

Forest therapy and ecosystem services

Scientific evidence on forests and human well-being; environmental prerequisites

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The poster features a background of a forest canopy with a blue sky, divided into geometric shapes. The text is arranged in a clean, modern layout with a color palette of orange, blue, and white.

 **Mediterranean** | **FORUM/26**
Network

WEBINAR SERIES

 **SESSION #2**

**Forest therapy: integrating
environmental science, medicine
and economics**

Led by the Mediterranean Model Forest Network

17 February 2026
(10 - 11:30 CET)
Online

FOREST THERAPY: Nature, Scope and Aims

As any other health intervention, **Forest Therapy must be administered by clinical professionals**, generally recognized as **Psychoterapists**, also aimed at the **timely identification and mitigation of possible individual risks**

Intervention \equiv **“Therapy”** if **significance and size of effects are known** on specific populations / cohorts, either general population if applicable, or patients affected by potentially treatable syndromes, also related to personal traits and/or stages of the disease

- **Forest immersion guided by clinical professionals**, consisting of minimal sensory focus on the surrounding environment;
- **Individual health intervention**, unlike all other forest immersion modalities (individual or group health/preventative practices).
- **Suitable sites**: accessibility, safety, environmental quality and properties, and direct evidence of the effects on people.

CNR-CAI CONDUCTION METHOD

Essential, interoperable



- Simple, structured and interoperable
- Faithfully reproducible by different therapists
- Adaptable to different environments
- Encourages exploration through the senses
- Encourages individual immersion

ISTRUZIONI PER SESSIONI SPERIMENTALI DI TERAPIA FORESTALE	
1	Ritrovo al punto d'incontro: partecipanti, Psicologo e operatore CAI
2	Presentazione dello Psicologo e delle attività previste - 5 minuti
3	Richiesta di presentazione da parte dei singoli partecipanti per chi lo desidera - 15 minuti
4	Pre Somministrazione test (istruzioni e compilazione) - 15 minuti
Totale parte reception e compilazione test (pre) considerare almeno 60 minuti (1h)	
5	Inizio attività: richiesta di spegnimento telefono e di massima riduzione degli scambi verbali
6	Percezione visiva - 15 minuti (intorno a un punto)
7	Camminata lenta per circa 400 m - 5 minuti
8	Percezione uditiva - 15 minuti (intorno a un punto)
9	Camminata lenta per circa 400 m - 5 minuti (progressivi 800 m)
10	Percezione tattile - 15 minuti (intorno a un punto)
11	Camminata lenta per circa 400 m - 5 minuti (progressivi 1.200 m)
12	Percezione olfattiva - 15 minuti (intorno a un punto)
13	Camminata lenta per circa 400 m - 5 minuti (progressivi 1.600 m)
Totale prima parte strutturata 80 minuti (1h 20 min)	
14	Attività percettiva e di movimento scelta a piacere da ogni partecipante - 20 minuti
15	Camminata per ritorno al punto di partenza/punto di arrivo, per circa 1.600 m - 20 minuti
Totale attività in foresta 120 minuti (2h)	
16	Post Somministrazione test - 15 minuti - <i>(il test deve essere disponibile e somministrato alla fine del percorso sia esso lo stesso punto di partenza oppure un punto di arrivo diverso)</i>
17	Chiusura delle attività
18	Condivisione dell'esperienza in gruppo (debriefing) - 30 minuti max
Note	<p>Per stimolare l'attenzione attraverso uno specifico senso può essere utile suggerire alle persone di ripetersi mentalmente: io vedo....., io ascolto....., io tocco... , io annuso.... facendo seguire l'oggetto della percezione (io vedo un albero, io ascolto il cinguettio di un uccello, io tocco la terra, io annuso un fiore).</p> <p>Per quanto riguarda l'udito, il tatto e l'olfatto l'attività può essere suddivisa in una sotto-sezione dove chiedere di focalizzare l'attenzione sullo specifico senso tenendo chiusi gli occhi (ultimi 5 minuti dei 15 previsti). La richiesta di chiudere gli occhi può creare disagio, dunque è un invito e non un obbligo. Chi non riesce è libero di tenerli aperti.</p>

STAZIONE DELL'OLFATTO
THE SMELL STATION

ELABORAZIONE/GRAPHICS: ENTE MONTI CIMINI - RISERVA NATURALE LAZIO DI VICO
CONTENUTI/TEXTS: CNR IBE

PERCORSO DI TERAPIA FORESTALE **FOREST THERAPY PATHWAY**

- PER 15 MINUTI FERMATI QUI E PROVA A CONCENTRARTI SULLE SENSAZIONI OLFATTIVE CHE LA NATURA TI INFONDE.
- QUANDO ARRIVA UN PENSIERO CHE TI DISTRAE, LASCIALO ANDARE E RIPORTA LA TUA ATTENZIONE SU QUELLO CHE STAVI ANNUSANDO.
- PUOI AIUTARTI RIPETENDO MENTALMENTE "IO ANNUSO..." ESPORANDO GLI ODORI, O SEMPLICEMENTE CONCENTRARTI SUL TUO RESPIRO.
- SE TI SENTI A TUO AGIO, PUOI PROVARE A CHIUDERE GLI OCCHI.

- STOP HERE FOR 15 MINUTES AND TRY TO CONCENTRATE ON THE OLFACATORY SENSATIONS THAT NATURE INSTILLS IN YOU.
- WHEN A THOUGHT DISTRACTS YOU, LET IT GO AND FOCUS BACK ON WHAT YOU WERE SMELLING.
- YOU CAN MENTALLY REPEAT "I SMELL ..." EXPLORING THE FOREST SCENTS OR JUST FOCUS ON YOUR BREATHING.
- IF YOU FEEL COMFORTABLE, YOU CAN TRY CLOSING YOUR EYES.

