

## Journal Pre-proof

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DOI: <https://doi.org/10.22365/jpsych.2025.022>

To appear in: Psychiatriki Journal

Received date: 11 March 2025

Accepted date: 15 July 2025

**Please cite this article as:** Fotini Tsoli, Ioanna Athina Botsari, Nefeli Menti, Panagiota Kontoudi, Aikaterini Pouliasi, Vaios Peritogiannis, Similar cost-better results: the case of the hybrid Assertive Community Treatment model of care for severely mentally ill patients in rural Greece, Psychiatriki (2025), doi: <https://doi.org/10.22365/jpsych.2025.022>

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## BRIEF COMMUNICATION

### Similar cost-better results: the case of the hybrid Assertive Community Treatment model of care for severely mentally ill patients in rural Greece

Fotini Tsoli,<sup>1</sup> Ioanna Athina Botsari,<sup>2</sup> Nefeli Menti,<sup>1</sup> Panagiota Kontoudi,<sup>1</sup> Aikaterini Pouliasi,<sup>1</sup> Vaios Peritogiannis<sup>1</sup>

1. *Mobile Mental Health Unit of the prefectures of Ioannina and Thesprotia, Society for the Promotion of Mental Health in Epirus, Ioannina, Greece*
2. *Early Intervention in Psychosis Unit, University Mental Health Research Institute, Athens, Greece*

**ARTICLE HISTORY:** Received 11 March 2025 / Revised 12 July 2025 / Published Online 5 August 2025

#### -----ABSTRACT-----

The present study evaluated the impact of a hybrid Assertive Community Treatment (ACT) model of care on the direct medical costs of treating severe mental illness (SMI) patients in rural Greece. The study aimed to determine whether this model resulted in significant cost differences compared to usual treatment while also assessing its cost-effectiveness based on clinical improvements. A total of 23 patients with SMI and multiple hospitalizations were followed up for 16 months under the hybrid ACT model. Direct medical costs were estimated using previously published Greek data on schizophrenia treatment costs. Cost differences before and after the implementation of the hybrid ACT model were calculated, and cost-effectiveness was assessed using the Incremental Cost-Effectiveness Ratio (ICER), which reflects the cost per unit increase in Global Assessment of Functioning (GAF) scores. There was no statistically significant difference in direct medical costs between usual care (310,029€) and hybrid ACT care (313,896€), with a small cost increase of 3,867€ ( $p = 0.077$ ). However, hybrid ACT care significantly reduced hospitalizations and length of inpatient stay, leading to an 86.9% reduction in total inpatient days. Clinical improvements were also observed, with GAF scores increasing from 40.43 to 47.26. Cost-effectiveness analysis demonstrated a particularly low ICER of 25.9€ per GAF point gained, suggesting a cost-efficient intervention. In an alternative scenario, the 2024 pricing was estimated with the use of the Consumer Price Index. In this case, the hybrid ACT care appeared to be significantly cost-saving by 25.5%. A rough estimation of indirect costs revealed further cost savings in favor of the hybrid ACT. The hybrid ACT model proved to be cost-effective due to its strong impact on reducing inpatient care and improving patient functioning. These findings align with international studies demonstrating the economic and clinical benefits of community-based mental health care. Future research should focus on larger, multicenter studies to confirm cost-effectiveness and explore the impact on indirect costs, such as caregiver burden and law enforcement involvement. The results support further investment in hybrid ACT services in rural Greece to enhance mental health care delivery in low-resourced settings.

**KEYWORDS:** Assertive community treatment, cost-effectiveness, functioning, rural areas, severe mental illness, treatment cost.

**Corresponding Author:** Vaios Peritogiannis, Mobile Mental Health Unit of the prefectures of Ioannina and Thesprotia, Society for the Promotion of Mental Health in Epirus, 58 T. Pashidi street, GR-454 45, Ioannina, Greece, E-mail: [vaios.peritogiannis@medai.gr](mailto:vaios.peritogiannis@medai.gr)

## Introduction

Severe mental illness (SMI), such as schizophrenia-spectrum disorders and bipolar disorder, is still one of the leading causes of disability and economic burden worldwide.<sup>1</sup> The economic burden of SMI is usually categorized as direct, indirect, and intangible costs, the latter being difficult to measure and often omitted from research.<sup>2</sup> Direct medical costs include expenditure on inpatient care, emergency department visits, community-based care, long-term institutional care, etc., whereas direct nonmedical costs include transportation and social services among other components. Indirect costs refer to productivity loss due to morbidity and premature mortality, such as unemployment, disability, and early retirement for patients or caregivers.<sup>2</sup>

