



Original article

Psychiatric readmissions following Soteria versus traditional inpatient care: a propensity score-matched cohort study

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ABSTRACT

The Soteria model offers a community-based, recovery-oriented alternative to traditional psychiatric hospitalization, yet long-term evidence regarding its association with readmission remains limited. This study evaluated whether treatment in a Soteria home is associated with lower psychiatric readmission rates compared to traditional hospital care.

A retrospective analysis was conducted using Israel Ministry of Health records for patients admitted to Soteria or traditional wards in 2018, with follow-up through May 2021 (N = 164). Outcomes included readmission proportion, frequency, time-to-first readmission, and length of stay. Analysis employed propensity score matching (PSM), logistic regression, and Cox proportional hazards modelling.

Soteria patients were significantly less likely to be readmitted at 24 months (41.5%vs. 61.0%) and 30 months (45.1%vs. 63.4%). They also experienced longer times to first readmission. Moderation analyses suggested that the association between Soteria care and delayed readmission was more pronounced among younger patients (≤ 30 years). To address diagnostic imbalances, a stratified PSM sensitivity analysis was conducted; the reduction in readmission hazard remained statistically significant (HR=0.65, 95% CI: 0.43–1.00, $p = 0.048$), providing partial support for the primary time-to-readmission findings.

Treatment in a Soteria home was associated with lower long-term psychiatric rehospitalization, particularly among younger individuals. While the observational design precludes causal conclusions, these findings suggest that Soteria-based residential alternatives may be associated with reduced long-term psychiatric readmission compared with traditional inpatient treatment.

1. Introduction

Recurrent psychiatric hospitalization remains a major challenge within mental health systems worldwide (Fonseca Barbosa and Gama Marques, 2023; Kalseth et al., 2016). Readmissions frequently reflect

relapse, fragmentation of continuity-of-care, and instability of clinical recovery. They also generate substantial economic burden through direct costs of acute inpatient treatment and indirect costs related to loss of productivity and long-term disability (Berardelli et al., 2022). Moreover, repeated admissions are associated with increased suicidal

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ideation, suicide attempts, and substance misuse (Berardelli et al., 2022). In Israel, approximately 20% of discharged patients are readmitted within one month and nearly 50% within one year, highlighting the need for effective alternatives to standard inpatient treatment pathways (Israel Ministry of Health, 2022).

One such alternative is the Soteria model, developed by Loren Mosher in the early 1970s as a small-scale, homelike residential environment for young adults experiencing first-episode schizophrenia-spectrum psychosis (Mosher, 1999; Mosher and Menn, 1978a). Rather than prioritizing antipsychotic medication, Soteria emphasized interpersonal presence ("being with"), shared living, non-hierarchical decision making, and minimal medication use when clinically appropriate. Randomized and longitudinal studies reported clinical and functional outcomes comparable or superior to standard hospitalization, despite substantially lower cumulative exposure to antipsychotic medication under Soteria care (Bola and Mosher, 2003; Ciompi et al., 1993). Replications, most notably Soteria Berne, reported favourable clinical and functional outcomes within a low-drug, milieu-therapeutic approach, with comparative follow-up studies suggesting outcomes broadly comparable to standard care. (Ciompi and Hoffmann, 2004; Ciompi et al., 1992, 1993).

Although the evidence varies in quality and scale, a systematic review described Soteria-type programs as promising and emphasized the need for further evaluation under real-world conditions (Calton et al., 2008).

Building on this foundation, the present study aims to provide a rigorous examination of long-term outcomes by retrospectively comparing psychiatric rehospitalization rates between a Soteria home and a traditional inpatient psychiatric ward. By evaluating time to readmission, number of readmissions, and differential risk across groups, we seek to contribute additional empirical evidence regarding long-term psychiatric readmission outcomes associated with Soteria-based care.

Since 2016, Soteria services have been implemented in Israel under full national health insurance funding while maintaining core principles of interpersonal presence, communal living, and reduced dependence on pharmacological treatment (Friedlander et al., 2022). However, several adaptations differentiate Israeli Soteria from the original California model: admission is no longer restricted to first-episode schizophrenia but includes broader diagnostic profiles (mood, psychotic, trauma-related disorders); multidisciplinary teams now include both companions and licensed clinicians; and treatment duration is shorter (typically 4–8 weeks), structured as a direct alternative to hospitalization rather than an experimental research setting (Friedlander et al., 2022). Research conducted in Soteria Israel has reported clinical outcomes comparable to inpatient care (Yonatan-Leus et al., 2025), and therapeutic alliance development at least as strong as in conventional hospitalization (Friedlander et al., 2024). Complementing this evidence, Lichtenberg et al. (2023) reported reduced readmission following Short-Term Acute Residential Treatment (START) programs, services inspired by Soteria principles, although absence of an inpatient comparison arm limited causal interpretation.

Together, the evolution of Soteria from its original formulation to its national-scale implementation in Israel, alongside the limited comparative rehospitalization data available globally, underscores the need for methodologically robust outcome evaluation. The present study seeks to address this gap by retrospectively comparing long-term readmission trajectories between Soteria and traditional hospitalization using retrospective clinical data and propensity-based sampling, thereby positioning the rationale for the methodology that follows.

2. Methods

2.1. Study design

This study retrospectively analyzed electronic data of all patients

admitted to either the acute care psychiatric wards of the Jerusalem Mental Health Center, or in one of two Jerusalem Soteria homes, men's and women's, between January 1, 2018, and December 31, 2018. For each individual, records of all psychiatric admissions up to and including May 31, 2021 (including entries before 2018) were retrieved from the Ministry of Health's psychiatric case register (Lichtenberg et al., 1999). Follow-up data were obtained from Israel's national psychiatric hospitalization registry, which captures all psychiatric admissions to inpatient facilities nationwide. The outcome was specifically defined as psychiatric readmission; medical admissions were not included. Information on mortality was not available in the registry data. Patients were followed from discharge through the end of the observation period (May 31, 2021), with administrative censoring at this date. No patients were lost to follow-up within the Israeli psychiatric system. Each admission record included the admission and release dates, the site of care (hospital / Soteria home), and whether the admission was voluntary or involuntary. Dataset available in Mendeley Data (Friedlander, 2025). The study was approved by the institutional review board of the Jerusalem Mental Health Center (no. 4–20). As this was a retrospective study utilizing existing administrative registry data, it was not pre-registered in a clinical trials registry.

