Research Article

Association Between Viewing Social Virtual Reality–Based Peer Dialogue and Perceived Public Stigma Toward Mental Illness Among University Students: A Longitudinal Observational Study of Viewers of a Television Program

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Background: Perceived public stigma toward mental illness—the belief that others hold negative views about people with mental illness—remains a major barrier to social inclusion and help-seeking.

Aim: To examine whether viewing social virtual reality (VR)–based peer dialogue is associated with changes in perceived public stigma toward mental illness among university students.

Design: Single-center longitudinal observational study.

Methods: University students viewed an episode of a Japanese public television program depicting peer dialogue among adolescents with psychiatric disorders in a social VR environment. Participants completed self-administered questionnaires before viewing, immediately after viewing, and three months later. Perceived public stigma was assessed using the Perceived Devaluation and Discrimination (PDD) scale. Depressive symptoms were assessed using the Patient Health Questionnaire-9 (PHQ-9). Changes over time were analyzed using linear mixed-effects models.

Results: Of 183 students initially approached, 127 completed the baseline assessment, 115 completed the post-viewing assessment, and 96 completed all three assessments. Perceived public stigma significantly decreased immediately after viewing and remained lower at the three-month follow-up ($p = .003$, $\eta p^2 = 0.051$). Reductions appeared to be greater among participants with higher baseline

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stigma levels. The results remained consistent in sensitivity analyses. Depressive symptoms showed no immediate worsening, and levels remained low throughout the follow-up.
Conclusion: Viewing social VR–based peer dialogue was associated with reductions in perceived public stigma among university students, with effects sustained over three months.
Implications for the profession and/or patient care: Social VR–based peer narratives may offer a scalable approach for reducing mental health stigma in educational settings, with potential implications for nursing practice and mental health promotion.

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Impact

What problem did the study address?

Perceived public stigma remains a barrier to mental health help-seeking among young adults.

What were the main findings?

Viewing VR-based peer dialogue was associated with sustained reductions in perceived stigma, particularly among those with higher initial stigma levels.

Where and on whom will the research have an impact?

These findings may inform stigma reduction interventions in university settings and among young adults without direct mental health experience.

Reporting Method

This study adhered to STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines.

Patient or Public Contribution

No patient or public involvement: This study did not include patient or public involvement in its design, conduct, or reporting.

Introduction

Stigma toward people with mental illness remains a major public health concern, contributing to social exclusion, reduced help-seeking, and delayed access to care. Perceived public stigma—beliefs about how others view people with mental illness—is sustained through prevailing cultural narratives and is difficult to modify through individual-level interventions alone, underscoring the need for scalable approaches that can influence public attitudes.

Narrative-based media interventions have demonstrated efficacy in reducing mental health stigma. Grounded in intergroup contact theory and narrative persuasion frameworks, these interventions expose audiences to first-person accounts from people with mental health problems, increasing empathy, facilitating perspective-taking, and challenging negative stereotypes. A meta-analysis of 40 studies found a small but consistent effect of narratives in reducing stigma, with first-person narratives demonstrating superior effectiveness[1]. Recent research on public disclosures identified specific factors associated with stigma reduction, including explicit diagnoses, emphasis on psychosocial causes, and audience empathy toward disclosers[2]. However, authentic disclosure faces a critical barrier: many individuals with mental illness prefer anonymity when sharing personal experiences, creating tension between genuine narratives and privacy protection.

Social virtual reality (VR) environments, in which users interact through avatars, may address this tension. Avatar representation may reduce social evaluative threat and enhance psychological safety, enabling communication about sensitive topics without revealing physical appearance or identity. Our previous research found that participation in avatar-mediated peer dialogue within a VR-based television program was associated with improvements in resilience and depressive symptoms among adolescents with psychiatric disorders[3]. The avatar-mediated format appeared to facilitate authentic emotional disclosure that participants indicated would have been difficult in face-to-face settings.

These findings suggest that VR-based avatar dialogue may benefit direct participants therapeutically. However, an important question remains unanswered: can the authentic narratives generated within VR environments—when transmitted through broadcast media—influence viewers who observe but do not directly participate? This question has both theoretical and practical significance. Theoretically, it addresses whether authentic peer dialogue enabled by VR can reduce perceived public stigma among observers, extending the impact beyond direct participants. Practically, if effective, VR-based programs could serve both therapeutic and public health roles as therapeutic interventions for participants and

public health tools for broader audiences. These potential benefits warrant further empirical investigation.