In Greece, there is only a previous study that addressed the direct cost of the treatment of schizophrenia in a comprehensive manner,<sup>3</sup> but research on the cost of the treatment of SMI in rural areas is lacking. In rural Greece, mental healthcare for patients with SMI is being delivered by the locally based Mobile Mental Health Units (MMHUs),<sup>4,5</sup> whereas in recent years a hybrid Assertive Community Treatment (ACT) model of care has been established, to address the needs of the most severely ill and difficult to engage patients.<sup>6</sup>

The objective of the present study was to estimate the changes in the cost of treatment in patients with SMI who received the comprehensive care delivered by a hybrid ACT team in a defined rural catchment area in Greece.

## Materials and methods

The basic principles of the hybrid ACT model in Greek rural areas have been previously described in detail.<sup>6</sup> In summary, a team of 4 mental health specialists (psychiatrist, psychologist, social worker, and nurse) delivers intensive mental health care for patients with severe mental disorders over working hours, based exclusively on regular home visits. That team is an expansion of the well-established MMHU of the area. The results of the hybrid ACT model in rural areas in the Epirus region, Northwest Greece, have been recently reported.<sup>7</sup> Briefly, over a mean 16-month follow-up of 23 patients with SMI and multiple previous hospitalizations, involuntary admissions were reduced by 80.1%; voluntary admissions were reduced by 82.3%; whereas inpatient stay was reduced by 86.9%, from 52.83 to 6.91 days. Moreover, patients' functioning was significantly improved (scores in the Global Assessment of Functioning (GAF) scale from 40.43 to 47.26). The symptomatology of patients measured with the Brief Psychiatric Rating Scale (BPRS) was also significantly improved (from 42.91 to 36.68). Those data were further processed for the evaluation of cost differences concerning established treatments.

For the estimation of treatment costs in the present sample of patients, we used previously published data from Greece regarding the cost of treating patients with schizophrenia.<sup>3</sup> According to that study, the direct annual cost of treating schizophrenia in Greece in 2005 was 10135€ for the subgroup of patients with a 100% possibility of a 50-day inpatient stay in 1 year, which corresponds to the mean 52.83-day inpatient stay of the present sample over 16 months. The 16-month follow-up was achieved within a 3-year operation of the hybrid ACT team; accordingly, the 3-year operating cost of the hybrid ACT team was considered.

In an alternative scenario, we adjusted 2005 cost estimates to the pricing year 2024, with the use of the consumer price index (CPI) data, a methodology that has been previously used in research.<sup>8</sup> According to the Hellenic Statistical Authority,<sup>9</sup> the CPI in Greece in the years 2005 and 2024 was 84.75 and 117.98, respectively. Subsequently, it was hypothesized that 2024 direct treatment costs would be 1.392 times higher than 2005 costs.

A standard deviation of 10000€ was assumed based on ranges reported in similar

economic evaluations of mental health interventions.<sup>10</sup> A normal distribution of cost differences was assumed, consistent with the Central Limit Theorem and common practice in economic evaluations. This assumption allows for the use of a paired t-test to assess statistical significance in pre- and post-intervention cost comparisons, even in studies with small sample sizes.

For the performance of a cost-effectiveness analysis, the average cost-effectiveness ratio (ACER)

$$\text{ACER} = \frac{\text{The average cost of each patient}}{\text{GAF value increase unit}}$$

and the incremental cost-effectiveness ratio (ICER)

$$\text{ICER} = \frac{\text{Average cost with the ACT treatment} - \text{Average cost prior to ACT treatment}}{\text{GAF with ACT treatment} - \text{GAF prior to ACT treatment}}$$

were used. The ICER indicates the mean additional mental healthcare costs, which must be spent to gain one additional point in the GAF scale in patients assigned to the hybrid ACT treatment.

