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Research paper

Longitudinal patterns of alcohol use and psychological symptoms during COVID-19 pandemic and role of alexithymia: A latent transition analysis in the FinnBrain Birth Cohort Study

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ABSTRACT

Background: The COVID-19 pandemic has been posing widespread influence on mental well-being. However, research on the dynamic relations between alcohol use and psychological symptoms in the context of the pandemic and the role of alexithymic traits in predicting the development of mental health problems longitudinally remains scarce.

Methods: Latent profile and transition analyses were conducted to model the longitudinal patterns of transitions in the profiles of alcohol use and psychological symptoms across 10 months during the pandemic (from May 2020 to March 2021) and to investigate the role of alexithymia and its dimensions Difficulty Identifying and Describing Feelings (DIF and DDF), and Externally Oriented Thinking (EOT) in 720 parents from the FinnBrain Birth Cohort Study.

Results: Three profiles, *Risky Drinking*, *Distressed Non-Risky Drinking*, and *Non-Distressed*, *Non-Risky Drinking*, and their transitions were identified. The role of alexithymia appeared to be stronger in *Risky Drinking* than *Non-Distressed*, *Non-Risky Drinking*. DIF predicted the development of symptoms in *Risky Drinking*, whereas DDF predicted *Risky Drinking* remaining stable over time and showed a trend towards psychological distress in *Risky Drinking* and *Non-Distressed*, *Non-Risky Drinking*. EOT was more likely to be a risk factor for *Risky Drinking* remaining constant and *Non-Distressed*, *Non-Risky Drinking* becoming *Risky Drinking*.

Limitations: This study was mainly limited by the generalizability of the findings.

Conclusions: Our findings add deeper insights into the longitudinal development of alcohol use and psychological symptoms as well as evidence on the role of alexithymia in shaping mental health, providing implications for tailoring clinical preventive and therapeutic measures.

1. Introduction

Although various psychological and behavioral responses to the COVID-19 pandemic including depression, anxiety, and substance use have been reported (Czeisler et al., 2021; Nolvi et al., 2021), little is known about their relationship from a development perspective. Psychological distress may cause a change in the use of substances such as increased alcohol consumption (Clay and Parker, 2020). According to the self-medication theory, drinking might be used as a means of alleviating psychological distress among specific individuals (Khantzian, 1997; Rolland et al., 2020). However, resorting to drinking to cope with stress may also cause more severe mental health outcomes (Gauthier et al., 2019).

Evidence on the co-occurrence of alcohol use problems and common

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mental illnesses such as anxiety or depression is mixed. For example, individuals with depression or anxiety may consume more alcohol, whereas several studies reported higher levels of alcohol use in individuals without such mental health problems (de Sousa et al., 2017; Piwoński et al., 2010; Puddephatt et al., 2022). The associations between alcohol use and psychological symptoms are indeed complex, especially when considering the characteristics of study population and environmental factors such as a pandemic situation (Austin and Villarosa-Hurlocker, 2021; Chodkiewicz et al., 2020; Kuntsche et al., 2017). A prior study investigating longitudinal relations between alcohol consumption and mental health suggested mental health to be a causal factor for alcohol consumption but no reciprocal effects (Bell and Britton, 2014), implying that their association patterns may differ over time. More understanding of the dynamic relationships of alcohol use and psychological symptoms is warranted for mental wellbeing of populations during the pandemic, which, however, is unexplored.

Additionally, specific personality traits may predispose one to mental health problems. For instance, alexithymia, literally meaning "no words for feelings", is a personality trait characterized by a lack of emotional awareness and expression (Sifneos, 1973), which has long been reported to be associated with a variety of mental health problems including depression and anxiety, as well as substance use (Devine et al., 1999; Honkalampi et al., 2000; Li et al., 2023; Thorberg et al., 2009). Difficulty identifying (DIF) and describing feelings (DDF), and externally oriented thinking (EOT) constitute three dimensions representing the core features of alexithymic traits (Taylor et al., 1991). These dimensions reflect distinct components of alexithymia that appear to be differentially linked to emotions and behaviors. Specifically, DIF appears to contribute to psychological symptoms, while EOT refers to a cognitive style that may be independent of psychopathology and tend to be associated with substance use (Grabe et al., 2004; Kajanoja et al., 2018). For example, the research by Kajanoja et al. (2018) has highlighted a relation between higher EOT and more alcohol use per occasion.

Alexithymia has shown high stability in general populations (Hiirola et al., 2017). Albeit controversial that alexithymia may display a state-dependent phenomenon in patients with mental disorders, it has been found to be stable in alcoholic patients even regardless of a large change of psychological distress, suggesting that alexithymia is more likely to function as a trait-like factor predisposing mental health changes (de Haan et al., 2014; de Timary et al., 2008; Thorberg et al., 2016). Nevertheless, evidence on the role of alexithymia in the development of psychological symptoms and substance use based on longitudinal settings remains scarce (Honkalampi et al., 2022; Li et al., 2015).

