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An ecological momentary assessment of the dynamic relationship between microaggression, idea of reference and affects in patients with first-episode psychosis

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Abstract

Background Microaggression is the subtler and milder form of stigma that may be faced by patients with psychosis in everyday life. Momentary affective states and referential ideations may play a role in the processing of microaggression. The current study examined the relationship between microaggression, momentary affective states, and Ideas of Reference (IoR) in patients with first-episode psychosis.

Methods Experience Sampling Method (ESM) with 28 time points across a two-week study period was adopted. All participants had face-to-face clinical assessment at baseline. ESM data was analysed using both multiple regression models and data-driven Causal Discovery Analysis (CDA), which provide both group level and individual level analysis. Thirty-six participants that completed at least 60% of the assessment time points were included for analysis.

Results The multilevel regressions suggested that IoR and negative affects were significantly associated with microaggression. There is also a trend to significance between positive affect and microaggression. The CDA identified two causal pathways leading to microaggressions. One pathway was having more negative affects (sad, stressed, irritable) leads to more IoR experience which then leads to microaggression. The other pathway was through reduced positive affects (happy and relaxed). High heterogeneity was shown in the causal pathways leading to microaggression when personal causal models were examined.

Conclusion These results suggested that negative affects and the presence of IoR may influence their perception of microaggressive experiences. The study allows a better understanding of the role of different factors in the processing of microaggression experiences and facilitates the development of tailored intervention strategies for individuals facing microaggression.

Keywords Psychosis, Microaggression, Ideas of reference, Experience sampling method, Causal discovery analysis

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Background

Microaggression is a product of historical systematic oppression and devaluation of minority groups in society, which has infiltrated into everyday verbal and non-verbal language. Though its presentations may vary across different social contexts, microaggression generally refers to subtle and brief experiences of recurrent daily indignities and discrimination directed towards marginalized groups [1, 2]. It is considered to be a subtler and milder form of stigma [3, 4], and it is associated with poor mental health and functioning including higher risk of depression, anxiety, suicide attempts, alcohol abuse and poor academic performance in minority population, such as racial, sexual and gender minorities [5, 6]. While perpetrators may not always have ill intentions, the subtle and ambiguous nature of microaggressions often leads recipients to perceive these acts as having negative connotations related to their marginalized status [7].

Daily experiences of microaggressions reinforce self-stigmatizing beliefs, leading individuals with mental illness to devalue themselves further [8, 9] Due to their recurrent, subtle, and possibly unintended nature, microaggressions can be particularly challenging for individuals to resolve their negative impacts [10]. Additionally, self-stigma may sensitize individuals to ambiguous acts and appraise them as microaggressions [11], creating a vicious cycle which perpetuates the sense of self-stigmatization and its detrimental impacts.

A scoping review identified 11 studies investigating microaggression in the population with mental illness [7]. Although no studies have specifically focused on patients with psychosis, research indicated that individuals with psychosis experience unpleasant social interactions akin to microaggressions. Likewise, prior research in the U.S. has suggested that microaggressions among racial minorities contribute to increased self-reported psychotic experiences [12]. Furthermore, positive symptoms in individuals with psychosis were found to be positively associated with self-stigma [13–16]. These findings suggest a complex and dynamic relationship between psychotic symptoms, microaggressions, and self-stigma.

Though microaggressions are often ambiguous across contexts, the experience of individuals with psychosis may differ from those faced by historically oppressed groups—such as women—or other groups who experience systemic discrimination, including people of colour and lesbian, gay, bisexual, transgender, and queer (LGBTQ) individuals. While discrimination such as rejection is common for patients with psychosis, they may experience other subtler forms of degradation. The label "patient with psychosis" inherently signifies "a person in need", which is intended to encourage more assistance and compassion [17]. However, the label may also imply stereotypes such as 'incompetence' [18], undermining the perceived ability of individuals to take care of themselves even when patients are functioning well or have achieved recovery. This labeling is particularly salient within healthcare systems, workplace environments, and family caregiving settings. For instance, actions intended to provide support may be perceived as microaggressions if they are seen as unwarranted, potentially eliciting feelings of inadequacy. Thus, there is a critical need to explore the various factors that influence the perception of microaggressions experienced by this population.

Ideas of reference (IoR), a common psychotic symptom in patients with schizophrenia, refers to the phenomenon where an individual ascribes strong personal significance to daily occurrences that have low relevance to the individuals themselves [19, 20]. IoR exists on a continuum ranging from milder forms that could be transient to stable, to firm delusions of reference with detrimental impacts on functioning and moods in patients with psychosis [21, 22]. According to the aberrant salience hypothesis, it is proposed that the dysregulation in striatal dopamine in patients with psychosis causes the misattribution of salience to irrelevant stimuli [23]. The impairment in attribution of stimuli means that patients may perceive neutral acts as self-directed with negative connotations, potentially leading to increased perceived experiences of microaggression.

Affective states are also known to be influential towards information processing [24]. People experiencing negative mood states have a greater tendency to process events as unpleasant [25] and neutral stimuli as negative [26]. Studies have shown a relationship between negative mood states, namely anxiety and IoR belief conviction [27]. Similarly, a meta-analysis found that microaggression was associated with higher negative and lower positive affect in individuals with various marginalized statuses [28]. Conversely, other studies suggested that experiences of microaggression could lead to increases in negative mood [29, 30].