To address this question, we conducted a viewer study using Project Aliens, a VR-based peer dialogue television program produced by NHK (NIPPON HOSO KYOKAI; Japan Broadcasting Corporation). While our previous study examined therapeutic effects among adolescent participants in an earlier episode of this program[3], the current study examined whether university students who viewed a subsequent episode showed reductions in perceived public stigma toward mental illness. We selected university students (aged 18-25) as our target population because this age group represents the peak period for psychiatric disorder onset, making stigma reduction particularly relevant. In exploratory analyses, we examined whether baseline stigma level moderated program effects, as prior research suggests that individuals with stronger negative attitudes may show greater change following exposure to counter-stereotypical narratives.

Methods

Study Design

This was a single-center, longitudinal observational study examining changes in perceived public stigma toward mental illness among university students who viewed an episode of Project Aliens, a social VR–based television program broadcast on Japanese public television.

Participants

Eligibility Criteria

Eligible participants were undergraduate students enrolled at Yokohama City University who met the following inclusion criteria: (1) aged 18-25 years, and (2) able to provide informed consent. Exclusion criteria included: (1) severe cognitive impairment precluding completion of self-report questionnaires, (2) difficulty understanding Japanese, and (3) current or planned employment in mental health professions such as psychiatrists, psychiatric nurses, psychiatric social workers, clinical psychologists, certified psychologists, occupational therapists, or related professions, as professional training may systematically influence stigma-related attitudes.

Recruitment, Consent, and Ethical Considerations

Participants were recruited during a university lecture at the School of Economics and Business Administration, Yokohama City University, on October 27, 2025. The study was introduced during a regularly scheduled lecture session, and interested students received detailed information via an online platform (Microsoft Forms). Participation was entirely voluntary, and students were explicitly informed that their decision to participate would not affect their academic standing. Electronic informed consent was obtained prior to participation. To ensure confidentiality and minimize response bias, the lecture instructor had no access to individual response data.

The study was conducted in accordance with the Declaration of Helsinki and the Ethical Guidelines for Medical and Health Research Involving Human Subjects in Japan and approved by the Ethics Committee of Yokohama City University (approval number: General 2025-040). Data were collected anonymously, with no personally identifiable information linked to questionnaire responses. Participants were informed that they could withdraw at any time without penalty. Because the program included emotionally sensitive content, information about available mental health support resources was provided at each assessment point, with contact information for the university counseling center included in all questionnaires. No adverse events were reported.

Television Program Description

Participants viewed Episode 10 ("Difficulties in Interpersonal Relationships") of Project Aliens, a VR-based peer dialogue television program produced by NHK, during a lecture on October 27, 2025. The episode had been broadcast on September 14, 2025. Episode 10 followed the program's standard format, featuring four adolescent participants. The episode included brief self-disclosure videos in which participants shared their mental health experiences, followed by avatar-mediated dialogue within a space journey narrative framework facilitated by Moon Rabbit, a virtual character portrayed by a professional performer. Over the course of the 45-minute episode, the dialogue unfolded across four virtual scenes—Cityscape (Shibuya), Spaceship, Spaceport, and the Moon—designed to support progressively deeper emotional disclosure and peer interaction. Participants discussed their mental health experiences, including diagnoses, symptoms, treatment, and daily challenges, with considerable emotional depth and authenticity. The program concluded with three segments: follow-up interviews showing participants' ongoing challenges, encouraging comments from the facilitator, and clinical commentary by a child

psychiatrist (JF, the principal investigator of the current study, identified by name and institutional affiliation) discussing the therapeutic value of peer dialogue and shared emotional experiences.

Measures

Primary Outcome: Perceived Public Stigma

Public stigma toward mental illness was assessed using the Japanese version of the Perceived Devaluation and Discrimination (PDD) scale[4]. The PDD consists of 12 items measuring the extent to which respondents believe that most people devalue and discriminate against individuals with mental illness. Items are rated on a 4-point Likert scale (1 = strongly disagree to 4 = strongly agree), and total scores range from 12 to 48, with higher scores indicating greater perceived public stigma. The scale has demonstrated adequate reliability and validity in Japanese populations. In the current sample, internal consistency was good (Cronbach's $\alpha = 0.85$). The PDD assesses perceived public stigma—respondents' perceptions of how most people in society view individuals with mental illness—rather than respondents' own personal stigmatizing attitudes or discriminatory behaviors[5]. This distinction is important because perceived public stigma reflects individuals' beliefs about societal attitudes and may differ from their personal views.