Accordingly, the aims of the present study were twofold: (a) to explore association patterns of alcohol use, depressive and anxiety symptoms and their longitudinal transitions during the pandemic, and (b) to investigate whether the dimensional alexithymic traits predict the patterns and their transitions.

2. Methods

2.1. Study participants

This is a sub-study based on the FinnBrain Birth Cohort Study (www.FinnBrain.fi), a prospective cohort study consisting of families (N = 3808) recruited between December 2011 and April 2015 from maternal welfare clinics in the South-Western Hospital District and the Åland Islands (Karlsson et al., 2018). The parents in the initial cohort were invited to this sub-study in May 2020 (T1), at the time when they were raising children around 5 to 8 years old. 856 parents responded to the pandemic sub-study, and they have been followed up at several timepoints across one year until June 2021.

Given the questionnaire assessing alcohol use in past year, an interval of measurements around one year were considered for modeling. However, to keep the sample size in latent profiles and their transitions as large as possible, March 2021, which was 10 months after T1, was selected as T2 due to only 377 respondents available at the June 2021 follow-up. Among all respondents, 726 parents who had completed the questionnaire for alexithymia between 2017 and 2020 were included, of which 6 with missing on all indicators for modeling (see the following sections) at both timepoints were excluded. Thus, the final sample for the current study consists of 720 parents who had no missing data at either timepoint. Of this study sample, 716 parents (99.4 %) reported either of the indicator measurements at T1 and 529 (73.5 %) at T2 (flowchart in Fig. 1).

2.2. Procedures

Background factors included age, gender, and education collected in the first trimester of pregnancy, pre-pandemic depressive and anxiety symptoms measured at 5 years after delivery, and pandemic stressors covering health events related to self, family members, friends, and acquaintances, free time restrictions, and economic burden assessed at T1 using a questionnaire modified based on the measurement for SARS-related stressors in a prior study (Main et al., 2011). The participants responded to the follow-up questionnaires during the pandemic electronically through the Research Electronic Data Capture (REDCap) platform (Harris et al., 2009).

Regarding the main study variables, alexithymia was measured at 5 years after childbirth (between 2017 and 2020). Alcohol use, as well as depressive and anxiety symptoms during the pandemic were measured at T1 and T2. All the parents gave their informed consent when participating in the study. The Ethics Committee of the Hospital District of Southwest Finland has approved the study baseline protocol (14.6.2011 ETMK:57/180/2011 § 168) and the protocol for the COVID-19 follow-up (ETMK: 17/1802/2020). All procedures in this study comply with the ethical standards of the national and institutional research committee on human experimentation, and with the 1964 Declaration of Helsinki as well as its later amendments.

2.3. Measures

2.3.1. Alcohol use

The Alcohol Use Disorders Identification Test (AUDIT) is a validated worldwide used instrument developed by the WHO for screening alcohol use during the past year (Babor et al., 2001; Saunders et al., 1993). It is a 10-item questionnaire assessing three conceptual domains including alcohol consumptions (domain 1: items 1 to 3), dependence (domain 2: items 4 to 6) and alcohol-related harm (domain 3: items 7 to 10). The AUDIT can be either scored separately on the three domains or as a whole with the scores ranging from 0 to 40, and a proposed cut-off score of 8 was used to identify hazardous or harmful drinking (Babor et al., 2001). In order to obtain more details about alcohol use related problems, the three domains were used as three indicators for modeling. The questionnaire showed sufficiently good internal reliability in our study (Cronbach's $\alpha = 0.74$ for T1 and 0.71 for T2).

2.3.2. Depressive and anxiety symptoms

The Edinburgh Postnatal Depression Scale (EPDS) (Cox et al., 1987), a valid and sensitive 10-item self-report questionnaire assessing depressive symptoms in the past week, has been widely used for screening pre- and postpartum depression for both mothers and fathers (Edmondson et al., 2010). The total scores range from 0 to 30 with higher scores indicating more symptoms (Cronbach's $\alpha = 0.85$ for pre-pandemic, 0.86 for T1 and 0.86 for T2). The EPDS was applied in this study given its wide validity in different populations and its longitudinal use in the initial cohort thus enabling the comparisons.

The anxiety subscale of the Symptom Checklist-90 (SCL-90) was used to assess the intensity of anxiety experienced in the past month (Derogatis et al., 1973; Holi et al., 1998). The scores of this subscale range from 0 to 40, with higher scores indicating more anxiety symptoms