To better understand the intricate and dynamic relationship between IoR, microaggression and mood states, it is essential to employ methodologies that could inform causality between the variables. Most previous studies conducted on microaggression adopted a cross-sectional survey assessment [7]. This methodology fails to reflect microaggression in everyday context, as it relies on a recollection of events of the past and is limited in capturing the fluctuations of mood states. A recent review on everyday racial discrimination using experience sampling methodology (ESM) highlighted the advantage of ESM in capturing experiences in real time, which is particularly valuable for detecting microaggressions due to their subtlety and often fleeting forms of discrimination that might be overlooked by traditional retrospective methods [6].

This also allows for collecting data in the context of individuals' daily lives which captures within-person changes [31, 32]. ESM introduces a shorter time lag between the event occurrence and response [33], which improves one's accuracy in the accounting of events and experiences [34]. To the best of our knowledge, there has been only one study that examined microaggression using ESM [29] in the general population. The results found an association between microaggression and negative mood in young gay or bisexual men of colour. However, there has not been any ESM study examining the association between microaggression, IoR, and momentary affective state in patients with psychosis.

Prior ESM studies used a multilevel modeling approach for data analysis to understand the relationship between variables over time at the group level [29, 35, 36]. Recently, novel analytical approaches have been developed to model the causal relationship among variables. Causal discovery analysis (CDA) is a data-driven approach to identify causal relationships between variables, combining graph theory and machine learning, to provide hypothetical causal models [37]. CDA has been used to draw causal inferences about the biomarkers of different mental disorders [38–40] and longitudinal data [41–43], as well as data collected by ESM [44], to identify the causal relationships among different factors and treatment outcomes to inform clinical interventions. Furthermore, heterogeneity exists within the clinical populations that cannot be represented by the traditional nomothetic group level analysis [45]. As an individual ESM dataset contains a large number of observations per person, personal causal models can be constructed [44, 46], providing insight into how the individual models contribute to the group findings. Accounting for the heterogeneity of the sample, the extent of generalisability of group-level findings on individuals within this sample can then be effectively evaluated [47, 48].

Individuals with first-episode psychosis (FEP) are especially vulnerable to stigma [49], experiencing microaggression in everyday life may intensify stigma in individuals with FEP which may result in poorer illness trajectories and engagement with mental health services [50]. Targeted support at an earlier stage of illness may mitigate the long-term impact of stigma and discrimination on recovery and functioning. Hence, this current study aimed to explore the relationship between daily experiences of microaggression, ideas of reference, and momentary affect in patients with first-episode psychosis using ESM. We attempt to understand the possible causal relationship between these variables by applying causal discovery analysis to construct causal models both at a group and individual level. Results will facilitate our understanding of the complex relationship of microaggression, idea of reference, and affect in these patients, and inform possible future intervention development.

Method

Study sample

Participants between 18 and 50 years of age with first-episode psychosis were recruited between January 2021 and May 2022. Patients were recruited from the Early Intervention Service, which provides multidisciplinary phase-specific care to patients with first-episode psychosis of age 15–64 years old, and the transition clinic of Queen Mary Hospital in Hong Kong [51, 52]. Diagnosis of patients was determined by their treating clinicians using The 10th revision of the Internal Statistical Classification of Diseases and Related Health Problems (ICD-10). Patients with a diagnosis of schizophrenia-spectrum disorders, affective disorders with psychotic symptoms, and with less than three years of illness duration, were included. A total of 58 participants were invited to the ESM study and 44 provided consent to the study. It has been suggested that for ESM studies with 28 time points, 40 participants should be sufficient to achieve 80% power with an effect size of 0.1 with 20% missing data [53]. The study was approved by the Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster (Reference number: UW 19–546). This study was conducted in accordance with the Declaration of Helsinki.

Study procedure

A face-to-face clinical assessment was conducted, followed by a two-week ESM assessment. Given that experiences of microaggression may be less frequent on a daily basis, only two assessment points per day were adopted in the current study to prevent oversampling [54]. The Qualtrics links to the ESM questions were sent out to the mobile device of each participant twice a day over two weeks (28 time points or beeps in total). The first notification was sent randomly between 9 am to 1 pm and the second was between 3 pm to 8 pm.

Cross-sectional clinical assessments

Demographic information of patients, including age, gender, and employment status, were collected. Positive and negative symptoms were obtained using the Scale to Assess Positive Symptoms (SAPS) [55] and Scale to Assess Negative Symptoms (SANS) [56] respectively. Internalized stigma was measured using the total score (excluding stigma resistance domain) of the Chinese validated Internalised Stigma of Mental Illness (ISMI) [57, 58], as studies have suggested that stigma resistance is conceptually different from the other domains [59–61]. Stigma resistance was separately measured by ISMI

- stigma resistance domain. Perceived stigma of patients was measured by the total score of the revised Chinese Link's Perceived Discrimination-Devaluation Scale (LPDDS) [62, 63], in which a higher score indicated a higher level of perceived stigma towards individuals with psychosis.