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STAZIONE DEL TATTO
THE TOUCH STATION

ELABORAZIONE/GRAPHICS: ENTE MONTI CIMINI - RISERVA NATURALE LAZIO DI VICO
CONTENUTI/TEXTS: CNR IBE

PERCORSO DI TERAPIA FORESTALE **FOREST THERAPY PATHWAY**

- PER 15 MINUTI RESTA QUI E PROVA A CONCENTRARTI SU QUELLO CHE LA NATURA TI TRASMETTE ATTRAVERSO IL TATTO.
- QUANDO ARRIVA UN PENSIERO CHE TI DISTRAE LASCIALO ANDARE E RIPORTA LA TUA ATTENZIONE SU QUELLO CHE STAI TOCCANDO.
- PUOI AIUTARTI RIPETENDO MENTALMENTE "IO TOCCO...", PER ESEMPIO "IO TOCCO UNA FOGLIA".
- SE TI SENTI A TUO AGIO, PUOI PROVARE A CHIUDERE GLI OCCHI.

- FOR THE NEXT 15 MINUTES FOCUS ON WHAT NATURE CONVEYS TO YOU THROUGH TOUCH.
- WHEN A THOUGHT DISTRACTS YOU, LET IT GO AND FOCUS BACK TO WHAT YOU WERE TOUCHING.
- YOU CAN MENTALLY REPEAT "I AM TOUCHING...", I.E. "I AM TOUCHING A TREE".
- IF YOU FEEL COMFORTABLE, YOU CAN TRY CLOSING YOUR EYES.

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STAZIONE DELL'UDITO
THE EARING STATION

ELABORAZIONE/GRAPHICS: ENTE MONTI CIMINI - RISERVA NATURALE LAZIO DI VICO
CONTENUTI/TEXTS: CNR IBE

PERCORSO DI TERAPIA FORESTALE **FOREST THERAPY PATHWAY**

- DEDICA 15 MINUTI PER CONCENTRARTI SU QUELLO CHE LA NATURA TI TRASMETTE ATTRAVERSO L'UDITO.
- QUANDO ARRIVA UN PENSIERO CHE TI DISTRAE LASCIALO ANDARE E RIPORTA LA TUA ATTENZIONE SU QUELLO CHE STAVI ASCOLTANDO.
- PUOI AIUTARTI RIPETENDO MENTALMENTE "IO ASCOLTO...", PER ESEMPIO "IO ASCOLTO UN UCCELLINO, IL VENTO" ECC.
- SE SEI A TUO AGIO PUOI PROVARE A CHIUDERE GLI OCCHI

- FOR THE NEXT 15 MINUTES FOCUS ON WHAT NATURE CONVEYS TO YOU THROUGH HEARING.
- WHEN A THOUGHT DISTRACTS YOU, LET IT GO AND FOCUS BACK TO WHAT YOU WERE HEARING.
- YOU CAN MENTALLY REPEAT "I HEAR ...", I.E. "I HEAR A BIRD, THE WIND", ETC.
- IF YOU FEEL COMFORTABLE, YOU CAN TRY CLOSING YOUR EYES.

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STAZIONE DELLA VISTA
THE SIGHT STATION

ELABORAZIONE/GRAPHICS: ENTE MONTI CIMINI - RISERVA NATURALE LAZIO DI VICO
CONTENUTI/TEXTS: CNR IBE

PERCORSO DI TERAPIA FORESTALE **FOREST THERAPY PATHWAY**

- PER 15 MINUTI RESTA QUI E PROVA A CONCENTRARTI SU QUELLO CHE LA NATURA TI TRASMETTE ATTRAVERSO LA VISTA.
- QUANDO ARRIVA UN PENSIERO CHE TI DISTRAE, LASCIALO ANDARE E RIPORTA LA TUA ATTENZIONE SU QUELLO CHE STAVI OSSERVANDO.
- PUOI RIPETERTI MENTALMENTE "IO VEDO...", PER ESEMPIO "IO VEDO UNA NUVOLE, IO VEDO UN FIORE", ECC.

- FOR THE NEXT 15 MINUTES FOCUS ON WHAT NATURE CONVEYS TO YOU THROUGH THE SIGHT.
- WHEN A THOUGHT DISTRACTS YOU, LET IT GO AND FOCUS BACK TO WHAT YOU WERE OBSERVING.
- YOU CAN MENTALLY REPEAT "I SEE ...", I.E. "I SEE A CLOUD, I SEE A FLOWER", ETC.

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STAZIONE MULTISENSORIALE
MULTI-SENSORY STATION

ELABORAZIONE/GRAPHICS: ENTE MONTI CIMINI - RISERVA NATURALE LAZIO DI VICO
CONTENUTI/TEXTS: CNR IBE

PERCORSO DI TERAPIA FORESTALE **FOREST THERAPY PATHWAY**

- PER 20 MINUTI ESPLORA LA NATURA CON I SENSI CHE PREFERISCI, SCEGLIENDONE SOLO UNO O ANCHE ALTERNARNE DIVERSI, A OCCHI APERTI O CHIUSI;
- TRASCORSI I 20 MINUTI, PUOI RECARTI LENTAMENTE VERSO LA FINE DEL PERCORSO, CHE TERMINA IN CORRISPONDENZA DEL PUNTO DI PARTENZA.

- FOR 20 MINUTES EXPLORE NATURE WITH THE SENSES YOU PREFER, CHOOSING ONE OR MORE, WITH YOUR EYES OPENED OR CLOSED.
- AFTER 20 MINUTES, YOU CAN SLOWLY WALK TOWARDS THE END OF THE TRAIL, WHICH ENDS AT THE STARTING POINT.