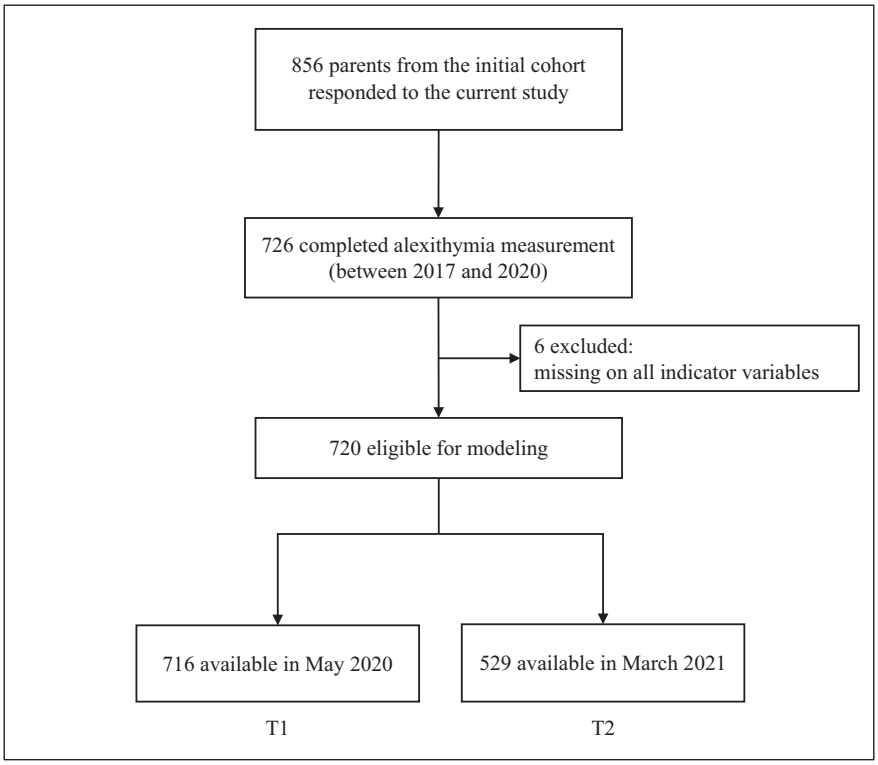

Fig. 1. Flowchart of the sample enrollment and follow up.

(Cronbach's α = 0.86 for pre-pandemic, 0.87 for T1 and 0.86 for T2).

2.3.3. Alexithymia

Alexithymic traits were measured by the 20-item Toronto Alexithymia Scale (TAS-20), one of the most widely used self-report scales for measuring alexithymia (Bagby et al., 1994; Joukamaa et al., 2001; Taylor et al., 2003). The scale consists of three subscales assessing the three main features of alexithymia (DIF, DDF and EOT). Each item is rated on a 5-point Likert scale that ranges from 1 (strongly disagree) to 5 (strongly agree), thus generating total scores ranging from 20 to 100. The Finnish version of the TAS-20 validated by Joukamaa et al. (2001) was used and it showed good internal consistency in the current study (Cronbach's α = 0.83).

2.4. Analysis strategy

Preliminary analyses including descriptive statistics and comparisons of all variables between T1 and T2 (Chi-square test and Mann–Whitney *U* test) were conducted using IBM SPSS 28. The main analysis, latent transition analysis (LTA) was performed using Mplus version 8.3 (Muthén and Muthén, 1998–2011). Five indicator variables, that is, alcohol consumption, alcohol dependence, alcohol-related harm, as well as depressive and anxiety symptoms were used for modeling.

The LTA modeling was composed of four steps. First, latent profile analysis (LPA) was used to explore classification based on combination patterns of the indicators at each timepoint. Second, measurement invariance of the models across the two timepoints was tested. Third, LTA, a longitudinal extension of LPA, was performed to investigate the movement of latent profiles over time. Fourth, covariates were included as predictors after the LTA model was specified correctly. The LTA modeling used full information maximum likelihood (FIML) to handle missing data on the indicator variables. Few missing values on background factors were imputed by mean values (Table 1). Detailed descriptions of the procedure for LTA modeling were presented in the Supplementary material.

3. Results

3.1. Preliminary analysis

Table 1 presents the descriptive statistics and the proportion of missing data on all variables of the participants at each timepoint. No significant differences were found in the background factors and alexithymia between sample at the two timepoints. The T2 participants showed lower mean values of the AUDIT, domain 1, and the EPDS than the T1 participants. 7.7 % of the participants at T1 and 7.4 % at T2 reported hazardous drinking (cut-off point of 8). No significant differences in the prevalence of hazardous drinking between T1 and T2 were observed.

3.2. Latent profile analyses (LPA)

The fit indices for evaluating models with increasing number of latent profiles are enumerated in Supplementary material (Table S1). The results suggested the 3-profile solution to be the optimal LPA model for both T1 and T2. No significant differences between full invariant model (i.e., all measurement parameters being constrained across T1 and T2) and baseline model (i.e., all parameters being freely estimated) were observed by using the likelihood-ratio test ($df = 15$, $\chi^2\text{diff} = 24.65$, $p = .055$). Moreover, Table 2 (upper part) shows that although the item levels slightly changed across T1 and T2, their relative levels within profiles at each timepoint were basically similar, suggesting the general interpretation on the profiles to be equal over time. Hence, the full measurement invariance was reasonably assumed.

3.3. Latent transition analyses (LTA)

3.3.1. LTA model without covariates

As presented in Table 2 (middle part), the first profile representing the individuals with relatively higher levels of alcohol use related problems but low in depressive and anxiety symptoms was named as

Table 1
Descriptive statistics for all variables and the proportion of missing data for the respondents at T1 and T2.