ESM measures

In each ESM assessment, participants were presented with three main sets of questions. The first set of questions was on the affective states of participants who were asked to rate their affect state on six items of a five-point Likert scale based on previous ESM studies [64–66]. The six items included three positive (happy, relaxed, and energetic) and three negative affect states (irritable, stressed, and sad).

The second set of questions was on the experience of microaggression and IoR during the half day before the assessment. The ESM measurement of daily microaggression experiences was developed based on the framework of previous studies on microaggressions [7, 67]. To ensure the comprehensibility and relevance of the questions, four patients, two researchers, and a clinician were invited to examine the content validity of the questionnaire and revisions were made accordingly. There are six items including subtle expressions of others being perceived as offensive, accused of being lazy and over dramatic, being ignored, treated condescendingly, and treated like a child. Four items were modified from the Ideas of Reference Interview Scale (IRIS) [20], focusing on the referential process without specific content on patients' interpretation of the experience, to prevent overlaps with the constructs of microaggression assessed in this study. These include being laughed at by others, being discussed by others, being taken special notice by others, and special references to self on social media. The participants were asked to rate 'yes/no' on whether they had encountered the listed experiences and more than one experience could be selected. The questionnaire takes two minutes to complete.

The third set of questions included a question on oversensitivity, "Do you think that you are oversensitive to the words and actions of others?", it was rated on a five-point Likert scale ranging from never to always. In addition, respondents who reported positively on the microaggression or IoR assessment were asked to select the reason(s) behind the microaggression or IoR experiences. Only responses of perceived microaggression experience due to the **diagnosis of psychosis** or **illnesses-related characteristics** [68], were included in the analysis.

Statistical analyses

Participants who had completed at least 60% of the assessment time points were included in the analysis. The Mann-Whitney U test was conducted to compare the demographic, clinical, and stigma-related variables between the participants included in the analysis and those who were not.

The multilevel regression modeling [35] approach was first used to investigate the relationship between daily experiences of microaggression and ideas of reference at the group level. As the repeated observations were nested within the individuals for ESM data, the participant-specific random effect was used to control for the clustering of the multiple responses within participants. The total number of microaggression experiences was entered into the regression model as the outcome variable. The total score of positive and negative affect were calculated by summing up the ratings of the six positive and negative affect items (three each) respectively, and entered into the multilevel regression model as separate variables. The total number of IoR items reported by the participants was also entered as an independent variable. Age, gender, internalised stigma, stigma resistance, perceived stigma, positive, and negative symptoms were included in the regression model. The multilevel regression analysis was conducted using the lme4 version 1.1.30 [69] and lmerTest version 3.1.3 [70] packages in R (version 4.2.1).

A group causal discovery analysis was conducted on the ESM data to identify the causal relationships among the different affect states, IoR, and experiences of microaggression. Lagged variables were created for the number of IoR reported and each mood state to encode the values of the variables of the previous assessment. The Greedy Fast Causal Inference (GFCI) algorithm [71] for continuous variables was used to establish the best-fitting causal graph for the causal relationships between the six affect items, IoR, their lagged versions, and experiences of microaggression. GFCI enables the detection of potentially bidirectional relationships by evaluating directionality in a data-driven manner, without imposing a priori assumptions. The GFCI analysis was conducted using the causal-cmd software package version 1.1.3 (https://github.com/bd2kccd/causal-cmd). A temporal condition was set so that the variables could be causal for the lagged variables [48]. Structural equation modeling (SEM) was then applied to quantify the strength and sign of the causal relationships using the causal graph from GFCI and the ESM data. The strength was shown with a standardized r value varying from – 1 (strongest negative relationship) to 1 (strongest positive relationship), with a value closest to 0 representing the weakest relationship. Causal discovery analyses on the ESM measurements for individuals were also conducted to estimate individual causal models.

Table 1 Comparison of baseline information between participants included and excluded in the analysis

	Included[a] (*n* = 36)	Excluded[1a] (*n* = 22)	Between-group differences	
			Test statistic	*p*
Gender (N, %)			$\chi^2 = 0.00$	0.985
Male	13 (36.11)	8 (36.36)		
Female	23 (63.89)	14 (63.64)		
Age (In Years), S.D.	28.39 ,7.65	30.05, 7.33	U = 338.00	0.352
Duration of Illness (In Years), S.D.	1.79, 1.43	2.30, 1.55	U = 320.00	0.223
Diagnosis (N, %)			$\chi^2 = 1.13$	0.287
Schizophrenia spectrum	34 (94.44)	19 (86.36)		
Affective disorder with psychotic features	2 (5.88)	3 (13.63)		
Employment status (N, %)			$\chi^2 = 2.98$	0.226
Unemployed	6 (16.67)	6 (27.27)		
Competitive employment	23 (63.89)	15 (68.18)		
Others[2]	7 (19.44)	1 (4.55)		
ISMI total[3] (S.D).	2.14 (0.42)	2.07 (0.51)	U = 381.00	0.810
Stigma resistance[4] (S.D.)	2.73 (0.35)	2.70 (0.41)	U = 373.50	0.715
LPDDS (S.D.)	2.49 (0.51)	2.58 (0.61)	U = 316.50	0.202
SAPS (S.D.)	5.03 (10.08)	3.14 (5.19)	U = 376.50	0.723
SANS (S.D.)	15.19 (12.88)	17.36 (17.13)	U = 388.50	0.904