2.2. Measures

2.2.1. Available variables

For this analysis, we utilized sociodemographic variables (age, gender), clinical variables (psychiatric diagnoses), and psychiatric admission variables (admission history, frequency, duration). Psychiatric diagnoses were coded according to ICD-10 categories and retrieved from the national registry, including substance use disorders (F10–F19), schizophrenia spectrum disorders (F20–F29), mood disorders (F30–F39), anxiety disorders (F40–F48), and personality disorders (F60–F69). However, diagnostic information exhibited differential availability between treatment settings. Specifically, Soteria patients presenting for their first psychiatric admission often lacked formal diagnostic codes in the registry, reflecting institutional differences in documentation practices rather than true absence of psychiatric pathology. This differential measurement pattern was considered in the analytic approach, as described in the statistical analysis section. The dataset represents administrative registry data with limited clinical variables; no additional measures of psychosocial functioning, symptom severity, comorbid substance use or medical disorders, treatment adherence, adverse life events, or socioeconomic status were available in the source database.

2.2.2. Intervention event definition

An intervention event was defined as the first admission in 2018 that was voluntary and lasted at least 5 days. We assessed admission-related variables by analyzing each patient's admission history and follow-up data. This included the presence and frequency of admissions, and the total duration of inpatient stays before and after the intervention.

In analyzing hospitalization events for all patients, we identified 27 events with overlapping dates (less than a day apart), which were removed from further analysis and not considered separate events. Additionally, events occurring closely together (sequences of discharge-admission-discharge) were consolidated into a single event if they were not spaced by at least 24 h. This consolidation included events involving transfers between care sites or additional hospitalizations occurring within 24 h of discharge. Events were categorized as "before" the intervention if they occurred before the intervention sequence and "after" if they commenced following the sequence.

2.2.3. Outcome measures

For the purposes of validation and a more complete understanding of the concept of readmission, outcomes were analyzed across four dimensions:

- **Likelihood of readmission:** Any psychiatric readmission occurring within specified time periods (6 months, 1 year, 2 years, 2.5 years) following discharge from the intervention event, coded as a binary variable (yes/no).
- **Frequency of readmissions:** Total number of psychiatric readmissions occurring within each time period, analyzed as count data.
- **Duration of readmissions:** Total number of days hospitalized across all psychiatric readmissions within each time period, analyzed as count data.
- **Time to first readmission:** Days from discharge of the intervention event to the first subsequent psychiatric readmission, analyzed as time-to-event data. Patients without readmission were censored at the end of the follow-up period (May 31, 2021).

2.3. Statistical analysis

Descriptive statistics (means, standard deviations, medians, inter-quartile ranges, and percentages) were used to characterize the entire sample and each group individually. To identify initial differences between groups, we compared demographic and pre-intervention clinical variables using *t*-tests for continuous variables (or the nonparametric Kruskal-Wallis test for skewed distributions) and chi-square tests for categorical variables. Standardized Mean Difference (SMD) scores were calculated for each comparison, with SMD values below 0.10 considered indicative of adequate balance, 0.10–0.20 acceptable balance, and above 0.20 indicating potential imbalance.

2.3.1. Propensity score matching

Given significant baseline differences between groups, propensity score matching was used to improve comparability across measured covariates before post-intervention analyses. Variable selection for propensity score matching was guided by both conceptual and statistical considerations. We included all available demographic characteristics (age, gender) and clinical variables that could plausibly influence both treatment assignment and readmission outcomes, specifically intervention length and prior hospitalization history.

The propensity score, representing the probability of assignment to the Soteria group, was calculated using a logistic regression model incorporating pre-intervention variables that significantly differed between groups (age, gender, pre-intervention admission patterns). Variables with skewed distributions were log-transformed before inclusion. We employed optimal pair matching, pairing each Soteria patient with one control patient while minimizing the overall distance between pairs (Gu and Rosenbaum, 1993; Hansen and Klopfer, 2006). Following matching, groups were re-compared using the same statistical tests and recalculated SMDs to evaluate the extent of covariate balance achieved.

2.3.2. Sensitivity analysis: stratified propensity score matching

To address the differential availability of diagnostic information between treatment groups, we conducted a sensitivity analysis using stratified propensity score matching that returned to the full pre-matched cohort. We stratified the sample by admission history (first psychiatric admission versus prior admission history) prior to matching, recognizing that diagnostic coding availability differed substantially between these subgroups.

For patients experiencing their first psychiatric admission, propensity score matching was performed using optimal pair matching on demographic characteristics (age, gender) and pre-intervention clinical variables (intervention length, any prior admissions in the preceding 180 days, 1 year, and 2 years) only. Diagnostic variables were excluded from this stratum due to the systematic absence of diagnostic coding at Soteria for patients without prior psychiatric hospitalization, reflecting institutional policy differences rather than true absence of pathology.

For patients with prior psychiatric admission history, diagnostic information was reliably available for both groups. Propensity score

matching was therefore performed on the full covariate set, including demographic characteristics, pre-intervention clinical variables, and all diagnostic categories (F1-F6 disorders from ICD-10).

The two matched strata were subsequently combined into a single analytic sample maintaining equal group sizes. Covariate balance was assessed using standardized mean differences. All outcome analyses were repeated using this stratified matched sample, with results reported in the sensitivity analysis section.

2.3.3. Outcome analysis methods

For each outcome dimension, we employed appropriate statistical models accounting for the distributional properties of the data. All analyses covered multiple time periods (6 months, 1 year, 2 years, and 2.5 years post-discharge), with follow-up until May 31, 2021. Patients not readmitted by the end of follow-up were censored at this date.

For likelihood of readmission (binary outcomes), we used logistic regression models to compare the odds of any readmission between groups. For frequency and duration of readmissions (count outcomes), we used negative binomial regression due to overdispersed count data with excess zeros. The negative binomial model was chosen over Poisson regression based on likelihood ratio tests. Among readmitted patients only, Wilcoxon rank-sum tests compared median values between groups.

For time to first readmission (survival outcomes), we used Kaplan-Meier curves to visualize the cumulative probability of remaining non-hospitalized and Cox proportional hazards models to estimate hazard ratios. The proportional hazards assumption was assessed using Schoenfeld residuals testing and visual inspection of residual plots. For the sensitivity analysis using stratified matching, we conducted Cox proportional hazards regression stratified by admission history to account for potential differences in baseline hazard between the two strata while estimating a common association across strata.