Secondary Outcome: Depressive Symptoms

Depressive symptoms were assessed using the Japanese version of the 9-item Patient Health Questionnaire (PHQ-9)[6]. The PHQ-9 assesses the presence and severity of depressive symptoms over the past two weeks, with total scores ranging from 0 to 27; higher scores indicate more severe symptoms. Severity categories are 0–4 (minimal or none), 5–9 (mild), 10–14 (moderate), 15–19 (moderately severe), and 20–27 (severe). The PHQ-9 has demonstrated good reliability and diagnostic validity in Japanese populations. In the present study, it was included as a safety outcome to evaluate whether exposure to emotionally salient mental health narratives resulted in worsening depressive symptoms among viewers.

Demographic Information

At baseline, participants self-reported age and sex.

Procedure

Data were collected at three time points: (1) immediately before viewing the program (baseline), (2) immediately after viewing (within 10 minutes of program completion), and (3) three months after viewing. All assessments were administered online via Microsoft Forms. The program was viewed during a lecture session on October 27, 2025. All participants viewed the program simultaneously in a university lecture hall under standardized conditions. Baseline and immediate post-viewing assessments were completed during the same session. The 3-month follow-up assessment was conducted during a subsequent lecture session on January 26, 2026.

Statistical Analysis

The target sample size of approximately 80 participants was determined based on feasibility within the recruitment period. Assuming a 10% attrition rate and an expected standard deviation of 5 points on the PDD scale, a sample of 72 completers would provide an 80% probability that the 95% confidence interval for the mean change would be within ±1.25 points of the true population mean.

The analysis sets were the Full Analysis Set (FAS; all participants with a baseline PDD assessment, n = 127), the Per-Protocol Set (PPS; n = 96 with complete data at all time points), and the Safety Analysis Set (SAS; n = 127 with baseline data).

Primary Analysis

A linear mixed model (LMM) was used to examine changes in PDD scores (primary outcome) and PHQ-9 scores (secondary outcome) across three time points (pre-viewing, immediate post-viewing, 3-month follow-up). The LMM was selected to optimally use all available data and handle missing data under the missing at random assumption. The models included time as a fixed effect (pre-viewing as the reference) and random intercepts for participants. Parameters were estimated via restricted maximum likelihood with the Satterthwaite approximation for degrees of freedom. Post hoc pairwise comparisons were conducted using the Bonferroni adjustment.

Exploratory Analysis

To explore whether baseline stigma moderated program effects, participants were stratified into lower and higher groups using a median split of baseline PDD scores (median = 29.0). An LMM including a Group × Time interaction was fitted to examine differential effects across baseline stigma levels.

Sensitivity Analysis

To assess robustness to missing data assumptions, we compared baseline characteristics (age, sex, PDD score, PHQ-9 score) between completers (n = 96) and non-completers (n = 31) using independent samples t-tests for continuous variables and chi-square tests for categorical variables.

Additionally, we conducted sensitivity analyses using the same LMM approach with the PPS (participants with complete data at all time points) to verify consistency with the primary analysis results.

Effect sizes were calculated as Cohen's d using baseline pooled standard deviations. All analyses were conducted using IBM SPSS Statistics version 31 (IBM Japan, Tokyo). Statistical significance was set at $p < 0.05$ with Bonferroni correction for multiple comparisons.

Results

Participant Flow and Characteristics

Of 183 students enrolled in the course, 127 completed baseline assessments and viewed the program (Figure 1). Among these participants (n = 127), 115 (90.6%) completed the immediate post-viewing assessment, and 100 (78.7%) completed the 3-month follow-up assessment. Complete PDD data across all three time points were available for 96 participants (75.6%). Participants had a mean age of 20.0 ± 1.1 years (n = 125), and 44.9% were female. The mean baseline PDD score was 28.5 ± 6.1, and the mean baseline PHQ-9 score was 4.1 ± 3.9, indicating minimal depressive symptoms. No significant differences were observed between completers (n = 96) and non-completers (n = 31) in age, sex, baseline PDD, or baseline PHQ-9 scores (all $p > .05$) .

