3% [8] and 21% [29] among adults, between 12% [24] and 26% [30] among students, and between 3.5% [23] and 30% [16] among adolescents? All of these describe the prevalence of CPU among the general population, but since different measurements have been used, the results are barely comparable. Furthermore, it is impossible to conclude how large or small the differences really are, since all the results of previous studies are based on different data. When measuring CPU, the use of 12 months' time span, in particular, may easily overestimate the phenomenon, especially if the amount and the frequency of substances used are not taken into consideration, and the overall impression about the prevalence of polydrug use remains vague. Hence, definitions and measurements that are currently in use make a big difference when studying the prevalence of polydrug use and the estimates vary according to the timing of ingestion and the substances included.

The definitions of the measurements were especially crucial when observing the trends. It turned out that even the course of the trend – whether increasing or decreasing – depended on the measurement. Although it is often claimed that polydrug use has increased, there is not much research evidence to confirm this, at least not among the general population. An increasing trend was found among French adolescents during 1993–1999 [14], but otherwise the changes in the prevalence of CPU have been very modest (this study) or the trend has remained stable [15, 16].

Furthermore, as shown in our results, the substances included into the CPU combination have a significant influence on the prevalence trends. This was evident especially when current daily smoking was considered one of the substances (Loose CPU). With this measure, the trend was decreasing, and thus in the opposite direction to the other measures, which did not include smoking (Strict CPU and Medial CPU). The decreasing trend was due to the significant reduction in smoking in Finland during the 2000s [31]. Similarly, since 2008, the use of alcohol is slowly decreasing among the Finnish general population [32], and therefore, the increase in CPU in our example may mostly be due to the increasing use of illicit drugs [33]. These alterations in the use of single substances should be taken into consideration when measuring polydrug use, since CPU in particular may be prone to these kinds of changes. Moreover, even though including smoking as a part of polydrug use is justified from the perspective of health and long-term effects of substance

use (since it provides a measure of all the different substances a person uses), it is also somewhat problematic, especially if those using alcohol only become classified as polydrug users due to their smoking, as noted elsewhere, too [25].

The alcohol measure (alcohol use [any amount]/binge drinking) did not seem to have an effect on the prevalence or the prevalence trends of Medial CPU. It may be that those classified as alcohol users in this study were in fact mostly also binge drinkers. Or it may be that those who used alcohol but were not binge drinkers did not report about the use of other substances, and therefore they did not become classified as polydrug users. Indeed, at least in Finland, especially heavy episodic drinking has shown to be associated with other drug use [26]. We used binge drinking as a measure for risky drinking, but the results may have been somewhat different if we had used, for example, hazardous or harmful alcohol use based on the AUDIT (Alcohol Use Disorders Identification Test) score.

Although there is some evidence that the number of drugs used concurrently could be used as a proxy of the severity of polydrug use [34], CPU still fails to measure whether the substances are used at the same time intentionally, for instance, to get more intoxicated or to enhance the effects of other drugs [17]. This is of concern, since the harms and risks of SPU may have more detrimental consequences than those of CPU, for instance, unpredictable joint effects of different substances or greater intoxication, which increases the risk of injury or overdose [9, 35, 36]. If a rationale for the study of polydrug use as a separate phenomenon is that it induces particular negative health consequences [37], occasional concurrent use of 2 or more substances during a year does not make much sense. The concept of CPU may help to identify those possibly at risk, but by adhering to joint effects of different substances, SPU would be even more useful in preventing or reducing harms caused by polydrug use. Although SPU would be a better measure from this point of view and although the relevance of SPU as a measure was emphasized already in the 1990s [38], CPU continues to be very widely used.

As shown in this study, there are problems with CPU as a measure, and therefore more emphasis should be put on measuring SPU, in spite of the finding that the majority of CPU are also using drugs simultaneously [11, 39]. Regardless of the high correlation of CPU and SPU, they have remained 2 distinct phenomena [34, 40]. Hence, we argue that as a measure, SPU would be more recommendable in order to improve the comparability of the results of different studies across time and cultures, and these measures should be developed further in population surveys worldwide.

EMCDDA has stated that: "it is not possible to arrive at a single definition of polydrug use, which would be necessary to develop standardized measures" [41], but in our opinion it is important, and possible, to strive towards a better and more comprehensive understanding of the phenomenon using more uniform measures. Furthermore, it should be noted that the prevalence alone does not reveal the harmfulness of polydrug use; rather, additional factors such as the intensity of use or potential harms of combining different substances need to be taken into consideration [12, 13]. One possibility to measure SPU in population surveys would be to include questions concerning, for instance, different combinations of substances used at the same time or in temporal proximity, frequency and motivation of such use as well as perceived harms of SPU. Such questions might reveal detrimental combinations and their prevalence, for example, among adolescents and young people. However, more profound research, especially qualitative research, is needed in order to develop appropriate, effective and comparable measures of SPU.

In preventing polydrug use, health education should not separate different substances but rather treat them in conjunction, and attention should be paid, in particular, to their unexpected joint effects. In addition, an integrated approach and a shift from substance-specific policies towards a policy of psychoactive substances are needed. However, it is not possible to formulate adequate preventive actions until the phenomenon is accurately measured.

Strengths and Limitations

The data used covered a long period of time, and since the survey questions used have remained very similar throughout the time series, the data was highly comparable. New illicit substances that emerged during the survey period have been subsequently included in the questionnaires and, as a result, the list of illicit substances was notably longer in 2014 compared to that in 1998. Given the sampling protocol, where the institutionalized population and those without permanent address were excluded, the results may be somewhat underestimated, since this kind of restriction excludes, for instance, problem drug users from the sample. In addition, the decreasing response rate and a rather small numbers of observa-

tions in certain variables can lead to unstable prevalence estimates. The data used was based on self-report and people may not want to reveal their illicit drug use patterns. On the other hand, the survey was confidential and anonymous, and this could probably reduce the response bias.

Conclusion

The prevalence of CPU varies greatly depending on the measurement used, as does the course of the prevalence trends. It is difficult to develop adequate preventive actions until the phenomenon is accurately measured. The concept of SPU may capture the essence of the phenomenon better than the concept of CPU.

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Disclosure Statement

The authors declare that they have no conflicts of interest.

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