[a]All values are mean (SD) unless otherwise indicated

[1]Excluded participants include those who have rejected and dropped out from the study

[2]Includes homemakers, those under sheltered employment, self-employed, and taking a break from school or work

[3]ISMI total does not include scores from Stigma resistance domain

[4]Stigma resistance domain of ISMI

Abbreviations: LPDDS, Link's Perceived Discrimination-Devaluation Scale; ISMI; Internalized Stigma of Mental Illness inventory; SANS, The Scale to Assess Negative Symptoms; SAPS, The Scale to Assess Positive Symptoms

Results

Out of the 44 consented participants, data from 36 participants were included for analysis (Supplementary Fig. 1 for the subject recruitment flowchart). The mean age was 28.3 years ($SD = 7.65$), 63.9% were female, and the mean duration of illness was 1.79 ($SD = 1.43$). There were no significant differences in the demographics and clinical variables between participants that were included and excluded in the analysis (Table 1). A total of 197 out of 950 ESM assessments (20.7%) reported experiences of microaggression, and a total of 256 out of 950 ESM assessments (26.9%) reported experiences of IoR across the 2-week study period. The most reported experience of microaggression was receiving insulting comments (25.38%), while the most reported IoR was being taken special notice by others (32.42%). Participants attributed the cause of the experiences to their actions most of the time (49.75%) (Supplementary Table 1).

Table 2 Multilevel regression of IoR, momentary affects, clinical and baseline variables on daily microaggression

Outcome variable: Daily microaggression (number of)			
	B	SE	p
Intercept	0.33	0.39	0.393
ESM variables			
Ideas of reference (number of)	0.40**	0.04	< 0.001
Oversensitivity	0.03	0.03	0.366
Positive affect	-0.02	0.01	0.077
Negative affect	0.03**	0.01	0.007
Clinical Variables			
SAPS	0.00	0.00	0.333
SANS	0.00	0.00	0.392
Baseline variables			
ISMI total[1]	-0.00	0.00	0.888
Stigma resistance	0.01	0.02	0.550
LPDDS	-0.06	0.08	0.411
Age	-0.01	0.00	0.174
Gender	-0.08	0.08	0.310

*$p < .05$, **$p < .01$ (2-tailed)

[1]ISMI total does not include scores from Stigma resistance domain

Abbreviations: LPDDS, Link's Perceived Discrimination-Devaluation Scale; ISMI; Internalized Stigma of Mental Illness inventory, SANS: Scale of Assessment of Negative Symptoms, SAPS: Scale of Assessment of Positive Symptoms

The multilevel regression model that included both ESM and baseline items found that IoR ($B = 0.421$, $SE = 0.036$, $p < .001$) and negative affect (sadness, irritable and stressed) ($B = 0.030$, $SE = 0.012$, $p = .009$) were positively associated with experiences of microaggression, while a trend of significant negative association between positive affect (happiness, relaxed and energetic) and microaggression experiences was found ($B = -0.020$, $SE = 0.010$, $p = .077$) (Table 2). None of the cross-sectional clinical or baseline variables were significantly associated with microaggression.

The group level causal discovery analysis using the GFCI algorithm is shown in the partial ancestral graph in Fig. 1. The temporal structure reveals both immediate and lagged relationships. Lagged effects demonstrate how previous states influence subsequent experiences, while momentary effects show immediate within-time-point associations. For example in Fig. 1, Stressed_lag has a positive causal relationship ($r = .13$) to Stressed. This means that if the individual experienced more stress previously it will be positively causal for higher stress now. This would represent in essence a positive feedback loop.

In the graph, only direct edges from the GFCI algorithm are shown, with the standardised edge weights from the SEM. Correlation coefficients range from small (r = .10–0.11) to moderate (r = .43–0.44) [72]. For the group model, GFCI identified two causal pathways for Microaggression, the first through Happiness (r = – .126, p < .001) and the second through IoR (r = .113, p < .001), such that lower happiness and higher number of ideas of