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STRUCTURAL / ENVIRONMENTAL CRITERIA



- Natural woodland/forest (no plantations) or renaturalized (environmentally consistent).
- Sufficient vegetation density.
- Presence of surface water (preferable).
- Exposure: sunlight at least 9:00 am to 3:00 pm.
- Refuge/reception/ refreshment at the start/finish.
- Absence of artificial sounds ~ 70% of trail
- No grazing! (ticks, insects)

- Accessibility and safety
- Geomorphological features (slope)
- Context Features →
- Ecological-forestry characteristics →



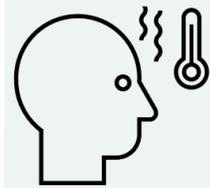
Low allergens



No grazing



VARIABLE ENVIRONMENTAL CRITERIA / DIRECTIONS (1)



Microclimate

Thermal comfort is a strong moderator

- **Report a comfort index**, not just T/RH: use **DI (Discomfort Index)** or **UTCI** alongside air T°, RH, wind, radiation.
- **Target “thermally neutral” conditions: DI 16–24** (benefits consistent mainly here).
- **Rule-of-thumb window:** aim ~**15–25 °C**, RH ~**40–70%**, light-to-moderate wind; **avoid warm-hot DI ≥25** days when effects become inconsistent.
- Key Refs: [Song et al. 2025 \(Sci Rep\)](#) · [Wang et al. 2025 \(J For Res\)](#)



BVOCs (Monoterpenes)

Dose depends on species, stand & timing

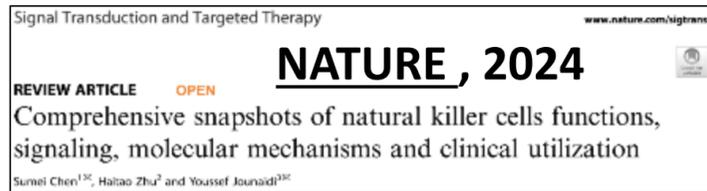
- **Typical field levels (temperate stands):** α -pinene ~ 60-200 ng/m³; Σ MTs ~80–300 ng/m³.
- **Pragmatic “site qualification” target (working threshold):** α -pinene $\geq 60 \mu\text{g}/\text{m}^3$ or $\Sigma(\text{monoterpenes}) \geq 80 \mu\text{g}/\text{m}^3$ during session hours (rank sites by seasonal distribution).
- **Where/when you maximize monoterpenes: older conifer stands** (often higher α -pinene), warm & dry early morning–afternoon, low wind; **avoid high O₃ episodes** (oxidizes BVOC) and high PM (adsorbs/attenuates).
- Key Refs: [Zhou et al. 2026 \(J For Res\)](#) · [Donelli et al. 2023 \(IJERPH\)](#) · [Meneguzzo et al. 2019 \(IJERPH\)](#)

MONOTERPENES: EVIDENCE

Molecule	Biological effects
α-pinene (conifers)	Anti-inflammatory, analgesic, antioxidant, antiproliferative, antiasthmatic. Anxiolytic, antidepressant, sedative.
Limonene (conifers)	Anti-inflammatory, analgesic, antioxidant, antiproliferative. Anxiolytic, antidepressant.
Camphene (mainly conifers)	Lipid-lowering, antioxidant, analgesic, antiproliferative.
Eucalyptol (eucalyptus, conifers)	Anti-inflammatory, anti-asthmatic.
o/p-cymene (broad-leaved trees)	Antimicrobial, anti-inflammatory, anti-hyperemic, anti-hemorrhagic.
Sabinene (beech)	Antimicrobial, anti-inflammatory, neuroprotective.