2.3.4. Moderation analyses

Moderation analyses were conducted to assess whether associations between treatment setting and outcomes differed across demographic and clinical subgroups. For each outcome, we tested interactions between treatment group and three potential moderators: gender, age (dichotomized as ≤ 30 vs > 30 years for increased statistical power), and previous admission history. Moderation was formally evaluated by including multiplicative interaction terms (Treatment $\times$ Moderator) in the primary regression models. For binary outcomes, we used logistic regression with interaction terms. For count outcomes, we used negative binomial regression with interaction terms. For time-to-event outcomes, we used Cox proportional hazards models with interaction terms. Significant interactions ($p < 0.05$) were followed by stratified analyses estimating associations separately within each level of the moderator. For the sensitivity analysis, we formally tested whether associations differed by admission status using an interaction term (Treatment $\times$ Admission History) in the Cox model.

Given the exploratory nature of moderation testing and correlated outcomes across time periods, we report effect sizes and confidence intervals alongside *p*-values to facilitate interpretation. Information on post-discharge follow-up care was not available in the national psychiatric hospitalization registry, which captures admission and discharge dates but does not include outpatient treatment records. Differential engagement with outpatient services between Soteria and traditional inpatient care graduates could partially explain the observed group differences in readmission outcomes.

Statistical analyses were conducted using R version 4.4.2 (2024–10–31) using the following packages: readxl, dplyr, lubridate, MatchIt, tableone, MASS (for negative binomial regression), survival, and survminer. Complete reproducible analysis code is available as supplementary materials.

3. Results

3.1. Demographic and clinical characteristics of the study sample

The original data included 9442 admission events for 1008 patients. 95 in the Soteria group and 913 in the Control group. After excluding 296 patients without a valid intervention event (all 2018 hospitalizations were involuntary or <5 days), the valid sample comprised 82 Soteria patients (395 admission events) and 630 Control patients (6956 admission events). See Fig. 1 for a detailed description of excluded cases.

Among patients with recorded diagnoses, the Control group had more Schizophrenia Spectrum Disorders (F20-F29; 60.6% vs. 46.3%, $p = 0.032$, $SMD = 0.291$), while the Soteria group had more Mood Disorders (F30-F39; 43.3% vs. 27.3%, $p = 0.009$, $SMD = 0.339$). Severe mental disorders (F20-F39) were similar (Soteria: 80.6% vs. Control: 83.8%, $p = 0.617$, $SMD = 0.084$). Other diagnoses included substance use disorders (14.1%), anxiety disorders (9.3%), and personality disorders (18.4%), with no significant group differences. Notably, 15 Soteria patients with no other admissions lacked formal diagnoses, reflecting institutional policy differences in diagnostic coding for first-admission patients.

The Soteria group had more first-time admissions (37.8% vs. 25.1%, $p = 0.020$, $SMD = 0.277$). The Control group had more pre-intervention admissions ($M = 7.3$, $SD = 11.5$ vs. $M = 2.4$, $SD = 3.5$, $p < 0.001$, $SMD = 0.579$) and total days in pre-intervention admissions ($M = 484.1$, $SD = 1181.5$ vs. $M = 128.5$, $SD = 292.0$, $p = 0.007$, $SMD = 0.413$). While no significant differences were observed in mean days from prior discharge to intervention admission, the median interval was significantly shorter for Soteria (64 days vs. 359 days, $p < 0.001$, $SMD = 0.173$).

See Table 1 (Full Sample) for details.

3.1.1. Propensity score matching

Propensity score matching balanced baseline differences using a logistic regression model based on age, gender, and pre-intervention admission patterns. Psychiatric diagnoses and time since last admission were excluded due to missing data and undefined values, respectively. The matched sample included 164 patients, 82 per group.

Mean propensity scores were identical (Control: $M = 0.176$, $SD = 0.087$; Soteria: $M = 0.176$, $SD = 0.086$), with similar ranges (Control: 0.016–0.412; Soteria: 0.015–0.378). **$SMD < 0.10$ indicated adequate balance for 6 of 11 covariates, although some residual imbalance remained.** Four other variables showed moderate imbalance, with SMD s ranging from 0.196 to 0.268. One variable, personality disorders (Control: 34.1% vs. Soteria: 14.9%, $p = 0.013$, $SMD = 0.458$), remained with a notable, significant difference that exceeded the accepted threshold for balance. See Table 1 for matched sample characteristics.

3.1.2. Describing the intervention events in the two groups

Intervention event duration differed significantly between groups, with the Soteria group having longer stays ($M = 56.6$ days, $SD = 56.0$) compared to the Control group ($M = 41.4$ days, $SD = 90.9$, $p = 0.004$, $SMD = 0.201$). Of Soteria patients, 75.6% arrived from home, while 98.8% of Control patients arrived from home ($p < 0.001$, $SMD = 0.742$). Discharge patterns also differed: 90.2% of Soteria patients were discharged home, 4.9% had voluntary readmissions, and 4.9% had involuntary readmissions within 24 h; in contrast, 98.8% of Control patients

