



## Review

## Latent classes of polysubstance use among adolescents—a systematic review



Samuel Tomczyk\*, Barbara Isensee, Reiner Hanewinkel

Institute for Therapy and Health Research, Harmsstraße 2, 24114 Kiel, Germany

## ARTICLE INFO

## Article history:

Received 11 August 2015

Received in revised form

25 November 2015

Accepted 30 November 2015

Available online 11 December 2015

## Keywords:

Polysubstance use

Polydrug use

Adolescent

Finite mixture modeling

Latent class analysis

Systematic review

## ABSTRACT

**Background:** This systematic review aims to summarize latent classes of polysubstance use in adolescents (10–19 years), and to describe predictors of polysubstance use.

**Methods:** A systematic literature review was conducted in three databases (PUBMED, PsycINFO, PsycARTICLES) to identify peer-reviewed articles on latent classes of adolescent polysubstance use (published through June 30, 2015), and to assess the comparability of their results.

**Results:** 23 studies ( $N=450$ – $N=419,698$ ) met the inclusion criteria. The studies showed predominantly (18 studies) average to low risk of bias. 17 studies (74%) identified between three or four latent classes, with “no use” or “low use” classes being the largest and “polysubstance use” being the smallest ones. Intermediate classes included extensive single substance use, such as “alcohol only” classes. Polysubstance use classes were unanimously predicted by higher age, higher parental and peer substance use, and poor academic performance, other predictors were highly heterogeneous.

**Conclusions:** Latent classes deliver solid information on polysubstance use in adolescence. Despite their sample sensitivity, the studies possess manifold similarities, hence, modeling latent classes seems to be an ecologically valid approach to further research, e.g., for subgroup analyses or on substance use trajectories. Finally, latent classes may help to illustrate differential effects and special groups in prevention and treatment that depend on the actual consumption pattern. However, there are certain methodological recommendations to be considered in order to obtain reliable results.

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\* Corresponding author. Fax: +49 431 570 29 29.

E-mail address: [tomczyk@ift-nord.de](mailto:tomczyk@ift-nord.de) (S. Tomczyk).

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## 1. Introduction

Polysubstance use among adolescents remains an important topic for researchers, practitioners, and policymakers, as it is associated with dependence, and delinquency. Adolescent polysubstance users have increased odds to develop an addiction, and to be involved in violent or other criminal incidents (Hopfer et al., 2014; Kokkevi et al., 2014; Wannner et al., 2009).

However, the operationalization of polysubstance use presents a few statistical and methodological challenges. First, polysubstance use is usually assessed via contingency tables of multiple substances, leading to small subsamples, which make it difficult to run complex statistical analyses (Choquet et al., 2004). Second, these measures often lead to highly skewed distributions, which complicate the application of distribution-based methods like hierarchical multilevel regressions and limit their interpretability (Raudenbush and Bryk, 2002). Third, polysubstance use is currently a broad term, describing the use of at least two different psychoactive substances in a defined period of time, either simultaneously or separately (Connor et al., 2014). Hence, there are many types of polysubstance users that are difficult to distinguish, although wide-ranging users (alcohol, tobacco, marijuana, prescription medication misuse, and other illicit drugs) seem to suffer worse consequences than low-ranging users (alcohol, tobacco, marijuana; Connor et al., 2014). However, these associations were found for polysubstance use in general. It is not entirely clear, what types of polysubstance use are predominant among adolescents, and how they can be predicted. From a prevention standpoint, it seems therefore indispensable to investigate polysubstance use patterns in adolescents, as their (cognitive) development may be severely affected (Medina et al., 2007; Moss et al., 2014).

In recent years, specific forms of Finite Mixture Models (FMM), such as latent class analysis (LCA) emerged as modern, and person-centered rather than variable-centered approaches to polysubstance research. FMM postulate a definite amount of homogeneous, mutually exclusive classes of behavior that can be identified by analyzing response patterns on any number of categorical or continuous variables—based on a probabilistic model (Hagenaars and McCutcheon, 2002). Latent classes are determined in an iterative process: once the researcher approximates a number of classes, a process of maximum-likelihood estimations compares this number to the data. Finally, comparing fit indices for different numbers of classes leads to a model that presents the best fit, and consequently, is ecologically valid, while remaining theoretically sound. In terms of validity, the empirical, person-centered nature of FMM might surpass mere summarized scores or frequencies, as FMM are able to integrate different response patterns at the same time, e.g., “low use”, “occasional”, and “frequent” polysubstance use, depending on the chosen indicators. Thus, prevention specialists are able to identify actual patterns and predictors of use, and

tailor their educational and preventive strategies to these specific risk profiles.

Contrary to conventional methods, FMM are not strongly affected by distributional restrictions. If variables exhibit skewness or low cell frequencies, FMM would most likely reveal a small group of users that still allows for further testing, for instance, the prediction of a distal outcome like academic success (Kelly et al., 2015).

In addition, FMM are highly flexible, since there is no definite cut-off for the number of classes, but instead a combination of statistical fit indices, and theoretical tenability (Hagenaars and McCutcheon, 2002). Thus, FMM results can be adapted to the relevant research question, and multiple class solutions can be compared. In order to guarantee replicability and avoid arbitrary results, however, FMM have to be conducted and reported systematically and rigorously. Nevertheless, the flexibility of these types of FMM and the possibility of further statistical testing render them superior to other person-centered classification methods, such as traditional clustering approaches. In contrast to FMM, traditional clustering approaches like k-means clustering may be biased according to the chosen measure of proximity and thus, are not as flexible as probabilistic FMM with regards to modeling restrictions (Jain et al., 1999).

To summarize, latent classes of polysubstance use in adolescence show great promise in extending existing knowledge, and guiding research and practice, as they present person-centered solutions that fit the target population, while remaining statistically transparent and replicable. Therefore, this systematic review aims to identify and summarize studies on latent classes of polysubstance use in adolescents. Moreover, this review wants to illustrate the examined predictors of these classes and connect them to previous research using more conventional approaches. Since FMM can be used to answer a variety of research questions, this review is not limited to certain study designs, comparisons or interventions, but includes different types of latent FMM, such as latent transition analysis (LTA), latent class or profile analysis, and latent class growth models.

## 2. Method

This systematic review was conducted in accordance with the PRISMA Statement (Liberati et al., 2009; Moher et al., 2009).

### 2.1. Search strategy

Three electronic databases (MEDLINE via PUBMED; PsycINFO and PsycARTICLES via EBSCOhost) were systematically searched for publications of all years through June 30, 2015. Keywords and search terms can be found in Supplementary material. We combined phrases, keywords and headings for the major topics “latent

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