MECHANISMS

All Senses – Focus on Smell

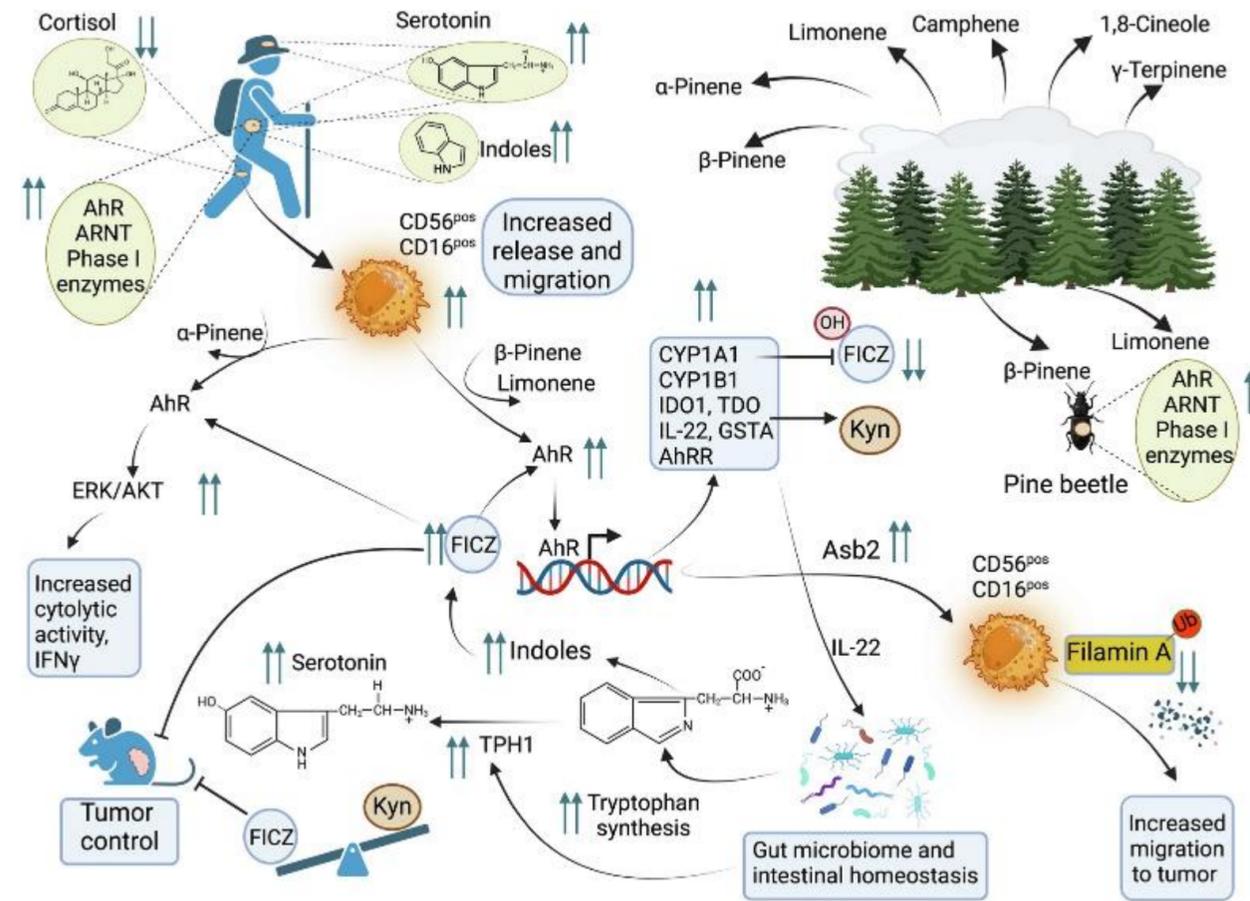


- **Direct anti-inflammatory activity**
- Synergistic increase in **Natural Killer (NK) cell activity**

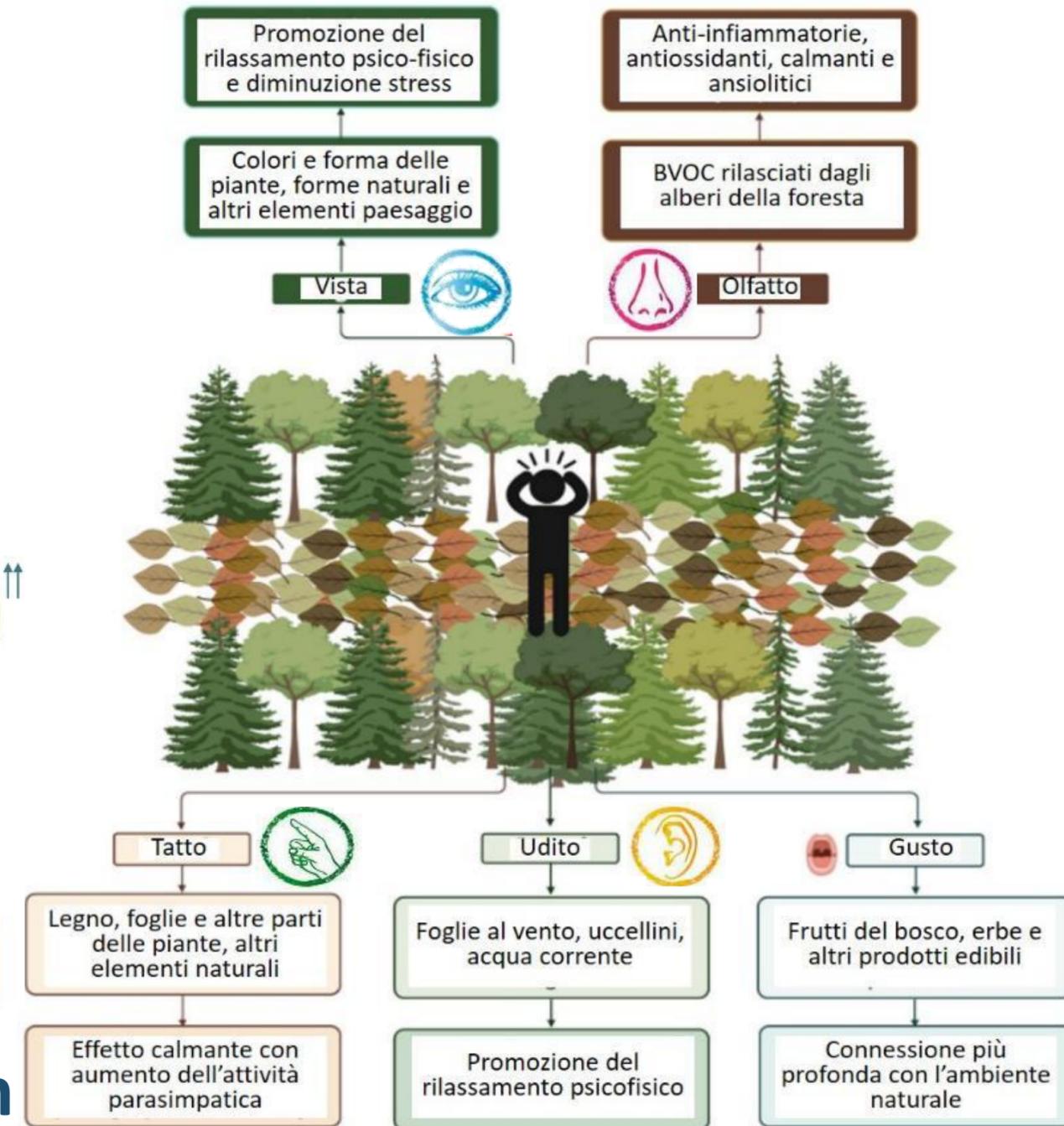
- Gut microbiota homeostasis

Synergy

- FT → reduction (always) **Cortisol** which is immunosuppressive → NK activation via MTs