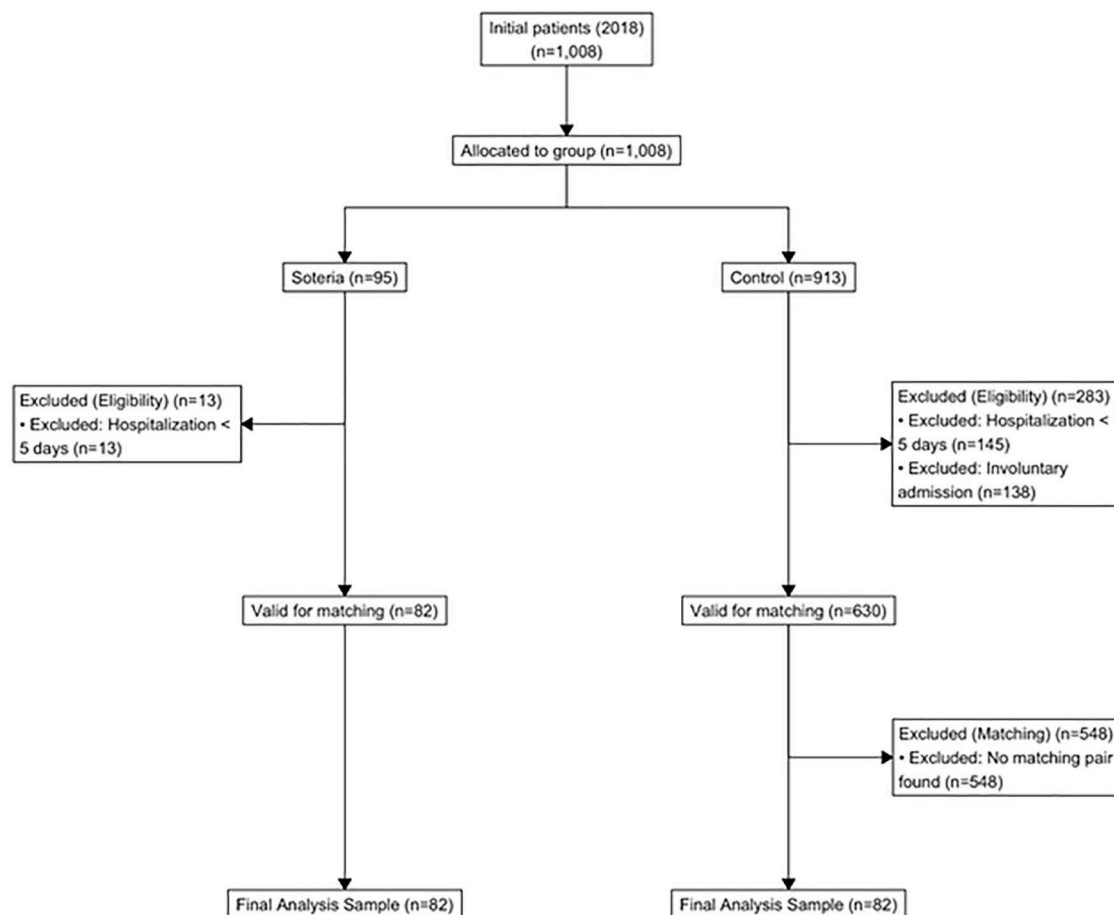


Fig. 1. CONSORT Flow Diagram of patient selection and matching process.

The flowchart illustrates the exclusion criteria applied to the initial cohort of 1008 patients, the propensity scores matching process, and the final analytical samples for the primary and sensitivity analyses.

Table 1

Demographic and clinical characteristics of the study sample before and after propensity score matching.

	level	Soteria	Full Sample			Primary Matched sample		
			Control	p	SMD	Control	p	SMD
N		82	630			82		
Age (years) (mean (SD))		34.56 (14.97)	43.06 (17.51)	<0.001	0.522	34.56 (16.74)	1	<0.001
Gender (%)	Men	42 (51.2)	375 (59.5)	0.188	0.168	40 (48.8)	0.876	0.049
	Women	40 (48.8)	255 (40.5)			42 (51.2)		
Substance Use Disorders (F1) (%)	No	58 (86.6)	541 (85.9)	1	0.02	68 (82.9)	0.701	0.101
	Yes	9 (13.4)	89 (14.1)			14 (17.1)		
Schizophrenia Spectrum (F2) (%)	No	36 (53.7)	248 (39.4)	0.032	0.291	42 (51.2)	0.888	0.05
	Yes	31 (46.3)	382 (60.6)			40 (48.8)		
Mood Disorders (F3) (%)	No	38 (56.7)	458 (72.7)	0.009	0.339	57 (69.5)	0.148	0.268
	Yes	29 (43.3)	172 (27.3)			25 (30.5)		
Anxiety Disorders (F4) (%)	No	62 (92.5)	570 (90.5)	0.741	0.074	71 (86.6)	0.367	0.196
	Yes	5 (7.5)	60 (9.5)			11 (13.4)		
Personality Disorders (F6) (%)	No	57 (85.1)	512 (81.3)	0.549	0.102	54 (65.9)	0.013	0.458
	Yes	10 (14.9)	118 (18.7)			28 (34.1)		
Any prior admission (%)	No	31 (37.8)	158 (25.1)	0.02	0.277	39 (47.6)	0.269	0.198
	Yes	51 (62.2)	472 (74.9)			43 (52.4)		
Number of prior admissions (mean (SD))		2.39 (3.51)	7.31 (11.48)	<0.001	0.579	2.33 (4.48)	0.923	0.015
Total days in prior admissions (mean (SD))		128.51 (292.02)	484.15 (1181.50)	0.007	0.413	162.13 (431.42)	0.56	0.091
Days from prior discharge to intervention admission (mean (SD))		768.16 (2053.00)	1114.18 (1947.95)	0.205	0.173	392.33 (624.54)	0.225	0.248
Days from prior discharge to intervention admission (median [IQR])		64.00 [0.00, 483.25]	359.00 [103.00, 1093.00]	<0.001	0.173	143.00 [30.25, 440.75]	0.105	0.248

Note: SMD = Standardized Mean Difference. Comparison of demographic variables (age, gender), pre-intervention clinical history (diagnoses, prior admissions), and intervention characteristics between Soteria and Control groups. Values are presented as mean (SD) or median [IQR] for continuous variables and N (%) for categorical variables.

were discharged home, with 1.2% having voluntary readmissions within 24 h ($p = 0.047$, $SMD = 0.394$).

3.2. Primary analysis: post-intervention outcomes

Post-intervention outcomes were analyzed across four dimensions: likelihood of readmission, frequency of readmissions, duration of readmissions, and time to first readmission. Results are presented in Table 2.

3.2.1. Likelihood of readmission

In the Soteria group, 46.3% of patients were readmitted during the study period, compared to 63.4% in the Control group ($p = 0.041$, $SMD = 0.348$), a 17.1%-point difference. Significant differences were observed across time periods: 6 months (22.0% vs. 39.0%, $p = 0.027$, $SMD = 0.377$), 1 year (34.1% vs. 51.2%, $p = 0.040$, $SMD = 0.350$), 2 years (41.5% vs. 61.0%, $p = 0.019$, $SMD = 0.398$), and 2.5 years (45.1% vs. 63.4%, $p = 0.028$, $SMD = 0.374$). Logistic regression showed reduced odds of readmission in the Soteria group ($OR = 0.5$, 95% CI [0.27, 0.93], $p = 0.029$).

Moderation analyses revealed a significant Treatment $\times$ Age interaction ($b = -1.56$, $p = 0.016$). Stratified analyses showed that among younger patients (≤ 30 years), lower readmission odds were observed in the Soteria group ($OR = 0.23$, $p = 0.002$), whereas no significant association was observed among older patients ($OR = 0.83$, $p = 0.675$). Gender ($b = 0.42$, $p = 0.510$) and previous admission history ($b = -0.52$, $p = 0.435$) were not significant moderators.