	T1 respondents (N = 716)		T2 respondents (N = 529)	
	N (%) or mean (SD), range	Missing %	N (%) or mean (SD), range	Missing %
Gender		–		–
Women	568 (79.3 %)		417 (78.8 %)	
Men	148 (20.7 %)		112 (21.2 %)	
Education		0.1 %		0.2 %
Low	156 (21.8 %)		110 (20.8 %)	
Mid	214 (29.8 %)		154 (29.3 %)	
High	346 (48.4 %)		264 (49.9 %)	
Age	31.74 (4.58), 18–50	–	31.98 (4.66), 18–50	–
Pandemic stressors	4.42 (2.76), 0–15	0.1 %	4.34 (2.62), 0–15	0.4 %
EPDS (pre-pandemic)	4.81 (4.48), 0–26	0.1 %	4.72 (4.32), 0–23	0.2 %
SCL-90 (pre-pandemic)	3.96 (4.75), 0–28	0.3 %	3.87 (4.69), 0–28	0.2 %
TAS-20 total	39.82 (9.66), 20–79	–	39.82 (9.67), 20–75	–
DIF	11.69 (4.71), 7–33	–	11.69 (4.70), 7–32	–
DDF	9.78 (3.68), 5–23	–	9.80 (3.67), 5–23	–
EOT	18.34 (4.43), 8–30	–	18.33 (4.45), 8–30	–
AUDIT	3.54 (2.91), 0–32	11.5 %	3.21 (2.77), 0–26	13.4 %
Hazardous drinking	49 (7.7 %)		34 (7.4 %)	
Domain 1	1.77 (0.80), 0–3	10.8 %	1.55 (0.82), 0–3	11.9 %
Domain 2	0.10 (0.40), 0–3	3.1 %	0.07 (0.30), 0–3	5.7 %
Domain 3	0.38 (0.78), 0–4	3.4 %	0.33 (0.72), 0–4	4.9 %
EPDS (T1/T2)	6.71 (4.83), 0–24	4.7 %	5.82 (4.78), 0–22	–
SCL-90 (T1/T2)	4.76 (5.08), 0–29	5.0 %	4.35 (4.95), 0–33	0.8 %

Education: Low = high school or lower, Mid = vocational tertiary degree, High = university degree.
TAS-20 = 20-item Toronto Alexithymia Scale; DIF = difficulty identifying feelings; DDF = difficulty describing feelings; EOT = externally oriented thinking.
AUDIT = Alcohol Use Disorder Identification Test; Domain 1 = Items 1 to 3: alcohol consumption; Domain 2 = Items 4 to 6: alcohol dependence; Domain 3 = Items 7 to 10: alcohol-related harm.
Hazardous drinking: suggested cut-off scores of 8 or more of the AUDIT.
EPDS = Edinburgh Postnatal Depression Scale; SCL-90 = Symptom Checklist-90 (anxiety subscale).

Table 2
Latent transition analyses (LTA) for the movement of the profiles across T1 and T2.

	Risky drinking	Distressed non-risky drinking	Non-distressed, non-risky drinking
Baseline LTA model			
Membership probabilities			
T1	21.75 %	17.72 %	60.54 %
T2	21.08 %	15.86 %	63.06 %
Item value (Z-score)		*T1/T2*	
Alcohol consumption	0.61/0.76	−0.29/−0.44	−0.15/−0.16
Alcohol dependence	0.16/0.51	−0.16/−0.23	−0.21/−0.21
Alcohol-related harm	1.19/1.27	−0.46/−0.46	−0.48/−0.46
Depressive symptoms	0.07/0.09	1.13/1.24	−0.44/−0.44
Anxiety symptoms	−0.07/0.23	1.27/0.97	−0.49/−0.48
Full invariant LTA model			
Membership probabilities			
T1	22.30 %	18.14 %	59.55 %
T2	21.06 %	15.99 %	62.95 %
Item value (Z-score)			
Alcohol consumption	0.67	−0.34	−0.16
Alcohol dependence	0.26	−0.17	−0.21
Alcohol-related harm	1.22	−0.46	−0.47
Depressive symptoms	0.08	1.20	−0.43
Anxiety symptoms	0.05	1.17	−0.48
Transition probabilities		*T1 (rows) by T2 (columns)*	
Risky drinking	66.8 %	7.3 %	25.9 %
Distressed non-risky drinking	14.4 %	64.7 %	20.9 %
Non-distressed, non-risky drinking	5.9 %	4.4 %	89.6 %

"*Risky Drinking*". The second profile representing the individuals with low levels of alcohol use problems but high in psychological symptoms was named as "*Distressed Non-Risky Drinking*". The third profile in which all the indicator variables were low was named as "*Non-Distressed, Non-Risky Drinking*". Fig. 2 illustrates the three profiles based on the full measurement invariant model.

Table 2 (lower part) shows the transition probabilities reflecting the movement of the profiles over time. Most of the individuals remained stable in each profile, and most of the individuals in *Risky Drinking* and *Distressed Non-Risky Drinking* with profile changes moved into *Non-Distressed, Non-Risky Drinking*.