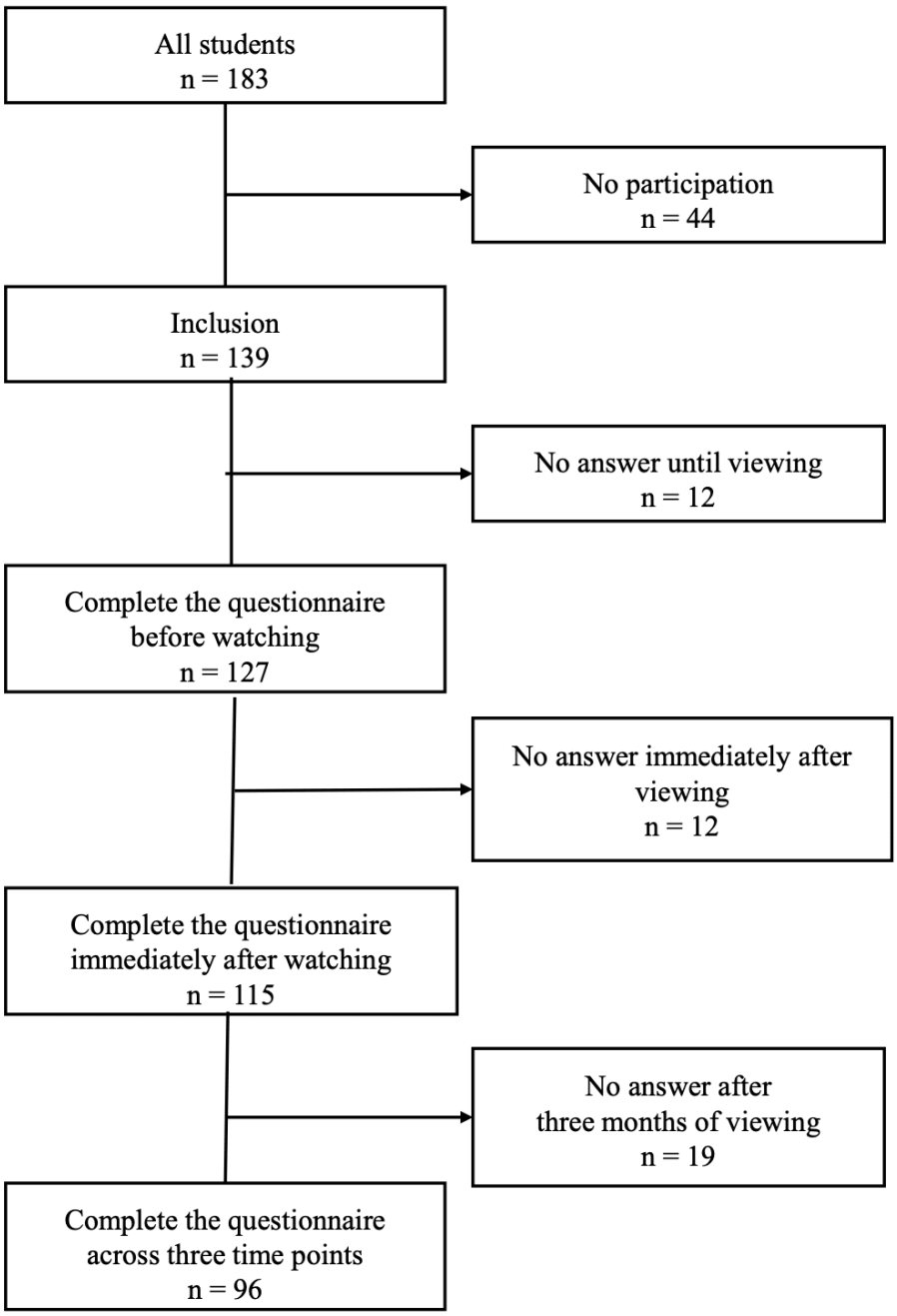

Figure 1. Participant Flow Diagram. **Footnote:** Of 183 students approached, 127 completed baseline (Full Analysis Set), 115 completed immediate post-viewing, and 96 completed all assessments (Per-Protocol Set). The primary analysis used the Full Analysis Set; the sensitivity analysis used the Per-Protocol Set.