3.2.2. Frequency of readmissions

The number of readmissions was highly skewed, with 45.1% of patients having no readmissions. Among readmitted patients, the median was 2 (IQR = 1, range = 1–10). Negative binomial regression showed that Soteria patients had 41% fewer readmissions ($b = -0.52$, $SE = 0.21$, $p = 0.011$, $RR = 0.59$). Mean readmissions differed significantly across time periods: 6 months ($M = 0.27$, $SD = 0.55$ vs. $M = 0.52$, $SD = 0.74$, $p = 0.014$), 1 year ($M = 0.41$, $SD = 0.63$ vs. $M = 0.84$, $SD = 1.05$, $p = 0.008$), 2 years ($M = 0.60$, $SD = 0.83$ vs. $M = 1.27$, $SD = 1.64$, $p = 0.003$), and 2.5 years ($M = 0.80$, $SD = 1.15$ vs. $M = 1.38$, $SD = 1.73$, $p = 0.011$). Neither age, gender, nor previous admission history were significant moderators.

Table 2

Comparison of post-intervention readmission outcomes between soteria and control groups (Primary Matched Sample, N = 164).

	Soteria	Control	P	SMD
N	82	82		
Any readmission = Yes (%)	38 (46.3)	52 (63.4)	0.041	0.348
Readmission within 6 months = Yes (%)	18 (22.0)	32 (39.0)	0.027	0.377
Readmission within 1 year = Yes (%)	28 (34.1)	42 (51.2)	0.04	0.35
Readmission within 2 years = Yes (%)	34 (41.5)	50 (61.0)	0.019	0.398
Readmission within 2.5 years = Yes (%)	37 (45.1)	52 (63.4)	0.028	0.374
Total number of readmissions (median [IQR])	0.00 [0.00, 1.00]	1.00 [0.00, 2.00]	0.013	0.379
Number of readmissions (6 m) (median [IQR])	0.00 [0.00, 0.00]	0.00 [0.00, 1.00]	0.014	0.394
Number of readmissions (1y) (median [IQR])	0.00 [0.00, 1.00]	1.00 [0.00, 1.00]	0.008	0.494
Number of readmissions (2y) (median [IQR])	0.00 [0.00, 1.00]	1.00 [0.00, 2.00]	0.003	0.516
Number of readmissions (2.5y) (median [IQR])	0.00 [0.00, 1.00]	1.00 [0.00, 2.00]	0.011	0.39
Total days in readmissions (median [IQR])	0.00 [0.00, 45.75]	9.00 [0.00, 60.00]	0.08	0.137
Days in readmissions (6 m) (median [IQR])	0.00 [0.00, 0.00]	0.00 [0.00, 14.25]	0.028	0.141
Days in readmissions (1y) (median [IQR])	0.00 [0.00, 14.25]	1.00 [0.00, 39.00]	0.034	0.202
Days in readmissions (2y) (median [IQR])	0.00 [0.00, 27.25]	7.50 [0.00, 52.50]	0.018	0.234
Days in readmissions (2.5y) (median [IQR])	0.00 [0.00, 34.75]	8.00 [0.00, 58.50]	0.051	0.146
Time to first readmission (days) (median [IQR])	856.38 [216.50, 1000.12]	325.00 [98.75, 929.12]	0.036	0.357

Note: Outcomes include the likelihood, frequency, and duration of psychiatric readmissions across multiple follow-up periods (6 months, 1 year, 2 years, 2.5 years), as well as time to first readmission. p-values are derived from logistic regression (binary outcomes), negative binomial regression (count outcomes), and Cox proportional hazards models (time-to-event).

(all $p > 0.10$).

3.2.3. Duration of readmissions

The distribution of readmission days was highly skewed. Among readmitted patients ($N = 90$), the median length of stay was 46.5 days ($IQR=85.25$, $range=1-436$). In the entire sample, the Soteria group had a median of 0 days ($IQR=45.75$) vs. 9 days ($IQR=60$) for the Control group. Negative binomial regression for the entire sample showed a non-significant trend for shorter stays in the Soteria group (22% fewer days, $b = -0.25$, $SE=0.39$, $p = 0.524$, $RR=0.78$). Moderation analyses found no significant effects for age, gender, or previous admission history (all $p > 0.10$).

3.2.4. Time to first readmission

Among readmitted patients, the mean time to first readmission was significantly longer for Soteria ($M = 660$ days, $SD=415.2$) compared to Control ($M = 506.9$ days, $SD=442.9$, $p = 0.024$, $SMD=0.357$). Kaplan-Meier analysis showed that the Control group had a significantly lower probability of remaining non-hospitalized over time (log-rank $\chi^2(1)=5.79$, $p = 0.04$). Restricted mean survival times were 781.2 days for Soteria and 581.6 days for Control, representing a difference of approximately 200 days. Cox proportional hazards regression indicated that Control patients had a 66% higher hazard of readmission compared to Soteria patients ($HR=1.663$, 95% CI $[1.095, 2.525]$, $p = 0.017$). The proportional hazards assumption was satisfied (Schoenfeld residuals test, $p = 0.401$), supporting the validity of the Cox model. See Fig. 2 for the Kaplan-Meier survival curves.

Moderation analyses revealed a significant Treatment $\times$ Age

interaction ($p = 0.026$). Stratified analyses showed that among younger patients (≤ 30 years), the hazard of readmission was significantly higher in the Control group compared to the Soteria group ($HR=2.703$, 95% CI $[1.476, 4.95]$, $p = 0.001$), **corresponding to a higher observed readmission hazard in the Control group**. Among older patients (>30 years), there was no significant difference between groups ($HR=1.01$, 95% CI $[0.551, 1.851]$, $p = 0.975$). Gender ($p = 0.684$) and previous admission history ($p = 0.287$) were not significant moderators.

3.3. Sensitivity analysis: stratified propensity score matching

To address the residual imbalance in personality disorder diagnosis ($F6$, $SMD=0.458$) observed in the primary analysis, we conducted a sensitivity analysis using stratified propensity score matching. This approach recognized that diagnostic information was systematically missing for 48% of first-admission Soteria patients (15 of 31 patients, compared to 0% of first-admission controls), reflecting institutional policy rather than clinical differences.

3.3.1. Sample composition and matching procedure

The full pre-matched cohort comprised 82 Soteria patients and 630 control patients. We stratified this cohort by admission history: 31 Soteria patients (37.8%) and 158 control patients (25.1%) were experiencing their first psychiatric admission, while 51 Soteria patients (62.2%) and 472 control patients (74.9%) had prior admission history.