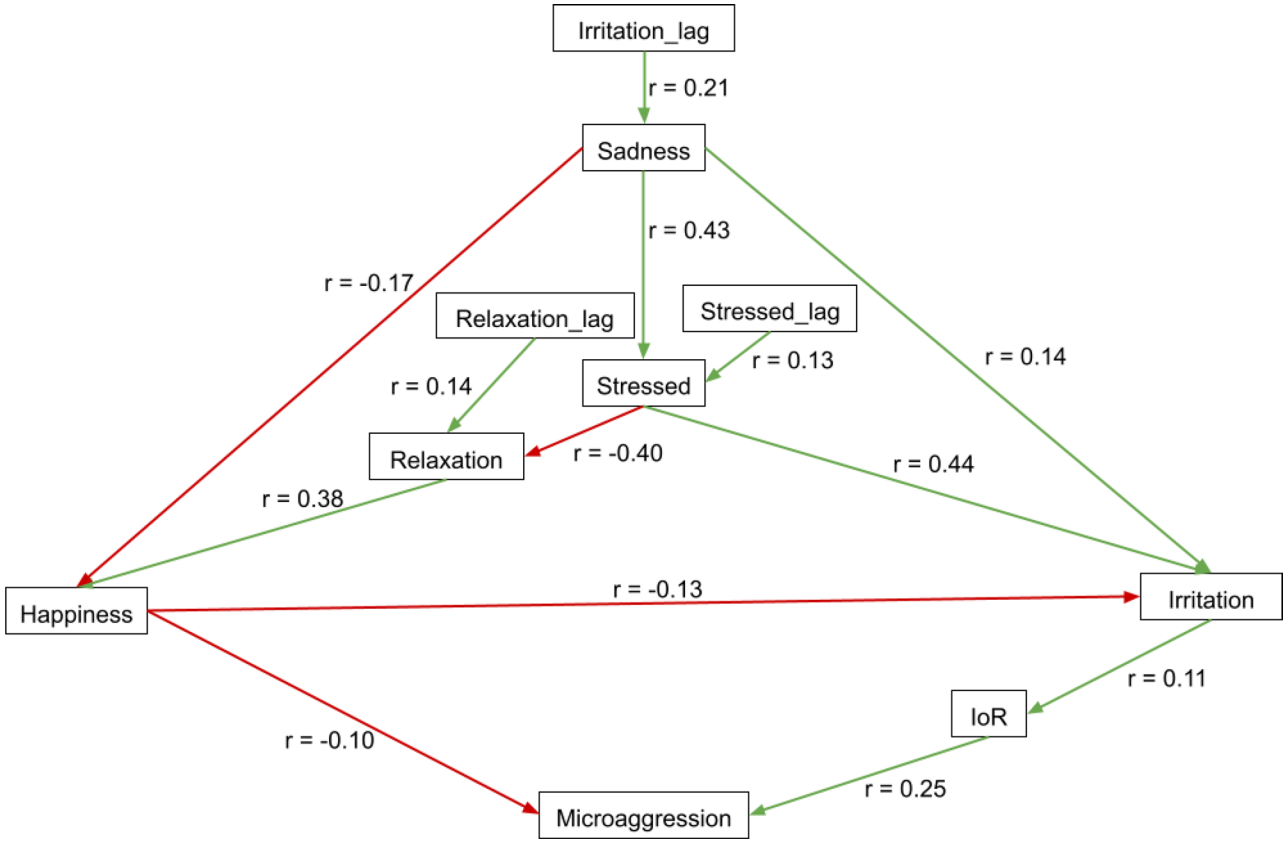

Fig. 1 A group causal graph on paths leading to experiences of microaggression. Notes. Only statistically significant directed paths are shown (all $p < .001$). Abbreviations: IoR, ideas of reference. The directed arrows indicate the direction of causal influence between variables. Lagged variables (denoted with '_lag') represent measurements from the previous time point. Green lines represent positive causal effects and red lines represent negative causal effects

reference were causal for microaggression experiences (Fig. 1).

Personal causal models on microaggression of each individual were also prepared. The mean and distribution of effect sizes of each variable on microaggression are shown in Fig. 2. Similar to the group causal model, momentary and lagged negative affect and IoR were found to positively influence microaggression, whereas momentary and lagged positive affect negatively influenced microaggression. However, heterogeneity within the sample was observed with effect sizes of each factor varying among individuals and different individual has different causal paths for microaggression experiences, including reverse pathways, such as microaggression leading to increased experiences of IoR (Supplementary Fig. 2b) or fewer microaggressive experiences leading to happiness (Supplementary Fig. 2c). Figure 3 displays the individual profiles for the variables causal for microaggression.

Discussion

This study examined the dynamic relationships between daily experiences of microaggression, IoR, and momentary affect, using the ESM within the daily lives of participants with first-episode psychosis. Thirty-six patients completed the ESM study and were included in the analysis. We conducted a multilevel regression and found that more experiences of IoR, lower levels of positive affect (i.e. happy, relaxed, and energetic) and higher levels of negative affect (i.e. sad, stressed, and irritable) were significantly associated with more experiences of microaggression after controlling for demographic and clinical variables. We further used Causal Discovery Analysis to examine the nature and direction of the relationships between the variables of interest. The group causal model identified two causal pathways leading to microaggression. One pathway leads to microaggression through IoR, which was in turn influenced by other negative momentary and lagged affects (i.e. sadness, stressed and irritable). The other leads to less microaggression through increased happiness, which was influenced by lagged and momentary relaxation. High heterogeneity was shown in