A gross estimation of indirect treatment costs was also attempted. According to previous European data,<sup>8</sup> the average proportion of indirect costs in total costs was 44%. Furthermore, previous research has shown that improvement in patients' functioning, measured by the GAF, is associated with significant cost savings.<sup>11</sup> Although previous studies have adopted a binary approach regarding the association of the GAF scores with cost savings, in this study, we considered a continuous approach. Accordingly, the previously reported increase in the GAF score of 16.9% in the present sample was assumed to result in at least a 10% decrease in indirect costs.

## Results

The expected cost of care of the 23 patients before engagement with the hybrid ACT team was estimated at 310029€, according to the 2005 data. The cost of the inpatient treatment over the 16-month follow-up by the hybrid ACT team (19071€) was added to the operating cost of the team (294825€). Table 1 shows the calculation of different costs. A paired t-test was conducted to assess whether the observed cost difference of 3867€ before and after the implementation of the hybrid ACT model was statistically significant. Given the lack of individual cost data, an assumed standard deviation of 10000€ was used for both pre- and post-treatment costs, based on similar economic evaluations. The analysis yielded a t-statistic of 1.85 and a p-value of 0.077, indicating that the cost difference was not statistically significant at the  $p < 0.05$  level. The ACER and ICER values were 1998.2€ and 25.9€, respectively.

Table 2 presents the 2024 direct treatment cost projection. It appears that the operation of the hybrid ACT led to significant cost-saving (110198€ or 25.5%), alongside symptomatology and functioning improvement. In this scenario, the ACER and ICER values were negative.

Regarding indirect costs, their proportion (44%) in total costs was estimated at 7963€ in 2005 prices, or 11085€ in 2024 projected prices per patient per year. Accordingly, a further 24358€ or 33909€ cost reduction, respectively, would be expected, due to the operation of the hybrid ACT (Table 3). Figure 1 depicts the cost-effectiveness of the intervention in each cost scenario (2005 and 2024, respectively).

## Discussion

The present study addressed the impact of a hybrid ACT model of care for difficult-to-engage treatment SMI patients in rural Greece on the direct medical costs of care. Based on 2005 pricing data, there were no significant differences between the expected cost of care of patients with usual treatments and the cost of hybrid ACT care. However, the hybrid ACT model demonstrated clear clinical benefits, as reflected in the improved GAF scores and the ICER of 25.9€/GAF point, highlighting its potential value in mental health care delivery. In other words, the ICER of 25.9€/GAF point suggests that the added cost resulted in clinically meaningful improvements in patient functioning. Even more positive results were revealed with the projection of 2024 pricing data. In that case, cost savings were estimated as high as 25.5%. Furthermore, the hybrid ACT delivered care resulted in a significant reduction of patients' hospitalizations and inpatient stay, and a significant improvement in patients' symptomatology.<sup>7</sup> An evaluation of a modified ACT model of care in Germany showed that the model was less costly and more effective compared with standard care in patients with SMI over 12 months. The favorable effects of that care on cost were mainly attributed to the significantly reduced inpatient treatment and the improvement of patients' symptomatology and functioning,<sup>12</sup> as is the case in the present study. A previous study in Spain also yielded similar results, as better patients' functioning was found to be correlated with lower care costs.<sup>13</sup> A recent study in Italy suggested that both symptom severity and functioning were predictors of direct treatment costs.<sup>14</sup> Finally, a previous review on the cost of schizophrenia in Europe identified several factors, such as hospitalization, symptomatology, and adherence, that have a substantial impact on direct healthcare costs of schizophrenia. Accordingly, the authors suggested that substantial savings could potentially be achieved by investing in the improvement of the efficiency of outpatient care, which would reduce the number of hospitalizations.<sup>15</sup>