3.3.2. LTA model with covariates

3.3.2.1. Effects of background factors. There were two ways to detect the role of the predictors as proposed, one for direct effects and another one for group-specific effects (see the Supplementary material). For the direct effects, male gender and lower education levels were associated with *Risky Drinking* at T1. More pandemic stressors and pre-pandemic psychological symptoms were related to *Risky Drinking* and *Distressed Non-Risky Drinking* at T1. T2 profiles were associated with pre-pandemic depressive symptoms but not anxiety symptoms. Considering a potential strong collinearity between the two symptoms, only depressive symptoms were included in subsequent modeling (Table 3).

Regarding the group-specific effects, relative to moving to *Non-Distressed, Non-Risky Drinking*, younger parents as *Distressed Non-Risky Drinking* at T1 were more likely to remain constant over time (OR: 0.799, 95 % CI: 0.725–0.881, $p < .001$). Pre-pandemic depressive symptoms increased the risk for *Non-Distressed, Non-Risky Drinking* (OR: 1.261, 95 % CI: 1.142–1.393, $p < .001$) and *Risky Drinking* (OR: 1.186, 95 % CI: 1.040–1.354, $p = .033$) transitioning into *Distressed Non-Risky Drinking*. There was a noteworthy trend in women remaining as *Distressed Non-Risky Drinking* over time during the pandemic (OR: 0.139, 95 % CI: 0.025–0.774, $p = .059$). Other background factors did not show significant effects.

3.3.2.2. Effects of alexithymic traits. Alexithymic traits were then included in the model controlling for the abovementioned background factors. Higher levels of alexithymia and the dimension DIF and DDF consistently associated with either *Risky Drinking* or *Distressed Non-Risky Drinking* at the two timepoints. There was a link between a lower level of EOT and *Distressed Non-Risky Drinking* at T1 (Table 3).

For the group-specific effects of alexithymia on the transition, as

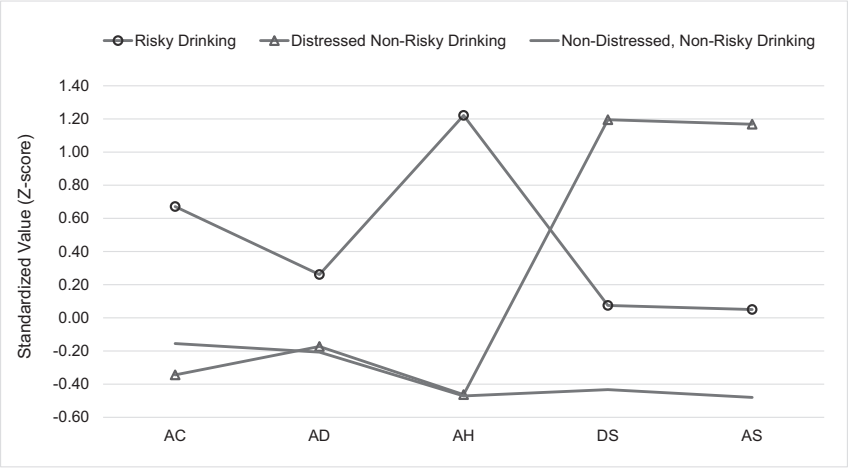

Fig. 2. Identified subgroups representing the three profiles of alcohol use and psychological symptoms during the pandemic based on the full measurement invariant model.
Note: AC = alcohol consumption; AD = alcohol dependence; AH: alcohol-related harm; DS = depressive symptoms; AS = anxiety symptoms.

presented in Fig. 3, *Risky Drinking* at T1 with higher overall alexithymia levels were more likely to remain constant or move into *Distressed Non-Risky Drinking* at T2 than into *Non-Distressed, Non-Risky Drinking*. Albeit with statistically nonsignificant *p* values, 95 % CI excluding one suggested that alexithymia may also play a role in the transition from *Non-Distressed, Non-Risky Drinking* to *Distressed Non-Risky Drinking* to some degree. A higher level of DIF increased the risk for the transition from *Risky Drinking* into *Distressed Non-Risky Drinking* relative to *Non-Distressed, Non-Risky Drinking*. *Risky Drinking* with a higher level of DDF were more likely to remain constant or tended to transition into *Distressed Non-Risky Drinking*. *Non-Distressed, Non-Risky Drinking* with higher DDF also showed a trend of becoming *Distressed Non-Risky Drinking*. A higher level of EOT increased the risk for more stable *Risky Drinking*. Moreover, *Non-Distressed, Non-Risky Drinking* with higher EOT were more likely to develop into *Risky Drinking*. Again, a lower level of EOT seemed to be related to *Distressed Non-Risky Drinking* remaining constant over time.