Smell ≥ Hearing > Sight ~ Touch

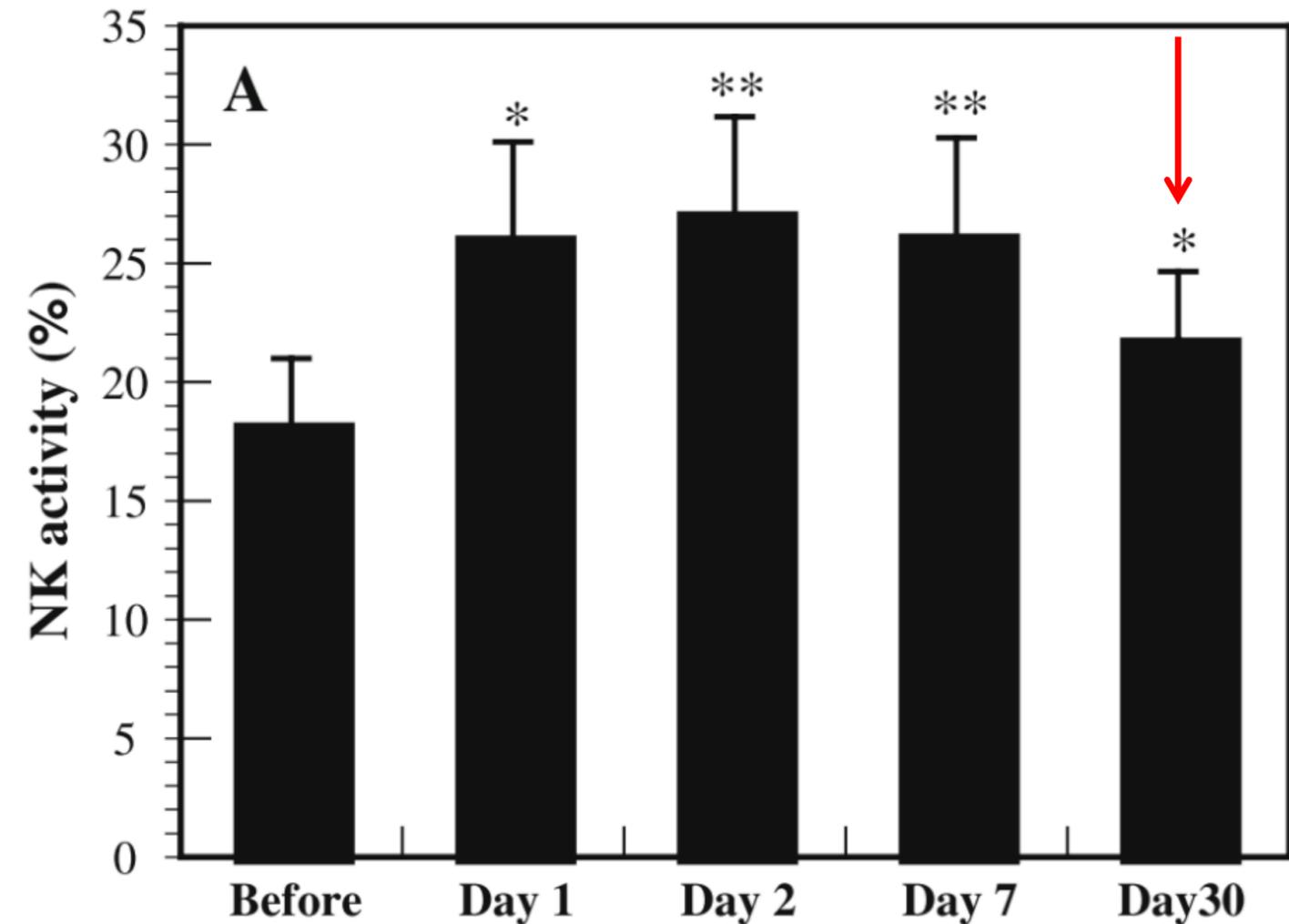


PERSISTENCE OF EFFECTS

Immune system

- 3 days / 2 nights in the forest vs. «normal» days
- Biomarker: NK activity values and the number of NK cells in the blood
Significant effects > baseline, up to a month later

Details of Persistence of physiological benefits are shared by psychological symptoms



[Li et al., 2010](#)

VARIABLE ENVIRONMENTAL CRITERIA / DIRECTIONS (2)



Negative Ions

Emerging player in nature-based healing

- **Typical magnitudes:** forest leisure areas can average ~6,000 ions/cm³ with waterfall-adjacent peaks up to ~68,000 ions/cm³ (context-dependent).
- **Pragmatic thresholds used in the literature:** >1,000 ions/cm³ is commonly treated as a “fresh air” benchmark; many forests can exceed this substantially.
- **Actionable “where to go” guidance:** pick moving water (waterfalls/streams), seafront forests (wave/aerosol charging), and conifer-rich areas; NAI tends to be suppressed by PM2.5 and shows strong diurnal dynamics, so measure during the actual session window.
- Key Refs: : [Zhou et al. 2026 \(J For Res\)](#) · [Liu et al. 2022 \(STOTEN\)](#) · [Jiang et al., Int. J. Mol. Sci., 2018](#)

Health effects of negative air ions (NAI)

- **Mood/depression: high-density NAI exposure** associated with reduced depression ratings, with weaker/inconsistent effects at low density ([Perez et al., BMC Psychiatry, 2013](#)).
- **Clinical trial evidence (SAD/depression):** Double-blind trials found high-density NAI improved depressive symptoms vs low-density control ([Terman & Terman, J Altern Complement Med, 1995](#); and related RCT evidence).
- **Field/nature context:** In a forest setting, higher NAI exposure has been linked to favorable autonomic regulation (HRV) and multi-omics signals consistent with reduced stress/inflammation ([Liu et al., Science of the Total Environment, 2022](#)).

**Mountain
(conifers +
waterstream /
waterfall)**



→ greater probability of monoterpenes (α -pinene)+ high NAI (especially near water)



**Coastal
pine forest**

→ marine aerosol + wave motion NAI
+ shading and thermal comfort

Mountain (pure beech stand)



→ typically, strong emission/concentration of monoterpenes (sabinene / cymene) + fascinating trees