The present study addressed the impact of hybrid ACT care on direct medical treatment costs, such as inpatient service use in SMI patients, whereas indirect costs associated with the care of schizophrenia, such as productivity loss of patients or informal care provided by caregivers for the patients, were only roughly considered. A recent study in the USA reported that the indirect costs of the care of schizophrenia represent 73.4% of the total costs. Importantly, 32.7% of the costs involved caregiving, whereas a further 7.6% of the costs involved law enforcement services.<sup>16</sup> Though the present study did not account for the latter costs, it is expected that they would be reduced due to the significant reduction in involuntary admissions and police involvement. It has been recently suggested that indirect costs of SMI are correlated with patients' symptomatology.<sup>17</sup> Accordingly, it would be expected that indirect costs to be significantly reduced in the present sample of patients, due to the observed improvement in symptomatology and functioning,<sup>7</sup> thus strengthening the case of hybrid ACT care delivery in rural areas of Greece. Indeed, the rough estimation of indirect costs in the present study, based on the improvement of patients' functioning and using European data on indirect costs of schizophrenia, revealed further cost savings. It should also be noted that the introduction of the hybrid ACT model of care may eliminate some of the direct non-medical costs associated with the care of schizophrenia, such as transportation, due to the care delivery exclusively with home visits and social work, which is integrated into the interdisciplinary team. Research on the economic evaluation of MMHUs in rural Greece is rare. Indeed, there is only one previous study that mostly involved common mental disorders in an insular area, which suggested that the MMHU is a cost-effective treatment option in remote areas.<sup>18,19</sup>

A limitation of the present study is that costs were calculated based on a previous report that used 2005 data, which represents the most comprehensive effort to calculate the cost of treatment of schizophrenia in Greece so far. Perhaps costs have changed over the last 20 years, particularly considering the economic recession in Greece in 2010 and the more recent

COVID-19 pandemic. The projection of costs in 2024 pricing was based solely on the CPI, which is an acceptable method for cost adjustment, but still may not be accurate. Other limitations that may impact the generalizability of findings include the small study sample and the study of a single hybrid ACT team.

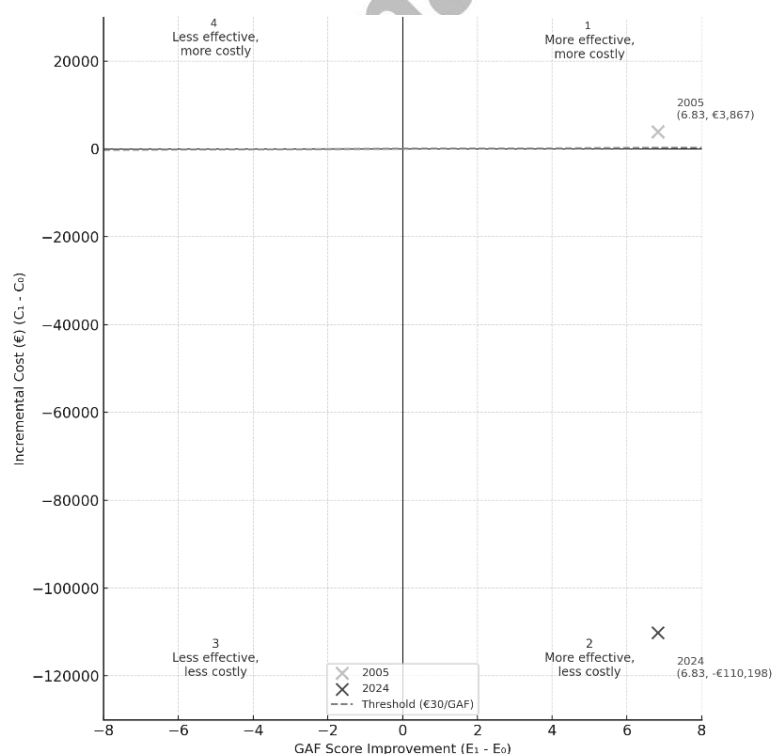
The results of the present study are relevant and highlight the positive impact of a low-cost modified version of a highly resourced specialized service on the cost of care of severely mentally ill patients in rural areas. Along with the previously reported notion that this type of care may improve symptomatology and functioning in those patients,<sup>7</sup> the findings of the present study could be relevant for mental healthcare and policy in rural and low-resourced settings.

The results reported here are encouraging and support the role of hybrid ACT care in the treatment of SMI in rural areas. It appears that a particularly small amount of further investment may result in a great reduction of inpatient treatment and significant improvements in patients' symptomatology and functioning, thus merits consideration by the Greek state. It is also possible that such positive results may result in significant cost savings. However, the present results warrant replication by multicenter studies, with the participation of large samples of patients, designed to address the cost-effectiveness of hybrid ACT care in rural settings.