4. Discussion

Based on five indicators (i.e., alcohol consumption, dependence, alcohol related harm, and depressive and anxiety symptoms), three distinct profiles namely *Risky Drinking*, *Distressed Non-Risky Drinking*, and *Non-Distressed, Non-Risky Drinking* as well as their transitions from May 2020 to March 2021 were identified. The findings suggested dynamic combination patterns of alcohol use and psychological symptoms during the COVID-19 pandemic. Moreover, alexithymia and its three dimensions were found to differentially predict the profile development.

At cross-sectional level, interestingly, simultaneous presence of problematic drinking and high levels of psychological symptoms during the pandemic was not identified in this study, which seems to be a paradox comparing with a number of previous findings that alcohol use disorders tend to be comorbid with major depression and anxiety disorders diagnosed clinically (Brière et al., 2014; Falk et al., 2008). This could be explained by the characteristics of the sample in our study that consists of highly educated parents in a long-term follow-up cohort with few problems in alcohol use and mental health, in which there may be counter-intuitive results. For example, several studies using the sample of general population have shown lower prevalence of alcohol use in individuals with depressive or anxiety symptoms than those without the symptoms (de Sousa et al., 2017; Piwoński et al., 2010; Puddephatt et al., 2021, 2022).

From longitudinal view, the sample characteristics can also account for the relatively small proportion of the transitions from *Non-Distressed, Non-Risky Drinking* into other profiles. Regarding the transitions between *Risky Drinking* and *Distressed Non-Risky Drinking*, on the one hand, 7.3 % of *Risky Drinking* at the initial stage of the pandemic became *Distressed Non-Risky Drinking* over 10 months. Pre-pandemic depressive symptoms had relations to the transition from *Risky Drinking* into *Distressed Non-Risky Drinking*. Psychological distress may be a reason for the decision to alcohol cessation (Sarich et al., 2019); however, in some cases, abstainers may experience more psychological symptoms (Alati et al., 2004; Rodgers et al., 2000; Skogen et al., 2011). On the other hand, 14.4 % of *Distressed Non-Risky Drinking* were observed to become *Risky Drinking*. It is suggested that mentally distressed individuals may use alcohol to alleviate their symptoms during the pandemic (Khantzian, 1997; Rolland et al., 2020). The probability of this transition was approximately twofold higher than their reverse change, which to some degree echoes the previous study suggesting that alcohol use more tended to be a consequence rather than a reason for mental health problems (Bell and Britton, 2014).

It is well documented that alexithymia is linked to depression, anxiety, and alcohol use (Devine et al., 1999; Honkalampi et al., 2000; Li et al., 2023; Thorberg et al., 2009). Similarly, the current study indicated alexithymia to be associated with *Risky Drinking* and *Distressed Non-Risky Drinking* at both two time points. One underlying mechanism may be hypothalamic-pituitary-adrenal axis dysfunction in alexithymic individuals thus having problems in the regulation of stress responses (Alkan Härtwig et al., 2013). However, alexithymia was found to be a relatively weak factor per se for the development of *Non-Distressed, Non-Risky Drinking* in our sample. The role of alexithymia may be clearer under specific conditions such as in clinical samples (Cruise and Becerra, 2018; Honkalampi et al., 2022; Luca et al., 2013). In addition, alexithymia may function as an indirect predictor (Honkalampi et al., 2010). A recent study, for example, demonstrated that alexithymia impacted mental health change during the pandemic via interacting with perceived stress but not directly (Li et al., 2022). Likewise, in the present study, alexithymia predicted *Risky Drinking* being in the same state or transitioning into *Distressed Non-Risky Drinking* over time, reflecting the interaction that alexithymia contributed to persistent alcohol use or subsequent psychological symptoms when the individuals had already had alcohol use related problems.

It is noteworthy that specific dimensions of the multifaceted alexithymic traits may play a distinguishing role in the development of mental health problems and alcohol use (Alkan Härtwig et al., 2014; Kajanoja et al., 2017, 2018). Among the individuals with *Risky Drinking* at T1, difficulty identifying (DIF) and describing feelings (DDF) respectively tended to be risk factors for becoming *Distressed Non-Risky*

Table 3
Direct effects of covariates on the profiles at T1 and T2.

	Risky drinking	Distressed non-risky drinking	Non-distressed, non-risky drinking
	On T1 profiles, OR (95 % CI)		
Gender	2.389 (1.599–3.571)*	0.719 (0.357–1.448)	1
Education	0.664 (0.537–0.823)**	0.981 (0.738–1.303)	1
Age	0.974 (0.940–1.009)	0.960 (0.912–1.010)	1
Pandemic stressors	1.120 (1.052–1.192)*	1.150 (1.067–1.239)*	1
Depressive symptoms (Pre)	1.095 (1.034–1.158)*	1.190 (1.103–1.283)*	1
Anxiety symptoms (Pre)	1.115 (1.040–1.195)*	1.203 (1.103–1.312)*	1
Alexithymia (TAS-20)	1.018 (1.000–1.036)	1.027 (1.006–1.049)*	1
DIF	1.097 (1.055–1.140)**	1.151 (1.101–1.203)**	1
DDF	1.036 (0.990–1.084)	1.071 (1.018–1.128)*	1
EOT	0.976 (0.938–1.015)	0.929 (0.894–0.966)*	1
	On T2 Profiles, OR (95 % CI)		
Gender	1.928 (0.991–3.750)	0.563 (0.103–3.066)	1
Education	0.763 (0.544–1.071)	0.854 (0.465–1.567)	1
Age	1.096 (1.038–1.157)*	1.018 (0.917–1.130)	1
Pandemic stressors	1.008 (0.911–1.116)	1.069 (0.889–1.285)	1
Depressive symptoms (Pre)	1.072 (0.986–1.166)	1.234 (1.101–1.382)*	1
Anxiety symptoms (Pre)	1.111 (1.012–1.220)	1.124 (0.966–1.309)	1
Alexithymia (TAS-20)	1.070 (1.018–1.126)*	1.134 (1.031–1.081)*	1
DIF	1.066 (0.962–1.182)	1.151 (1.068–1.241)*	1
DDF	1.181 (1.046–1.334)*	1.193 (1.064–1.338)*	1
EOT	1.090 (0.998–1.191)	1.054 (0.951–1.168)	1