For first-admission patients, matching was restricted to demographic and pre-intervention clinical variables (excluding diagnoses), yielding 31 matched pairs ($n = 62$). For patients with prior admission history,

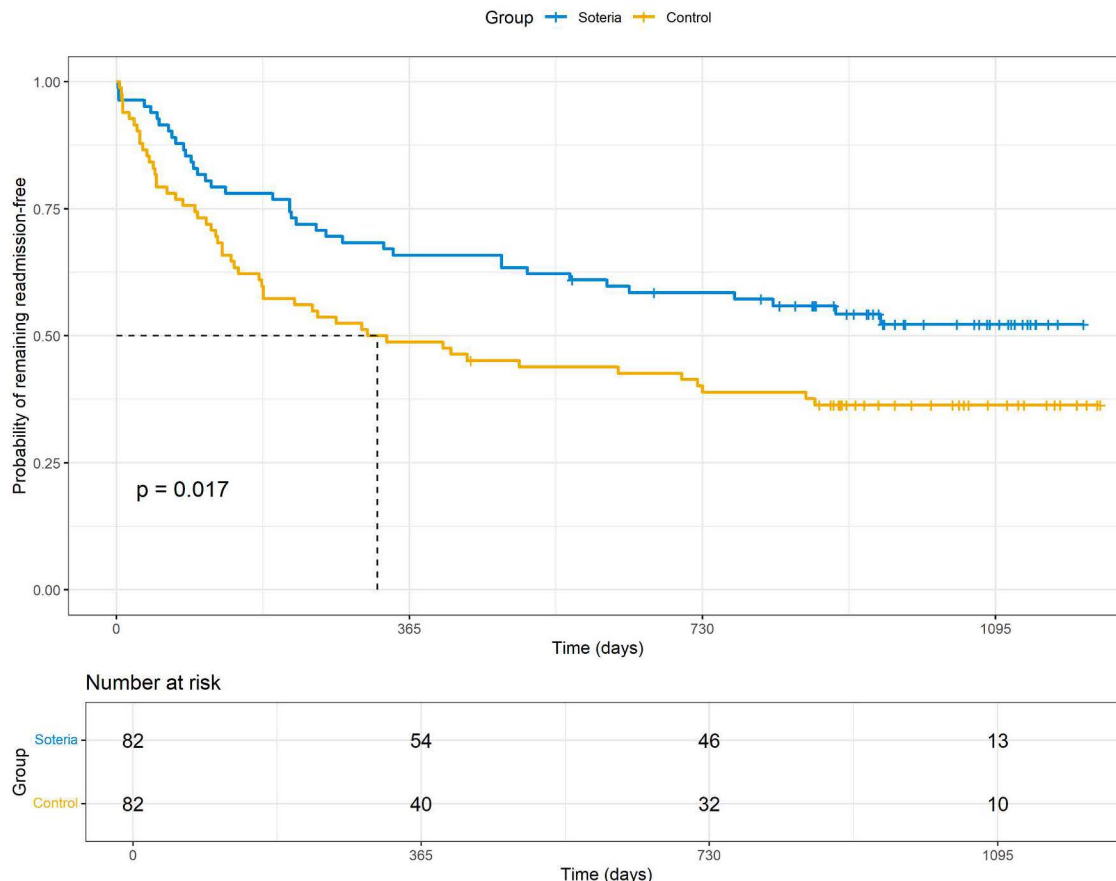


Fig. 2. Kaplan-meier survival estimates for time to first psychiatric readmission (Primary Analysis).

Survival curves showing the probability of remaining free from psychiatric readmission over time for the Soteria (blue) and Control (yellow) groups in the primary matched sample. The shaded areas represent 95% confidence intervals. The Control group showed a significantly higher hazard of readmission ($HR=1.66$, $p = 0.017$).

matching included the full covariate set including all diagnostic categories (F1-F6), yielding 51 matched pairs ($n = 102$). The combined stratified sample maintained $n = 164$ (82 per group) with substantially improved covariate balance. The personality disorder imbalance that characterized the primary analysis ($SMD=0.458$) was reduced to acceptable levels ($SMD=0.152$). All remaining covariates showed SMD values below 0.20, although some residual imbalance remained.

3.3.2. Outcome comparisons

Results from the sensitivity analysis are presented in Table 3. Treatment groups were compared across all outcome dimensions using the stratified matched sample. The proportion of patients experiencing any psychiatric readmission was 46.3% in the Soteria group compared to 59.8% in the control group ($\chi^2=2.46$, $p = 0.118$), representing a non-significant trend favoring Soteria with an odds ratio of 0.58. The mean number of readmissions was lower in the Soteria group ($M = 0.85$, $SD=1.22$) compared to controls ($M = 1.22$, $SD=1.74$), approaching but not reaching statistical significance (Wilcoxon test, $p = 0.084$).

For time to first readmission, survival analysis methods were employed. An initial unadjusted Cox proportional hazards model applied to the combined stratified sample yielded a hazard ratio of 0.66 (95% CI: 0.43–1.01, $p = 0.056$), indicating a trend toward reduced readmission hazard in the Soteria group that did not reach conventional statistical significance. However, recognizing that the two matched strata represented distinct clinical populations with potentially different baseline hazard functions, we conducted a stratified Cox proportional

hazards analysis that allowed for stratum-specific baseline hazards while estimating a common hazard ratio across strata.

This stratified approach yielded a hazard ratio of 0.65 (95% CI: 0.43–1.00, $p = 0.048$), indicating a statistically significant association between Soteria care and a 35% lower readmission hazard compared to traditional inpatient care. The proportional hazards assumption was satisfied for the stratified model (Schoenfeld residuals test, $p = 0.443$), validating the Cox regression approach. See Fig. 3 for the Kaplan-Meier survival curves for the stratified analysis.

To assess whether treatment effects differed between first-admission and non-first-admission patients, we tested for interaction using a multiplicative term (Treatment $\times$ Admission History) in the Cox model. The interaction was not significant ($p = 0.903$), indicating that treatment effects were consistent across strata. Stratum-specific hazard ratios were similar: first admissions $HR=0.64$ (95% CI: 0.31–1.35, $p = 0.243$, $n = 62$) and non-first admissions $HR=0.66$ (95% CI: 0.39–1.10, $p = 0.110$, $n = 102$). Neither stratum alone achieved statistical significance due to reduced sample sizes, but the combined stratified analysis with adequate power demonstrated a statistically significant association in the combined model, demonstrated a statistically significant association in the combined model.

3.4. Summary of findings

The primary analysis using standard propensity score matching ($n = 164$) identified significant group differences across multiple readmission outcomes, with effect sizes ranging from small to medium ($OR=0.50$ for any readmission, $RR=0.59$ for frequency, $HR=1.66$ for time to readmission favoring Soteria). However, residual imbalance in personality disorder diagnosis (F6, $SMD=0.458$) raised concerns about potential confounding, particularly given that personality disorders are associated with substantially elevated readmission risk.