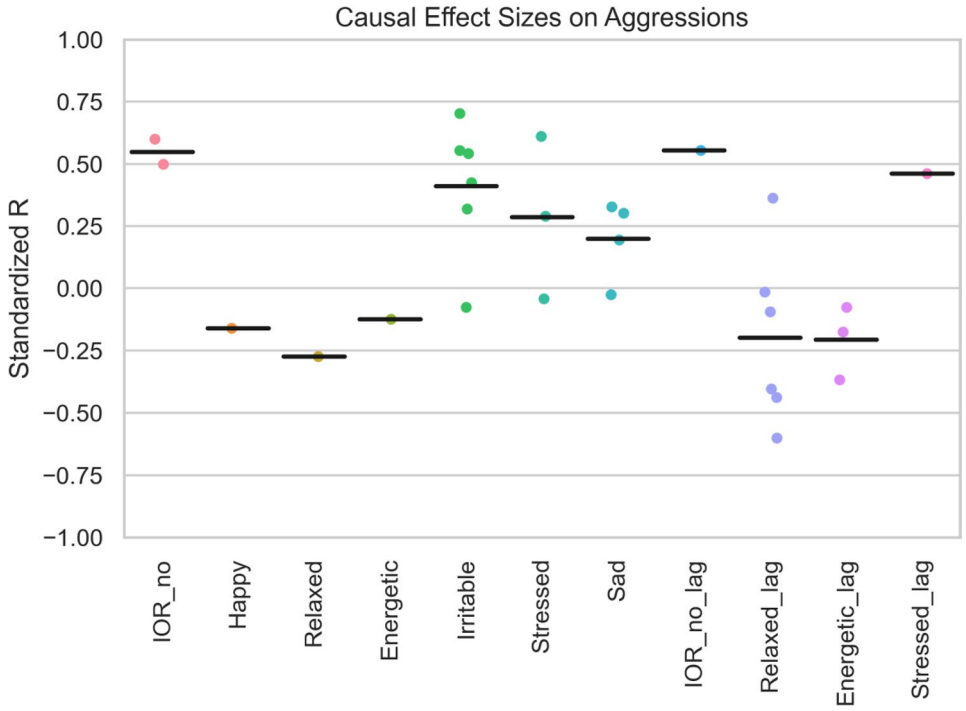

Fig. 2 Effect sizes of momentary and lagged IoR and affective states on microaggression experiences. Notes. The lines represent the group average for each variable and the dots represent the individuals. All individuals ($n = 12$) which reported a significant causal relationship between momentary and lagged IoR, positive and negative mood states and microaggression are shown in this figure ($p < .05$). 24 individuals did not report a significant causal relationship between variables and microaggression. One individual may have more than one causal relationship

the relationship of microaggression when personal causal models were examined.

People with ideas of reference (IoR) tend to perceive neutral and non-self-directed experiences as self-directed [73]. In the current study, only perceiving self-directedness from others or media was assessed as IoR without considering the content of those perceptions. This helps to reduce the possible overlapping nature between microaggression and perceiving IoR with negative content as aggressive. Though a previous study has found that being avoided is most frequently experienced by individuals with schizophrenia as ill-treatment [74], the current study found that the most prevalent microaggression experienced by the subjects in this study was being insulted, followed by others acting condescending towards the individual. This result is similar to a previous review of qualitative studies suggesting that patients frequently experience mockery, including the superficial and careless use of psychiatric terms in everyday language [75, 76]. The multilevel regression analysis of our study found that both IoR and negative affect had a positive association with microaggression and a negative association between positive affect and experiences of microaggression. This suggests that the tendency to judge stimuli as self-directed and having negative momentary affect, may play a part in driving the interpretation of stimuli as aggressive and increase saliency to microaggressive stimuli.

While the regression analysis provides a correlational understanding of the different variables, the data-driven causal discovery analysis (CDA) approach allows the exploration of the possible causal relationship of different variables in ESM data obtained over a period of time [44, 46]. Results of the group CDA analysis of the current study found two significant pathways leading to perception of microaggression. Though some with small effect sizes, they represent meaningful patterns happening in everyday life that may cumulatively affect recovery outcomes of patients over time. One pathway is through having negative affect, such as sadness, which leads to feeling irritated, which in turn leads to an increase of IoR, and finally leads to the perception of microaggression. These results echo the findings of the multilevel regression analysis, further explaining how the self-directedness judgment of stimuli and negative affect influence the perception of microaggression that negative mood may cause an increase of IoR, which then leads to the perception of microaggression. This is supported by earlier association findings between affect and IoR [20, 73]. The other pathway found from the CDA suggested that feeling relaxed leads to an increase in happiness, which then leads to a reduction in the perception of microaggression. These results again indicate that affect or mood