Primary Outcome: Perceived Public Stigma (PDD)

Main Analysis (Full Sample)

There was a significant main effect of time on PDD scores ($F(2, 220) = 5.93$, $p = .003$, $\eta p^2 = 0.051$; Figure 2A). Post-hoc pairwise comparisons with Bonferroni adjustment indicated significant reductions in perceived public stigma from baseline to immediate post-viewing ($p = .005$, Cohen's $d = 0.26$) and from baseline to 3-month follow-up ($p = .028$, Cohen's $d = 0.23$). The difference between immediate post-viewing and 3-month follow-up was not significant.

Sensitivity Analysis

To assess robustness to missing data assumptions, we repeated the analysis restricted to participants with complete data at all three time points ($n = 96$). The results remained consistent with the primary analysis (baseline: 28.2 ± 6.5; immediate: 26.8 ± 5.7; 3-month: 26.9 ± 5.5; $F(2, 190) = 3.85$, $p = .023$, $\eta p^2 = 0.039$).

Exploratory Analysis: Moderation by Baseline Stigma

To explore whether baseline stigma level moderated program effects, participants were stratified into lower and higher PDD groups using a median split of baseline scores (median = 29). A linear mixed model analysis revealed a significant Group × Time interaction ($F(2, 222) = 11.71$, $p < .001$, $\eta p^2 = 0.096$), suggesting that changes in perceived public stigma differed by baseline stigma level (Figure 2B).

Participants in the higher baseline stigma group showed significant reductions in PDD scores from baseline to immediate post-viewing ($p < .001$, Cohen's $d = 0.55$) that were sustained at the 3-month follow-up ($p < .001$, Cohen's $d = 0.59$).

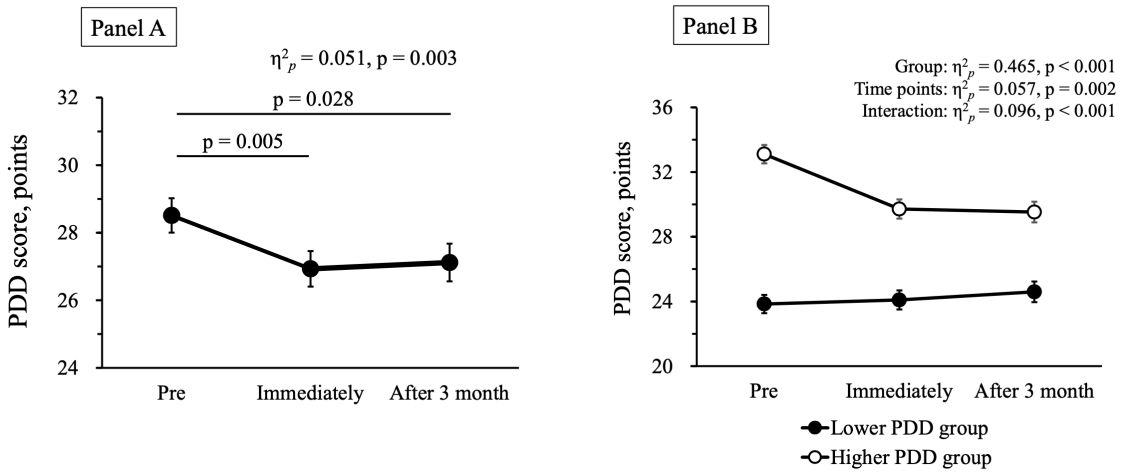

Figure 2. Changes in Public Stigma Over Time. **Panel A:** Full sample trajectory (n=127). **Panel B:** Moderation by baseline stigma (Higher vs. Lower groups). **Footnote:** Mean PDD scores (±SE) at baseline, immediately after viewing, and at the three-month follow-up. Panel A shows overall changes across all participants (n = 127). Panel B demonstrates differential effects based on baseline stigma level, showing that reductions were concentrated among participants with higher initial stigma. Abbreviations: PDD, Perceived Devaluation and Discrimination scale; SE, standard error.

Secondary Outcome: Depressive Symptoms (PHQ-9)

A linear mixed model analysis revealed a statistically significant but small time effect on PHQ-9 scores ($F(2, 214) = 3.76$, $p = .025$, $\eta p^2 = 0.034$). However, mean scores remained within the minimal to mild range throughout the study (baseline: 4.1 ± 3.9; immediate: 3.6 ± 4.2; 3-month: 4.6 ± 4.5). No participants showed clinically significant worsening from baseline to immediate post-viewing. At the 3-month follow-up, 7 participants showed PHQ-9 increases ≥5 points from baseline. No adverse events directly related to program viewing were reported.