The sensitivity analysis using stratified matching addressed this limitation by accounting for differential diagnostic availability between first-admission and non-first-admission patients. With improved covariate balance (F6 $SMD=0.152$), the stratified Cox proportional hazards analysis revealed a statistically significant 35% reduction in readmission hazard for Soteria patients ($HR=0.65$, 95% CI: 0.43–1.00, $p = 0.048$). This association remained statistically significant after accounting for differential baseline hazards between patient strata and was consistent across both first-admission and non-first-admission subgroups (interaction $p = 0.903$), suggesting that the observed association was similar across both admission-history strata.

The attenuation of effects for binary and count outcomes (any readmission: $p = 0.041 \rightarrow p = 0.118$; frequency: $p = 0.011 \rightarrow p = 0.084$) in the sensitivity analysis suggests that the magnitude of these observed group differences in the primary analysis was partially inflated by personality disorder imbalance. However, the preservation of statistical significance in the survival analysis effect ($p = 0.024 \rightarrow p = 0.048$ in stratified model) suggests that the observed association between Soteria care and delayed psychiatric readmission was less sensitive to diagnostic imbalance than the binary and count outcomes. Moderation analyses across both primary and sensitivity analyses consistently identified age as a significant moderator, with stronger associations with delayed readmission observed among younger patients (≤ 30 years), suggesting that associations between Soteria care and delayed readmission may be more pronounced among individuals earlier in their psychiatric treatment trajectory.

4. Discussion

This study identified an association between treatment in a Soteria home and lower long-term psychiatric readmission rates compared with traditional inpatient care. Primary analyses identified significant group differences across several readmission outcomes, while the stratified sensitivity analysis yielded partially consistent findings after improved

Table 3
Comparison of post-intervention readmission outcomes in the sensitivity analysis (Stratified Matched Sample, $N = 164$).

	Soteria	Control	P	SMD
N	82	82		
Any readmission = Yes (%)	38 (46.3)	49 (59.8)	0.118	0.271
Readmission within 6 months = Yes (%)	18 (22.0)	30 (36.6)	0.059	0.326
Readmission within 1 year = Yes (%)	28 (34.1)	38 (46.3)	0.152	0.251
Readmission within 2 years = Yes (%)	34 (41.5)	46 (56.1)	0.086	0.296
Readmission within 2.5 years = Yes (%)	37 (45.1)	49 (59.8)	0.085	0.296
Total number of readmissions (median [IQR])	0.00 [0.00, 1.00]	1.00 [0.00, 2.00]	0.084	0.243
Number of readmissions (6 m) (median [IQR])	0.00 [0.00, 0.00]	0.00 [0.00, 1.00]	0.048	0.285
Number of readmissions (1y) (median [IQR])	0.00 [0.00, 1.00]	0.00 [0.00, 1.00]	0.067	0.336
Number of readmissions (2y) (median [IQR])	0.00 [0.00, 1.00]	1.00 [0.00, 1.75]	0.039	0.358
Number of readmissions (2.5y) (median [IQR])	0.00 [0.00, 1.00]	1.00 [0.00, 2.00]	0.074	0.252
Total days in readmissions (median [IQR])	0.00 [0.00, 45.75]	10.50 [0.00, 50.25]	0.182	0.149
Days in readmissions (6 m) (median [IQR])	0.00 [0.00, 0.00]	0.00 [0.00, 15.75]	0.05	0.078
Days in readmissions (1y) (median [IQR])	0.00 [0.00, 14.25]	0.00 [0.00, 34.50]	0.136	0.09
Days in readmissions (2y) (median [IQR])	0.00 [0.00, 27.25]	7.00 [0.00, 46.75]	0.059	0.222
Days in readmissions (2.5y) (median [IQR])	0.00 [0.00, 34.75]	8.50 [0.00, 47.75]	0.125	0.156
Time to first readmission (days) (median [IQR])	856.38 [216.50, 1000.12]	397.00 [98.00, 941.62]	0.062	0.304

Note: Results from the sensitivity analysis using stratified propensity score matching (Stratum 1: First admissions matched on demographics/history; Stratum 2: Prior admissions matched on full covariates including diagnoses). p -values are derived from stratified analyses adjusting for the matching design.

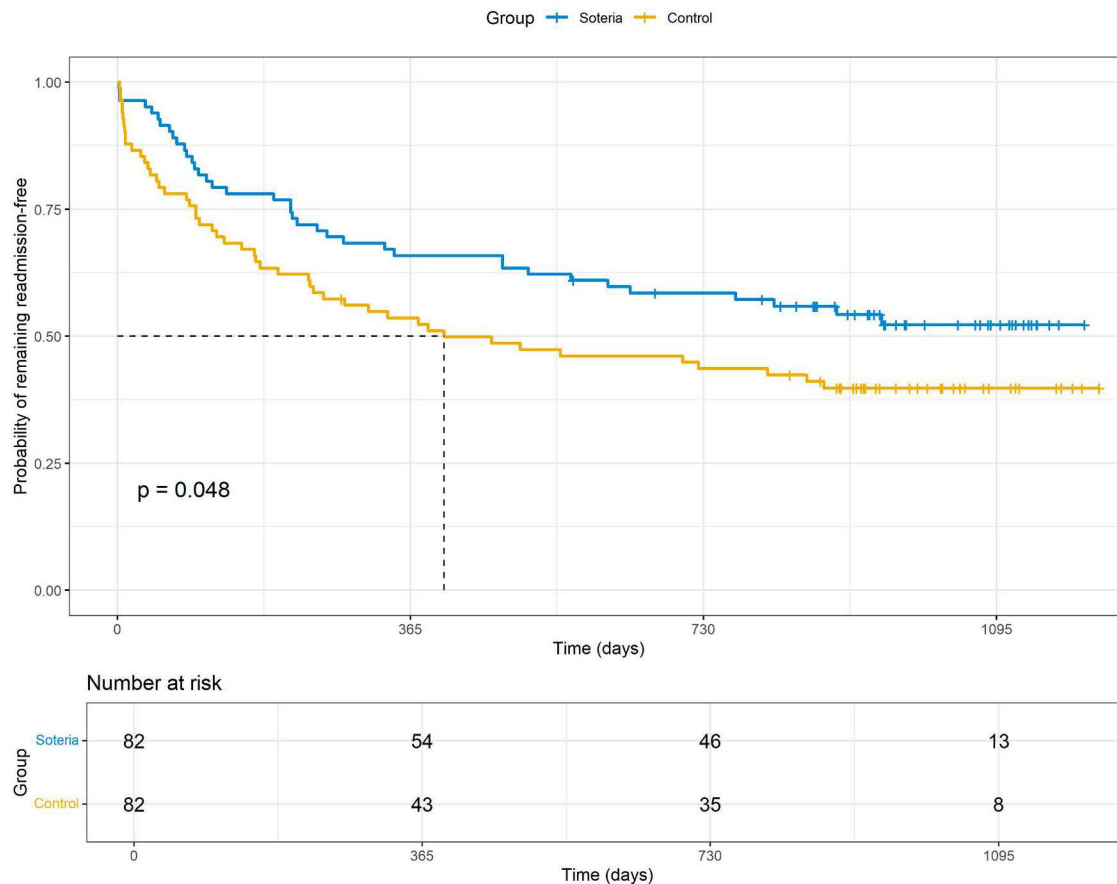


Fig. 3. Kaplan-meier survival estimates for time to first psychiatric readmission (Sensitivity Analysis).