FOREST THERAPY: EVIDENCE

Outcome cluster	Population / cohort	Effect (SMD / Cohen's d) + p	Evidence volume	Representative articles (2–3)
Mental health (stress/anxiety/depressive symptoms) + sleep + cortisol	Healthy adults (students/workers) + some clinical cohorts	Psychological ~0.5–1.0 Sleep/cortisol ~0.3–0.6 (mostly p<0.05–0.01)	Many	Zhang et al. (2023). https://doi.org/10.3390/f14091851 Bielinis et al. (2019). https://doi.org/10.3390/f10010034 Antonelli et al. (2019). https://doi.org/10.1007/s00484-019-01717-x
Cardiovascular & autonomic (BP, HRV) ± chronic heart failure	Middle-aged & older adults; hypertensive patients; CHF cohorts	BP/HRV ~0.3–0.6; p<0.05; cumulative with repeated sessions	Sufficient	Ideno et al. (2017). https://doi.org/10.1186/s12906-017-1912-z Mao et al. (2017). https://doi.org/10.3390/ijerph14040368 Li et al. (2025). https://doi.org/10.3389/fpubh.2025.1631613
Immune / inflammation markers (NK activity, cytokines)	Healthy adults + selected patient cohorts	~0.2–0.6; p<0.05 (heterogeneous endpoints)	Sufficient	Andersen et al. (2021). https://doi.org/10.3390/ijerph18041416 Tsao et al. (2018). https://doi.org/10.18632/oncotarget.24741 Wei et al. (2026). https://doi.org/10.1265/ehpm.25-00333
Cognitive function / cognitive decline (older adults)	Elderly with cognitive decline or aging cohorts	~0.3–0.7; p<0.05	Sufficient	Park et al. (2024). https://doi.org/10.12779/dnd.2024.23.1.44 Ramanpong et al. (2025). https://doi.org/10.1016/j.ufug.2025.128667 Law et al. (2026). https://doi.org/10.1186/s40795-026-01240-4
Neurorehabilitation: post-stroke functional recovery	Adults after ischemic stroke (acute and chronic)	~0.5–0.8; p<0.05	Few	Lee et al. (2024). https://doi.org/10.1016/j.ufug.2024.128537 Chun et al. (2017). https://doi.org/10.3109/00207454.2016.1170015
Respiratory: COPD + asthma (symptoms; lung function; biomarkers)	Older adults with COPD or at risk; children/adolescents with asthma	~0.3–0.8; p<0.05	Few	Jia et al. (2016). https://doi.org/10.3967/bes2016.026 Li et al. (2025). https://doi.org/10.1093/joccu/uaif041 Donelli et al. (2023). https://doi.org/10.3390/f14102012
Dermatologic: atopic dermatitis (symptoms/QoL; caregiver stress)	Children + caregivers/families	~0.4–0.8; p<0.05	Few	Kim et al. (2023). https://doi.org/10.3390/f14040758 Seo et al. (2015). http://ijaai.tums.ac.ir/index.php/ijaai/article/view/415
Pain/fatigue: fibromyalgia (pain mechanisms; affective burden)	Mostly women; fibromyalgia ± chronic fatigue	~0.3–0.6; p<0.05	Few	Gungormus et al. (2024). https://doi.org/10.1016/j.pmn.2023.06.014 Serrat et al. (2025). https://doi.org/10.3390/healthcare13141654