Gender: 1 = Women, 2 = Men; Education: 1 Low = high school or lower, 2 Mid = vocational tertiary degree, 3 High = university degree.
Pre = pre-pandemic.
TAS-20 = 20-item Toronto Alexithymia Scale; DIF = difficulty identifying feelings; DDF = difficulty describing feelings; EOT = externally oriented thinking.
OR = odds ratio; CI = confidence interval.
* $P < .05$.
** $P < .001$.

Drinking and remaining constant as *Risky Drinking*. Externally oriented thinking (EOT) was found to be the only one risk factor for both *Risky Drinking* remaining constant and *Non-Distressed*, *Non-Risky Drinking* becoming *Risky Drinking*. DIF and DDF represent the emotional component of alexithymia, which has been suggested to be associated with maladaptive defense style and social interaction difficulties (Taurino et al., 2021; Vanheule et al., 2007). Whereas EOT refers to a cognitive style with pragmatic thinking and lacking subjective significance of inner feelings (Müller et al., 2003), which may be linked to field dependence (i.e., a tendency to rely on information from outer world) and a lack of social self-confidence in alcoholics (Loas et al., 2000). Additionally, echoing the cognition-related nature of EOT, impaired executive functions may account for the contributing role of EOT in problematic alcohol use (Brion et al., 2017; Riadh et al., 2019).

Interestingly, individuals with *Distressed Non-Risky Drinking* exhibited a lower level of EOT than *Non-Distressed*, *Non-Risky Drinking* at T1. Lower EOT also showed a trend towards contributing to *Distressed Non-Risky Drinking* remaining over time rather than changing into *Non-Distressed*, *Non-Risky Drinking*. It is reported that EOT might play a protective role in mental health problems due to deficiencies of attending to negative emotions (Alkan Härtwig et al., 2014; Davydov, 2017; Wiebe et al., 2017). Nevertheless, EOT was found to act as a significant predictor for the increase of alcohol use problems. Thus, EOT plausibly has emotional protecting effects but simultaneously renders individuals poor in coping competence such as resorting to substance use when facing stress (Wiebe et al., 2017). Given that EOT was not observed to predict the other profiles moving into *Distressed Non-Risky Drinking*, we speculated that low EOT may be associated with continuing psychological symptoms to some degree, but it did not contribute to the deterioration of the symptoms.

Remaining as *Distressed Non-Risky Drinking* over time was more likely related to younger age and being mothers, supporting previous findings that these characteristics were associated with poor mental health during the pandemic (Fernández et al., 2020; Joshi et al., 2021). However, except for the aforementioned role of EOT, alexithymia and other dimensions seems unable to influence how *Distressed Non-Risky Drinking* develops. An explanation may be that the parents with *Distressed Non-Risky Drinking* at T1 already had high alexithymia levels, and a relatively low level of alexithymia in these individuals can be still high and thus hardly contributing to the decrease of psychological symptoms.

To our knowledge, this is the first study using an exploratory person-centered approach to identify latent profiles of the status of alcohol use and psychological symptoms as well as their development in the context of the COVID-19 pandemic. Moreover, we explore the predictive role of alexithymia in such development in a longitudinal setting, providing sounder understanding of how alexithymia contributes to mental well-being and relevant clinical implications such as identifying vulnerable individuals and designing preventive or therapeutic strategies.

However, there are several limitations that should be acknowledged. First, the inconsistent timeframe of the scales assessing alcohol use (for the past year), depressive (for the past week) and anxiety symptoms (for the past month) needs to be considered when interpreting the results. Nevertheless, the profiles identified based on these indicators were unvarying over time, suggesting that this should not be a major limitation. Second, the interval between the measurement of alexithymia and the indicators for modeling differed across individuals. However, alexithymia is regarded as a highly stable personality feature even over 11 years in adult general population (Hiirola et al., 2017; Karukivi et al., 2014; Tolmunen et al., 2011). Third, the sample consists of parents and is largely mothers, making that the profiles may be more representative of them identified among mothers than fathers and limiting the generalizability of the findings to other types of population. Whereas this did not involve the findings regarding the role of alexithymia in the profile transitions. Fourth, the profiles and transitions may not be applicable to other situations since they were, to a large extent, influenced by social factors such as restrictive policies that are related to alcohol availability and can continuously vary over time during the pandemic. Fifth, the levels of education as well as alcohol use and psychological symptoms reflected a low-risk and healthy population to some degree, which also limits generalizing the findings to other populations. However, since this appears to underscore the relationships between the profiles or transitions and alexithymia, more significant effects are likely to be found in high-risk populations.