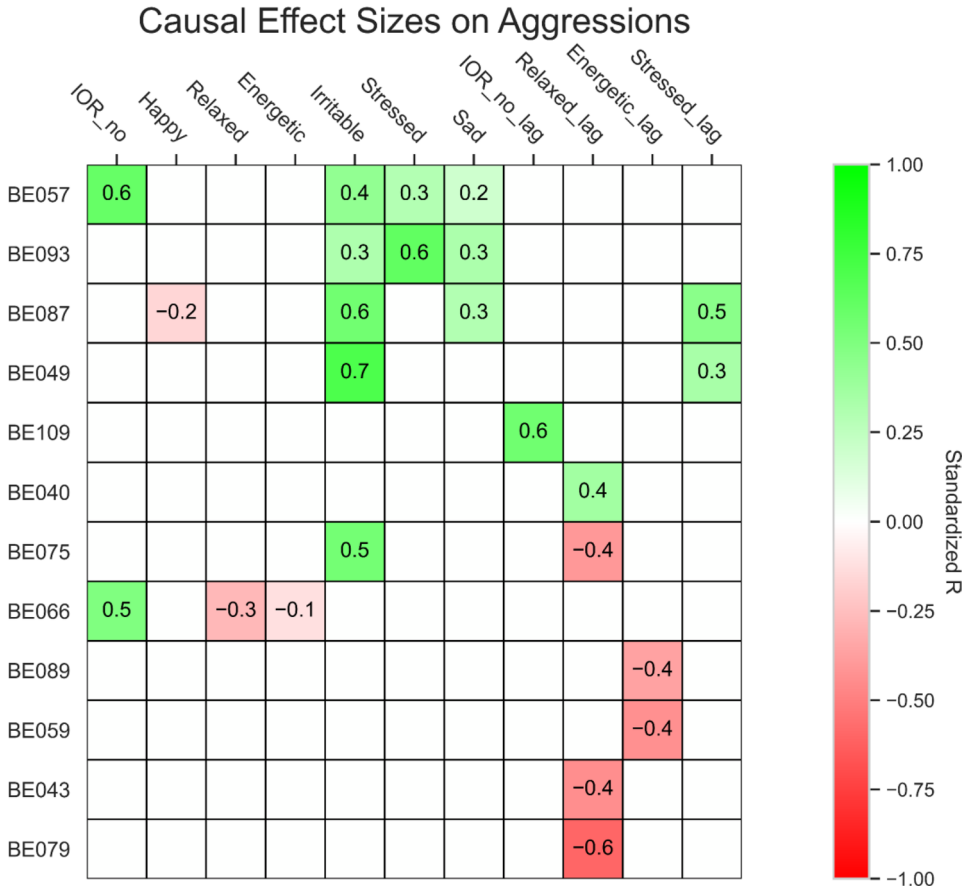

Fig. 3 Individual Profiles of the causal effect of momentary and lagged IoR, mood states on microaggression. Notes. Y-axis: anonymized participant codes to indicate results of each participant; X-axis: momentary and lagged (denoted with '_lag') no. of IoR and mood states variables. Green represents a positive relationship between the variable and microaggression whereas red represents a negative relationship. The gradient of colour represents the strength of the variable in influencing microaggression. All individuals ($n = 12$) with significant relationships between the variables and microaggression were shown in this figure ($p < .05$). 24 individuals did not report a significant causal relationship between variables and microaggression

could be a possible interventional target for the reduction of microaggression and possibly IoR. This suggests that social cognition interventions focused on emotional regulation [77] may help decrease the perception of self-directed stimuli and microaggression in this population, indirectly addressing their attributional biases towards self. Additionally, the results could inform the development of metacognitive training aiming for reducing delusional thinking [78], highlighting the potential to gently introduce doubt to patients' perception of self-directed stimuli and microaggression experiences, through reflecting the impacts of their internal emotional processes. Therefore, identifying momentary affects as immediate therapeutic targets and providing strategies to alter them sustainably in psychosocial interventions may help decrease the perception of self-directed stimuli and microaggression in this population.

Apart from nomothetic analysis, the ESM data allowed for a more idiographic approach to the analysis. Personal causal models of microaggression were constructed and demonstrated the individual heterogeneity of the variables' causal relationship with microaggression. Some individual models like the group causal model, momentary and lagged negative affect and IoR were found to be causal for microaggression, whereas momentary and lagged positive affect were causal for less microaggression experience (Supplementary Fig. 2a). However, some individual models showed a reverse model between microaggression and IoR (Supplementary Fig. 2b). Moreover, previous experiences of microaggression were found to influence future perceptions of microaggression experiences (Supplementary Fig. 2c). These observed individual heterogeneity aligns with the subjective and environment-dependent nature of microaggression. While at a group level, the path of increased referential thinking and affective dysregulation was significant in contributing to microaggression experiences, at an individual level, the relationship could be reversed. This highlighted that the perception of microaggressions is a unique process that differs for each individual, even among those with the same minority label. Interpretations and reactions to perceived microaggression depend on previous personal

experience in social interactions and cognitive schemas of the world and themselves. That is not all perceptions of microaggression of individuals with psychosis were because of individual affect. The contribution of environmental factors and the presence of devaluing comments should also be addressed. This underscores the critical role of case formulation in understanding the contributing factors of the perception of microaggression experiences for each individual, enabling the development of personalised interventions to mitigate their impact. More importantly, personal CDA analysis on ESM data demonstrated a potential in graphing individualised profiles of perception and microaggression experiences, which can be integrated into treatment plans to tailor psychosocial intervention strategies. Such an approach not only has the potential to enhance the therapeutic effectiveness, but also allow for more comprehensive appraisal of the situation and uphold patient dignity by preventing victim blaming.

Furthermore, microaggressions are considered as subtle and recurrent discriminatory acts experienced by marginalized individuals [3, 79] and have been suggested to be related to internalized stigma [79, 80]. However, the current study did not find a significant relationship between perceived stigma and microaggression in the multilevel regression analysis. One possibility is that the current sample generally has a low level of internalized stigma and a moderate level of stigma resistance compared to the average reported in the most recent meta-analysis [81]. Though one's conception of self is not easily changeable and internalized stigma could be deeply ingrained [82], the time lag between patients' completion of the baseline assessments (of internalized and perceived stigma and stigma resistance) and their participation in the ESM study may possibly introduce factors leading to changes of internalized stigma. Nevertheless, current results suggest that momentary affective states and the presence of IoR (or delusions of references) are more influential on experiences of microaggression compared to pre-existing levels of stigma or stigma resistance. These results also reflect the subjective nature of microaggression, and that one's interpretation of an act is crucial in daily life [83]. Microaggression should therefore be studied separately from more blatant acts of discrimination to gain better insight into the daily experiences of patients with psychosis.