Survival curves for the combined stratified matched sample, comparing time to first readmission between Soteria (blue) and Control (yellow) groups. This analysis accounts for the stratified matching design used to address differential diagnostic availability. The stratified Cox model identified a significantly lower readmission hazard in the Soteria group (HR=0.65, $p = 0.048$).

adjustment for diagnostic imbalance. Specifically, the stratified Cox proportional hazards model identified a 35% lower readmission hazard associated with Soteria treatment (HR = 0.65). These findings suggest that Soteria-based residential care may be associated with delayed psychiatric rehospitalization following discharge. However, given the retrospective observational design, residual imbalance in several measured covariates, and the possibility of unmeasured confounding, the findings should not be interpreted as establishing a definitive causal effect of the Soteria model.

The average length of stay observed in our control group (approximately 41 days) reflects the broader context of psychiatric care in Israel. According to the [Israel Ministry of Health \(2022\)](#), the national average length of stay in psychiatric wards was 41 days in 2022, with a historical range of 42–50 days in the years preceding the COVID-19 pandemic. While this duration is significantly longer than the stays typical in the United States, where the average duration is approximately 6.6 days ([Owens et al., 2019](#)), it represents the standard of inpatient care in the Israeli public health system, providing a relevant benchmark for evaluating the association between the Soteria model and long-term outcomes.

Group differences associated with Soteria care were most pronounced at the two-year and two-and-a-half-year follow-up points, with lower readmission proportions observed in the Soteria group (41.5% and 45.1%, respectively) compared with traditional inpatient care (61.0% and 63.4%). Soteria patients also showed fewer readmission events and longer time-to-readmission intervals on average, with a hazard ratio of 1.66 indicating lower readmission hazard relative to the control group.

Moderation analyses provided additional nuance, highlighting that age moderated treatment outcomes. Younger patients (≤ 30 years) showed stronger associations between Soteria care and delayed readmission outcomes, including lower odds of readmission and longer times to first readmission compared with hospital-treated counterparts. These findings suggest that the observed association between Soteria care and delayed readmission may be more pronounced among younger individuals, particularly those earlier during psychiatric treatment. No significant moderation effects were identified for gender or previous hospitalization history.

This study used rigorous statistical controls including propensity score matching and multivariate modeling across four complementary dimensions of readmission. This comprehensive analytic approach strengthens the methodological rigor of the study and extends prior observational work, such as that of [Lichtenberg et al. \(2023\)](#), by incorporating matched comparison groups and multiple complementary readmission outcomes. Our findings also resonate with systematic reviews that point to the potential of residential models to perform on par with, or better than, traditional inpatient care in terms of relapse prevention ([Gaebel et al., 2020](#); [Thomas and Rickwood, 2013](#)).

Previous studies have shown several factors and the complex interplay between them in reducing readmissions. These factors include individual vulnerability (e.g., treatment compliance, housing situation, substance abuse), aftercare factors (e.g., follow-up appointments, psychotherapy), community care, service responsiveness, social support, and medication adherence ([Johnson et al., 2018](#); [Müller et al., 2024](#); [Sfetcu et al., 2017](#)). Soteria homes, by design, incorporate many of these factors, offering a milieu that promotes self-efficacy, non-pathologizing

relationships, community care and social support, which may be associated with improved post-discharge continuity and reduced risk of rehospitalization.

A key strength of the current study is the use of stratified sensitivity analysis to account for differential diagnostic reporting between settings. Although the magnitude of effects for binary and count outcomes was somewhat attenuated after rigorous balancing, the persistence of the **survival-analysis association** (time-to-readmission) indicates a genuine treatment association that is not merely an artifact of baseline diagnostic differences.

Nevertheless, several limitations should be acknowledged. First, the retrospective observational design precludes causal inference. Although propensity score matching improved balance across several measured covariates, residual imbalance remained for some variables, and unmeasured confounding cannot be excluded. Important clinical variables such as symptom severity, psychosocial functioning, treatment adherence, insight, motivation for treatment, outpatient follow-up, and social support were unavailable in the administrative registry dataset. Consequently, some of the observed associations may partially reflect selection processes or contextual differences between treatment settings rather than associations specific to the Soteria model itself. In addition, reliance on administrative registry data may have introduced diagnostic misclassification or variability in documentation practices across settings. Finally, the single-site Israeli design may limit generalizability to other mental health systems and models of psychiatric care, rather than associations specific to the Soteria model itself.

5. Conclusion

This study identified an association between treatment in a Soteria home and lower long-term psychiatric readmission rates compared with traditional inpatient care, with effects most evident among patients aged 30 and below. Individuals treated in Soteria showed lower odds of readmission, fewer readmission events, and longer time to first readmission. However, interpretive caution is warranted given the retrospective observational design, remaining imbalance in measured covariates, and the possibility of residual confounding. These findings therefore reflect a promising association rather than a definitive causal effect.

Future research, ideally prospective, randomized, or quasi-experimental, is needed to validate these results, identify mechanisms underlying reduced readmission, and determine the extent to which the Soteria model itself, as opposed to contextual or selection-driven factors, contributes to improved outcomes over time.

Data availability statement

Data is available in Mendeley Data (Friedlander, 2025): doi: 10.17632/rhh9 × 3tn8f.1

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CRediT authorship contribution statement

Avraham Friedlander: Writing – review & editing, Writing – original draft, Validation, Software, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Sinai Oren:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation. **Dana Sinai:** Validation, Software, Methodology, Formal analysis, Data curation. **Dana Tzur Bitan:** Supervision, Conceptualization. **Rinat Yoffe:** Data curation. **Renana Eitan:** Writing – review & editing, Writing – original draft, Supervision, Conceptualization. **Pesach Lichtenberg:** Writing – review

& editing, Supervision, Project administration, Methodology, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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