Discussion

This longitudinal observational study examined whether viewing social virtual reality (VR)–based peer dialogue was associated with changes in perceived public stigma toward mental illness among university students. We found that perceived public stigma significantly decreased immediately after viewing and remained lower at the three-month follow-up. These findings suggest that viewing peer dialogue in VR environments may be associated with reductions in stigma among observers. Exploratory analyses

revealed that stigma reduction was not uniform across participants but was concentrated among individuals with higher baseline levels of stigma. This moderation pattern suggests that viewers holding stronger initial stigmatizing attitudes may be more responsive to such narratives, though controlled studies are needed to confirm this interpretation.

The observed effects extend beyond direct participants in the VR environment. In our previous participant-focused study, adolescents engaging in avatar-mediated peer dialogue showed improvements in psychological outcomes[3]. The current findings suggest that viewing such dialogues may also reduce stigma among observers who did not directly participate. Although these two studies examined different populations and outcomes, taken together, they suggest that VR-based peer dialogue programs may have value for both direct participants and audiences. Further research, particularly controlled studies with comparison conditions, is needed to determine whether these associations reflect causal effects and whether such programs might contribute to broader mental health promotion efforts.

Perceived public stigma—the belief that others devalue people with mental illness—is often elevated among individuals without personal experience of mental illness. Research has shown that people with lived experience of mental illness report significantly lower stigma toward mental illness compared to those without such experience[7]. While direct interaction with people who have mental illness can reduce stigma, such encounters are not always feasible and may create psychological demands for both parties. A meta-analysis of mediated intergroup contact demonstrated that positive exposure through media can reduce prejudicial attitudes, though the effects are typically smaller than those of direct contact[8]. Complementing this, a broader meta-analysis of real-world contact interventions showed that both direct and indirect forms of contact are effective in reducing prejudice, with effects that persist over time[9]. In this study, university students observed authentic peer dialogue presented in a VR setting. This viewing experience may have functioned as a form of mediated contact that facilitated perspective-taking and empathy without the psychological demands of face-to-face interaction.

In this study, the pattern of change in stigma appeared to vary by baseline stigma level. This pattern is consistent with theoretical frameworks in stigma reduction research. Intergroup contact theory suggests that exposure to counter-stereotypical exemplars can reduce prejudice, with effects potentially being stronger among those with more limited prior contact[10]. Research on narrative persuasion has demonstrated that argument strength has a greater impact on individuals who are initially more skeptical toward the story's message[11]. The present findings align with this perspective: viewers with

elevated baseline stigma appeared more responsive to exposure to authentic peer dialogue grounded in lived experience.

The observed effect sizes were small, consistent with prior research on contact-based interventions conducted in real-world settings, which typically yield modest but reliable effects[9]. Importantly, such interventions have been shown to produce changes that persist over time and generalize beyond the specific individuals involved. While the magnitude of change was modest, the sustained reduction over three months and the larger effects observed among participants with higher baseline stigma suggest potential practical significance. Small but sustained changes in perceived public stigma at a population level may contribute meaningfully to broader shifts in social attitudes toward mental health disclosure.

Several design features of the program may have contributed to the observed effects. Previous research has identified specific message characteristics associated with stigma reduction, including explicit disclosure of diagnoses and emphasis on psychosocial causes of mental ill health[2]. In the current program, the structured progression through VR environments facilitated gradually deepening emotional disclosure, culminating in an explicit discussion of diagnoses, symptoms, and recovery experiences. The use of avatars may have reduced visual markers associated with diagnostic labeling, potentially shifting viewers′ attention from categorical differences to shared human concerns. These narrative elements may have been particularly impactful for viewers initially holding stronger stigmatizing beliefs.

An important interpretive question concerns the extent to which observed effects were attributable to VR-specific features versus the content of the peer dialogue itself. Research has shown that avatar-mediated communication can facilitate emotional self-disclosure[12], which may have enabled participants to share richer emotional experiences and personal narratives. Patient narratives have been shown to enhance empathy and understanding while reducing prejudice toward mental illness[13]. However, the current study cannot isolate whether stigma reduction resulted from avatar-mediated features, the narrative content itself, or their combination with facilitator guidance and clinical commentary.