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**Figure 1.** Cost-effectiveness plane comparing the hybrid ACT intervention in 2005 and 2024 pricing scenarios. The horizontal axis represents the change in effectiveness (GAF score improvement), and the vertical axis shows incremental cost relative to standard care. The light grey point (Quadrant I) indicates a minimal cost increase (€3867) in 2005, with improved outcomes. The dark grey point (Quadrant II) reflects the 2024 projection, showing both improved outcomes and a significant cost saving (€110198). The dashed line represents a threshold of €30 per GAF point gained.

**Table 1.** Estimation of the cost difference between the previous treatment and treatment by the hybrid ACT team

Variable	Calculation
Previously expected total direct medical cost for 16 months	$10135\text{€}^* \times 23\text{patients} \times 1.33\text{year} = 310029\text{€}$
Inpatient treatment cost over the 16-month follow-up	$6.91\text{days} \times 23\text{patients} \times 120\text{€}^{**} = 19071\text{€}$
Total operating cost of the hybrid ACT team (3 years)	294825€
Cost difference	$294825 + 19071 - 310029 = 3867\text{€}$

\*Estimated annual cost per patient; \*\*daily hospitalization cost (2005 price); ACT: Assertive Community Treatment

**Table 2.** Projected estimation of the cost difference between the previous treatment and treatment by the hybrid ACT team for the year 2024

Variable	Calculation
Previously expected total direct medical cost for 16 months	$14108\text{€}^* \times 23\text{patients} \times 1.33\text{year} = 431564\text{€}$
Inpatient treatment cost over the 16-month follow-up	$6.91\text{days} \times 23\text{patients} \times 167\text{€}^{**} = 26541\text{€}$
Total operating cost of the hybrid ACT team (3 years)	294825€
Cost difference	$294825 + 26541 - 431564 = -110198\text{€}$

\*Projected estimated annual cost per patient; \*\*daily hospitalization cost (projected price); ACT: Assertive Community Treatment

**Table 3.** Estimated indirect cost reduction due to the functioning improvement

2005 pricing data	$7963\text{€} \times 23 \text{ patients} \times 1.33\text{year} \times 10\% \text{ due to GAF improvement} = 24358\text{€}$
2024 projected pricing data	$11085\text{€} \times 23 \text{ patients} \times 1.33\text{year} \times 10\% \text{ due to GAF improvement} = 33909\text{€}$

## ΣΥΝΤΟΜΟ ΑΡΘΡΟ

**Παρόμοιο κόστος – καλύτερα αποτελέσματα: Η περίπτωση του υβριδικού μοντέλου Ενεργητικής Κοινωνικής Θεραπείας για ασθενείς με σοβαρές ψυχικές διαταραχές σε περιοχές της ελληνικής επαρχίας**

**Φωτεινή Τσόλη,<sup>1</sup> Ιωάννα Αθηνά Μπότσαρη,<sup>2</sup> Νεφέλη Μεντή,<sup>1</sup> Παναγιώτα Κοντούδη,<sup>1</sup> Αικατερίνη Πουλιάση,<sup>1</sup> Βάιος Περιτογιάννης<sup>1</sup>**

1. *Κινητή Μονάδα Ψυχικής Υγείας Ιωαννίνων-Θεσπρωτίας, Εταιρεία Προαγωγής Ψυχικής Υγείας Ηπείρου, Ιωάννινα*
2. *Μονάδα Έγκαιρης Παρέμβασης στην Ψύχωση, Ερευνητικό Πανεπιστημιακό Ινστιτούτο Ψυχικής Υγιεινής, Αθήνα*

**ΙΣΤΟΡΙΚΟ ΑΡΘΡΟΥ:** Παραλήφθηκε 11 Μαρτίου 2025 / Αναθεωρήθηκε 12 Ιουλίου 2025 / Δημοσιεύθηκε Διαδικτυακά 5 Αυγούστου 2025