5. Conclusions

The present study determined the transitions in three distinct patterns of alcohol use and psychological symptoms, namely *Risky Drinking*

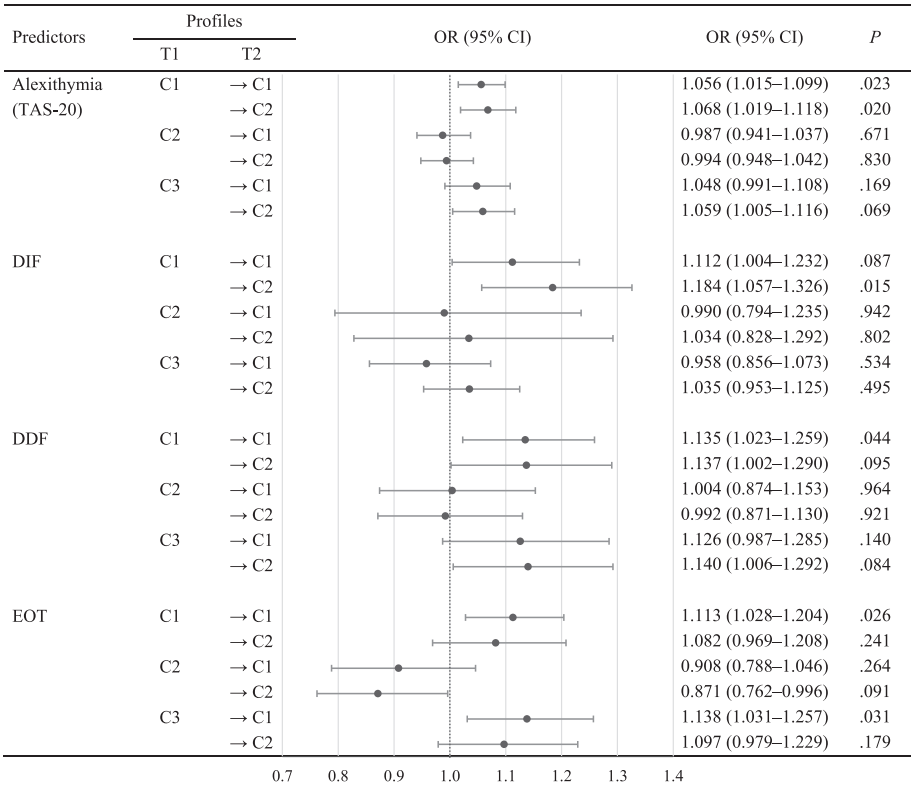

Fig. 3. Odds ratios for alexithymic traits predicting the transitions in the profiles from T1 to T2.
Note: Reference: transition to *Non-Distressed*, *Non-Risky Drinking* at T2.
C1 = *Risky Drinking*; C2 = *Distressed Non-Risky Drinking*; C3 = *Non-Distressed*, *Non-Risky Drinking*.
TAS-20 = 20-item Toronto Alexithymia Scale; DIF = difficulty identifying feelings; DDF = difficulty describing feelings; EOT = externally oriented thinking.

with only high levels of alcohol use, *Distressed Non-Risky Drinking* with only high levels of psychological symptoms, and *Non-Distressed*, *Non-Risky Drinking* with low levels of alcohol use and psychological symptoms, among the parents over 10 months during the COVID-19 pandemic. Furthermore, this study highlights that specific dimensions of alexithymic traits differentially predicted the longitudinal development of alcohol use and psychological symptoms. The current findings add deeper insights into the relations between alcohol use and psychological symptoms as well as the actual role of alexithymia in shaping mental health, which provides implications for tailoring clinical preventive and therapeutic measures. Future studies about long-term impacts of the pandemic on various aspects of mental wellbeing among more diverse populations are warranted.

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CRediT authorship contribution statement

Ru Li: Conceptualization, Methodology, Formal analysis, Data curation, Writing – original draft, Writing – review & editing, Funding acquisition. **Jani Kajanoja:** Supervision, Methodology, Writing – review & editing. **Linnea Karlsson:** Writing – review & editing, Project administration, Resources, Funding acquisition. **Hasse Karlsson:** Writing – review & editing, Project administration, Resources. **Saara Nolvi:** Data curation, Writing – review & editing, Project administration, Funding acquisition. **Max Karukivi:** Supervision, Methodology, Writing – review & editing, Funding acquisition.

Declaration of competing interest

The authors declare no conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jad.2023.06.056.

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