Regarding safety, depressive symptoms did not worsen immediately following program viewing. Although PHQ-9 scores showed a small increase at the three-month follow-up, which coincided with the end of the academic examination period, mean values remained within the minimal to mild range throughout the study. No participant required clinical intervention based on PHQ-9 scores. While these

findings provide some reassurance regarding short-term safety, longer-term monitoring in diverse populations would strengthen the evidence for broader implementation.

Limitations

Several limitations should be acknowledged. First, the observational design without a control group limits causal inference, and changes in stigma cannot be definitively attributed to program viewing. Second, participants were university students from a single institution, which may limit generalizability. Third, the exploratory subgroup analysis was based on a median split of baseline stigma, which may have reduced statistical precision and should therefore be interpreted cautiously. In addition, because subgrouping was based on baseline values of the same outcome, the observed differential change may partly reflect regression to the mean rather than true effect modification. Fourth, public stigma was assessed using self-report measures and may have been influenced by social desirability bias. Fifth, exposure consisted of a single episode, and the durability and cumulative impact of repeated exposure remain unknown. Finally, the study could not isolate VR-specific effects from the effects of the dialogue content itself. Although our previous research suggests that VR may facilitate authentic disclosure among direct participants, the present study did not compare VR-mediated dialogue with equivalent content delivered through conventional formats. Therefore, the relative contributions of VR as a medium and the narratives it enables remain unclear and warrant further investigation. Additionally, the program included multiple elements beyond the peer dialogue itself, including follow-up interviews with participants and clinical commentary on their experiences. While these additional elements may have contributed to the observed stigma reduction, the current design cannot determine their relative contributions to the overall effects.

Future directions

Future research should employ controlled designs to clarify causal mechanisms underlying selective stigma reduction. Randomized comparisons with conventional educational materials would help isolate the specific contribution of avatar-mediated peer dialogue. Examination of dose–response relationships and repeated exposure paradigms is warranted. Further investigation is needed to identify which narrative elements most strongly influence higher-stigma viewers, including diagnostic disclosure, emotional intensity, narrative coherence, and facilitation style. Expanding outcome measures beyond self-reported attitudes to include behavioral indicators and longitudinal follow-up would strengthen

ecological validity. Finally, future studies could explore the psychological mechanisms underlying these effects through additional outcome measures such as empathic response or perspective-taking.

Conclusion

Viewing social VR–based peer dialogue was associated with reductions in perceived public stigma toward mental illness among university students, particularly among individuals with higher baseline stigma, without evidence of adverse psychological effects. Effect sizes were small but consistent with prior research on mediated contact interventions. Together with prior participant-focused findings, these results suggest that social VR–based peer dialogue programs may have value both for direct participants and for audiences who view the interactions, though controlled studies are needed to establish causal effects and clarify mechanisms.

Abbreviations

- NHK: NIPPON HOSO KYOKAI
- PDD: Perceived Devaluation and Discrimination
- PHQ-9: Patient Health Questionnaire-9
- VR: Virtual Reality

Statements and Declarations

Funding

This study was funded by the Japan Science and Technology Agency (JST) under the Co-creation Opportunity Formation Support Program (COI-NEXT), FY2022–2031.

Potential Competing Interests

JF received a supervision fee from NHK for clinical consultation during program development and appeared in the program to provide expert commentary. The current study was conceived, designed, and conducted independently after the program broadcast. To ensure objectivity, data collection and statistical analysis were performed by independent research staff (MT, MM) who had no financial relationship with NHK. NHK was not involved in study design, data collection, analysis, or interpretation of results. All other authors declare no conflicts of interest.

Author Contributions

- JF: Conceptualization, Methodology, Investigation, Writing - Original Draft, Writing - Review & Editing, Supervision, Project Administration
- MT: Investigation, Writing - Review & Editing
- MM: Formal Analysis, Writing - Review & Editing
- YA: Resources, Writing - Review & Editing
- ToM, MI: Data Curation, Project Administration
- KH: Resources, Investigation (participant recruitment)
- TMi: Resources, Funding Acquisition, Supervision

All authors have read and approved the final manuscript.

Data Availability

The datasets generated and/or analyzed during the current study are not publicly available due to privacy protection and the scope of the research plan but are available from the corresponding author on reasonable request.

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Declarations

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