### ΠΕΡΙΛΗΨΗ

Η παρούσα μελέτη εξέτασε τον αντίκτυπο του υβριδικού μοντέλου Ενεργητικής Κοινωνικής Θεραπείας (Assertive Community Treatment, ACT) στο άμεσο ιατρικό κόστος της θεραπείας ατόμων με σοβαρές ψυχικές διαταραχές στην ελληνική επαρχία. Στόχος ήταν να προσδιοριστεί κατά πόσον το μοντέλο οδηγεί σε σημαντικές διαφορές κόστους σε σύγκριση με τη συνήθη φροντίδα, καθώς και να εκτιμηθεί η οικονομική του αποδοτικότητα με βάση τη βελτίωση στην λειτουργικότητα των ασθενών. Συνολικά 23 ασθενείς με σοβαρές ψυχικές διαταραχές και πολλαπλές νοσηλείες παρακολούθηθηκαν για 16 μήνες από την υπηρεσία ACT. Το άμεσο ιατρικό κόστος εκτιμήθηκε χρησιμοποιώντας προηγούμενα δημοσιευμένα ελληνικά δεδομένα για το κόστος θεραπείας της σχιζοφρένειας. Υπολογίστηκαν οι διαφορές κόστους πριν και μετά την εφαρμογή του μοντέλου και η αποδοτικότητα αξιολογήθηκε μέσω του λόγου κόστους-αποτελεσματικότητας (Incremental Cost-Effectiveness Ratio - ICER), ο οποίος εκφράζει το κόστος ανά μονάδα αύξησης της βαθμολογίας στην κλίμακα λειτουργικότητας Global Assessment of Functioning (GAF). Δεν υπήρξε στατιστικά σημαντική διαφορά στο άμεσο ιατρικό κόστος μεταξύ της συνήθους περίθαλψης (310029€) και της φροντίδας ACT (313896€), με μια μικρή αύξηση κόστους 3867€ ( $p = 0,077$ ). Ωστόσο, η φροντίδα ACT μείωσε σημαντικά τις νοσηλείες και τη διάρκεια νοσηλείας, επιφέροντας μείωση 86,9% στις συνολικές ημέρες νοσηλείας. Παρατηρήθηκε επίσης αύξηση της βαθμολογίας GAF από 40,43 σε 47,26. Η ανάλυση κόστους-αποτελεσματικότητας έδειξε εξαιρετικά χαμηλό ICER 25,9€ ανά βαθμό GAF, υποδεικνύοντας μια οικονομικά αποδοτική παρέμβαση. Σε μία εναλλακτική υπόθεση υπολογίστηκε το κόστος της φροντίδας κατά το έτος 2024 με τη χρησιμοποίηση του Δείκτη Τιμών Καταναλωτή. Σε αυτή την περίπτωση η φροντίδα από την υβριδική ACT ήταν σημαντικά πιο οικονομική κατά 25,5%. Ο αδρός υπολογισμός του έμμεσου κόστους της φροντίδας των ασθενών με σοβαρές ψυχικές διαταραχές από την υβριδική ACT αποκάλυψε περαιτέρω μείωση του κόστους. Το υβριδικό μοντέλο ACT αποδεικνύεται οικονομικά αποδοτικό λόγω της επίδρασης του στη μείωση των νοσηλείων και στη βελτίωση της λειτουργικότητας των ασθενών, ενδέχεται μάλιστα να οδηγεί σε εξοικονόμηση πόρων. Μελλοντικές έρευνες θα πρέπει να επικεντρωθούν σε μεγαλύτερες πολυκεντρικές μελέτες για την επιβεβαίωση της σχέσης κόστους-αποτελεσματικότητας και τη διερεύνηση του αντίκτυπου στο έμμεσο κόστος, όπως η

επιβάρυνση των φροντιστών και η εμπλοκή των αρχών επιβολής του νόμου. Τα αποτελέσματα υποστηρίζουν περαιτέρω επενδύσεις σε υβριδικές υπηρεσίες ACT στην ελληνική επαρχία για τη βελτίωση της ψυχιατρικής περίθαλψης σε περιβάλλοντα με περιορισμένους πόρους.

**ΛΕΞΕΙΣ ΚΥΡΕΤΗΡΙΟΥ:** Επαρχία, κόστος θεραπείας, λειτουργικότητα, ενεργητική κοινοτική θεραπεία, σοβαρές ψυχικές διαταραχές, σχέση κόστους/αποτελεσματικότητας.

**Επιμελητής συγγραφέας:** Βάιος Περιτογιάννης, Κινητή Μονάδα Ψυχικής Υγείας Ιωαννίνων-Θεσπρωτίας, Εταιρεία Προαγωγής Ψυχικής Υγείας Ηπείρου, Θ. Πασχίδη 58, 454 45, Ιωάννινα, Ελλάδα, E-mail: [vaios.peritogiannis@medai.gr](mailto:vaios.peritogiannis@medai.gr)

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