NATIONAL AGREEMENT ON FOREST THERAPY

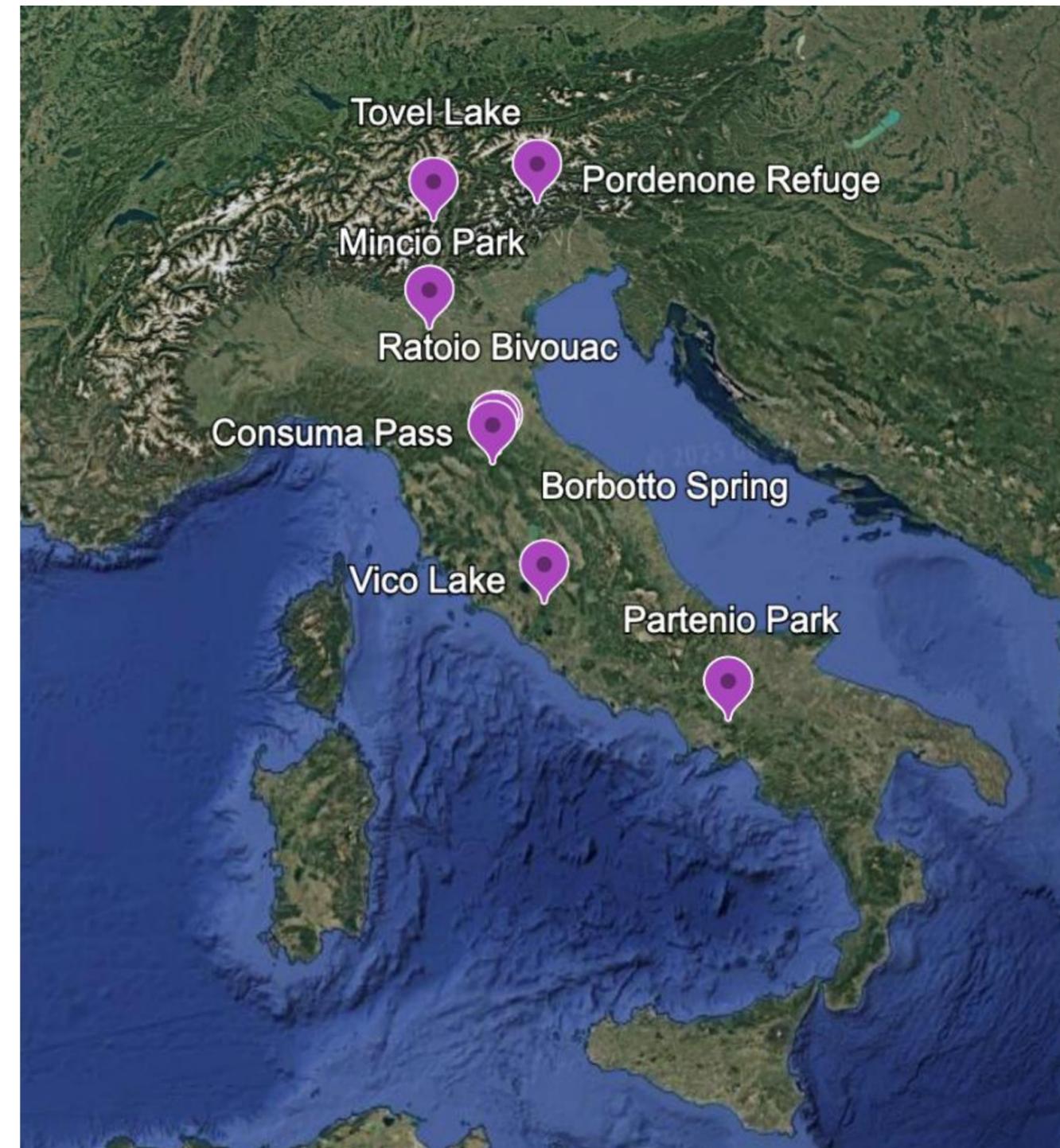
Objectives

- Single national reference standard.
- Register of qualified stations based on objective criteria.
- "Green prescriptions" → recognition by the National Health Service (NHS) as a preventive and complementary medical therapy.



Forest Therapy

*Added value of therapist guidance
and overall economic value
Early assessment*



behavioral sciences



Article

Therapist-Guided Versus Self-Guided Forest Immersion: Comparative Efficacy on Short-Term Mental Health and Economic Value

Rosa Riviaccio ^{1,†} , Francesco Meneguzzo ^{2,3,*,†} , Giovanni Margheritini ³, Tania Re ⁴, Ubaldo Riccucci ⁵
and Federica Zabini ² 



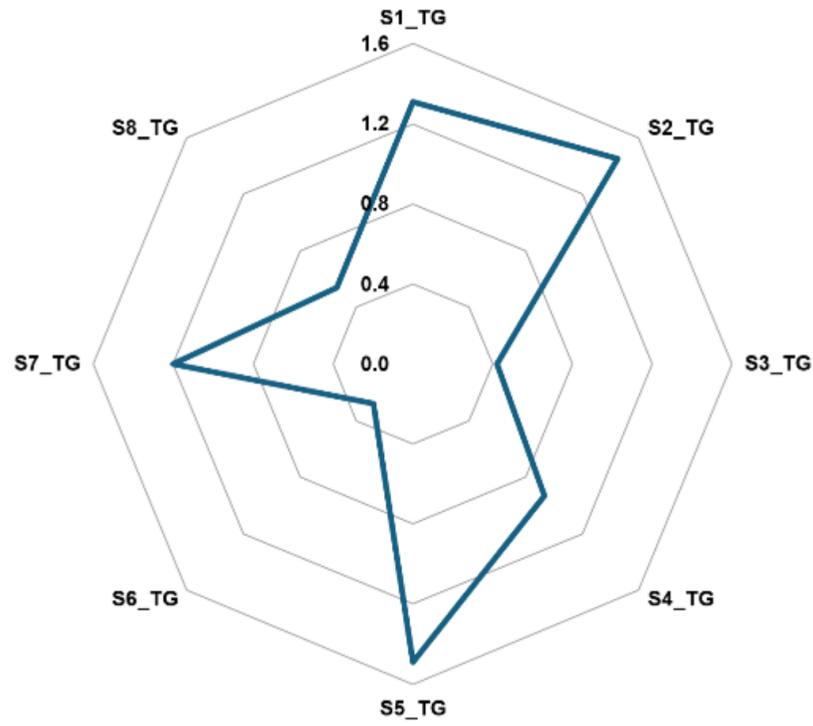
Forest Therapy

*Added value of therapist guidance
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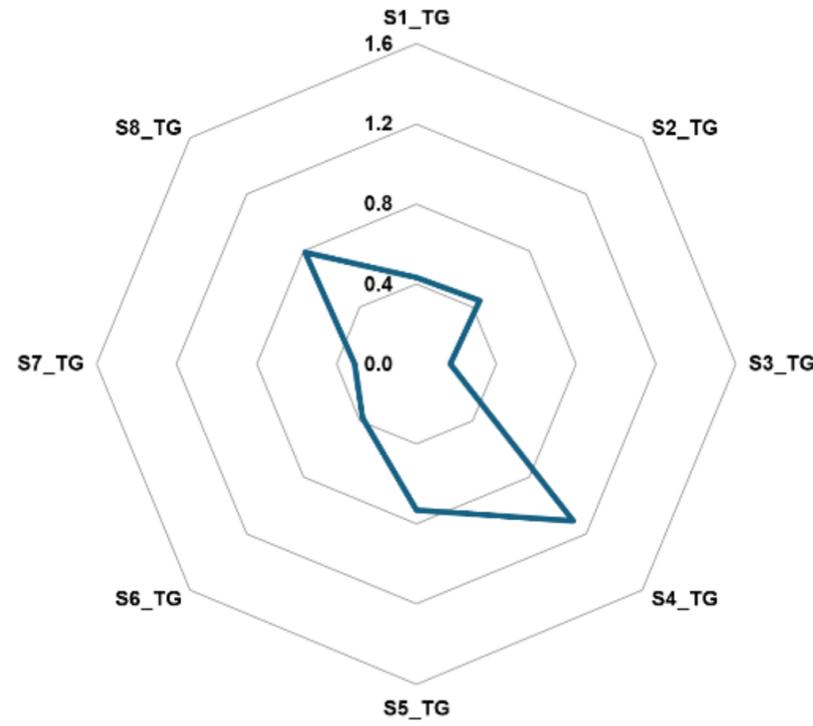
- **8 sites, 282 participants;** therapist-guided (TG) and self-guided (SG) paired sessions
- The only difference: instructions communicated verbally by the therapist (TG) / read and interpreted by signal panels (SG)
- **Outcome: Clinician-led (TG) sessions produce much higher significance (100% of cases in at least one domain) and intensity of effects than self-conduction (SG) (75% success rate in at least one domain)**
- Greater comparative advantages on **ANXIETY (STAI)** and **SELF-ESTEEM (POMS)**
- **TG sessions produce a very high and significantly higher absolute economic value than SG**