One of the key limitations of this study is the small sample size, which might have limited the power of the study to examine the relationships between variables. Although there were no significant differences in basic demographics and clinical variables between the participants included in this study and the whole sample, the possibility of selection bias remains. Our study included a higher proportion of female participants (69.4%) compared to the gender distribution reported in a cohort study of 617 participants from the same first-episode program in Hong Kong (48.5% female) [84]. The difference in gender proportion may result in an under-representation of the experiences of male individuals with psychosis in our findings. Another prominent limitation of this study is the lack of measurement of other minority statuses of participants. While the current study focused on illness-related microaggressions, the microaggression experience of participants may be affected by multiple factors. Apart from measuring gender, no information was collected on their sexual orientation, acceptance of gender identity, or racial and nationality profile. These social groups were often the victims of microaggression. Without acknowledging other minority statuses, the intersectionality between forms of microaggressions such as racial or sexual orientation could not be examined. To limit the scope of the study to microaggression experienced due to their psychotic illness, gender was controlled in the analysis. Only ethnically Chinese participants were recruited, as they comprised 91.6% of the population in Hong Kong [85]. Also, only microaggressions that were reported to be illness-related by the participants were included in the analysis. This approach reduced the possibility of intersecting with gender and racial microaggression. Therefore, it is important to interpret the result within the cultural context of Hong Kong and the scope of psychotic illness. Comparison with other populations in other cultural climates with more diverse racial profiles has to be made with caution. Additionally, future studies examining microaggressions could collect data on the participants' cultural background, gender identity or sexual orientations to investigate the intersecting effects of different forms of microaggression.

Additionally, the ESM only spanned for two weeks, which may not capture the impact of cumulative microaggression accurately. However, no significant association was found between the number of microaggressions and internalised stigma in the current study, indirectly suggesting that the influence of previous and cumulative microaggression was weak in the current sample, despite previous studies suggesting otherwise [79, 80]. Furthermore, patients were required to respond to questions that explicitly asked about their microaggression experiences repeatedly, with affect being addressed first. This may lead them to reinterpret events based on their mood and perceive neutral events as aggressive. Moreover, while the relationship between referential ideation and perceived microaggressions hinted at the relevance of positive symptoms, these were only assessed by trained clinician at baseline using SAPS but not included in self-reported EMA. Hence, their relationship was not explored in the CDA model. Future studies could examine how positive

symptoms interact with affect and IoR in relation to microaggressions.

Finally, due to the nature of the study, only patients who are smartphone users were included. Therefore, patients who were less technology savvy, and those who could not afford smartphones or data plans, were not included in this study. Furthermore, only patients from the outpatient settings were included. Thus, the results of this study may not be generalizable to other patients. The current study relied on self-reported measures of mood state, experiences of IoR, and microaggression, and the reliability of these reports was difficult to establish.

Conclusion

Despite the limitations, to our knowledge, this is the first study using ESM to understand the dynamic relationship between IoR, momentary affect state, and experience of microaggression in the psychosis population. The utilization of the data-driven causal discovery analytical approach allows for the understanding of such dynamic relationships at the individual level and highlighting heterogeneity in the pathways leading to microaggression within each individual. Furthermore, it potentially paves a way for a better understanding of the nature of microaggression in patients with psychosis, and facilitates the development of tailored intervention strategies for individuals. Future studies with larger sample sizes will be needed to replicate the results of this study.

Abbreviations

IoR	Ideas of reference
ESM	Experience sampling method
CDA	Causal Discovery Analysis
LGBTQ	lesbian, gay, bisexual, transgender, and queer
FEP	First-episode Psychosis
EIS	Early Intervention Service
ICD-10	The 10th revision of the Internal Statistical Classification of Diseases and Related Health Problems
SAPS	Scale to Assess Positive Symptoms
SANS	Scale to Assess Negative Symptoms
ISMI	Internalised Stigma of Mental Illness
LPDDS	Link's Perceived Discrimination-Devaluation Scale
IRIS	The Ideas of Reference Interview Scale
GFCI	The Greedy Fast Causal Inference
SEM	Structural equation modeling

Supplementary Information

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Supplementary Material 1

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Author contributions

MYS and CTWW share the first authorship. MYS is the investigator who designed the study with SKWC, KL and YNS. MYS is the major contributor to data collection with the help of STC and HKHT. MYS conducted the data analysis with SKWC and KL. MYS and CTWW wrote the original draft, and CTWW was the major contributor in writing the manuscript with the assistance from SKWC and KL. CTWW and MYS revised the manuscript with SKWC. All authors approved the final manuscript.

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Data availability

The datasets used and/or analysed during the current study are available from the corresponding author, Sherry Kit Wa Chan on reasonable request.

Declarations

Ethics approval and consent to participate

The study was approved by the Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster (Reference number: UW 19–546). Written informed consent was obtained before participating in this study.

Consent for publication

Not Applicable.

Competing interests

The authors declare no competing interests.

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