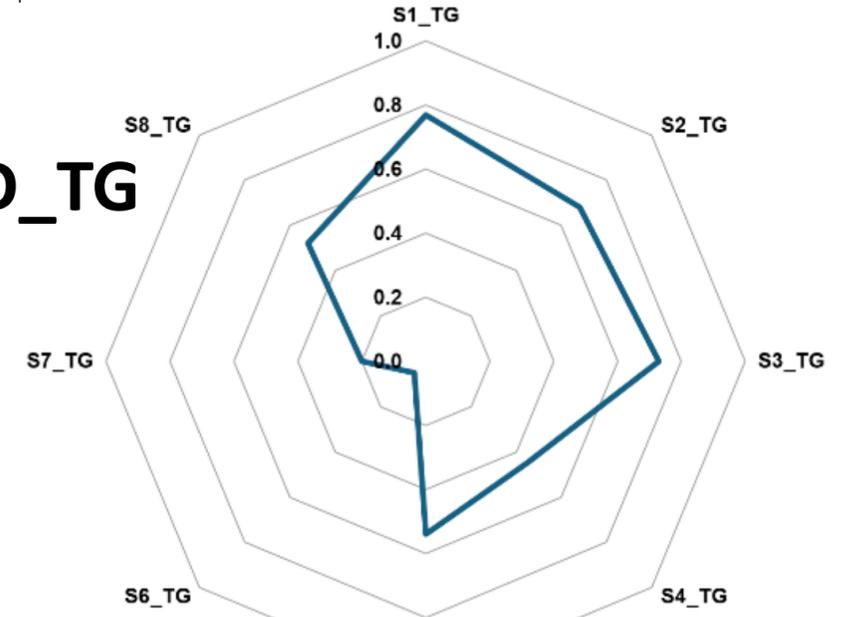
STAI_TG



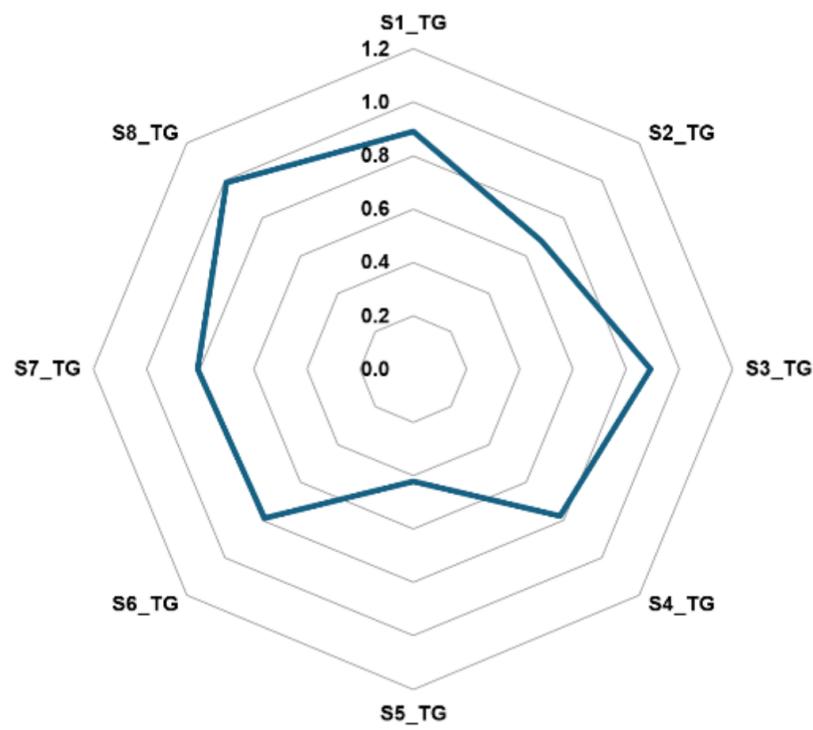
STAI_SG



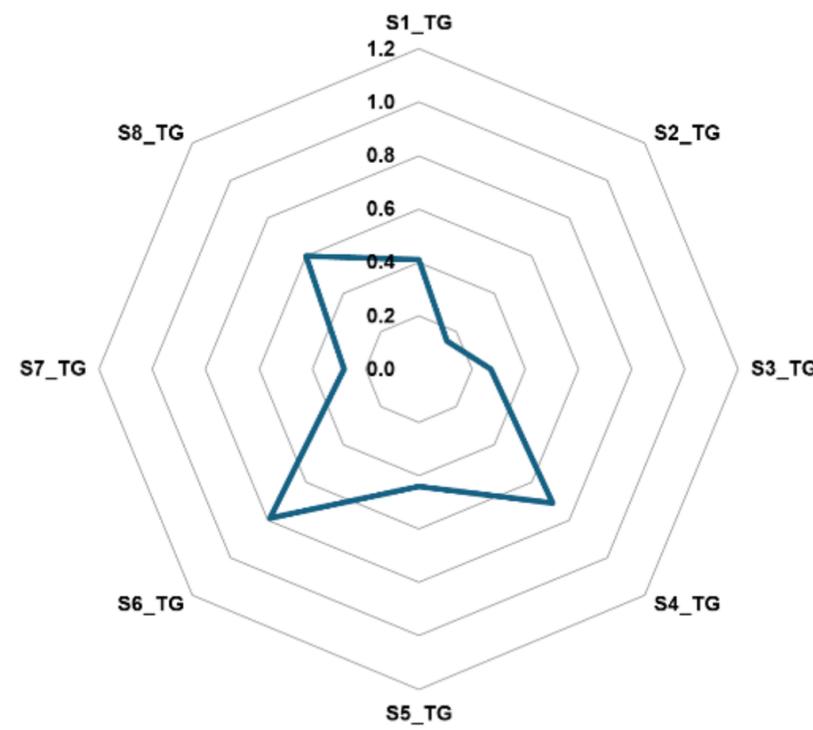
POMS-TMD_TG



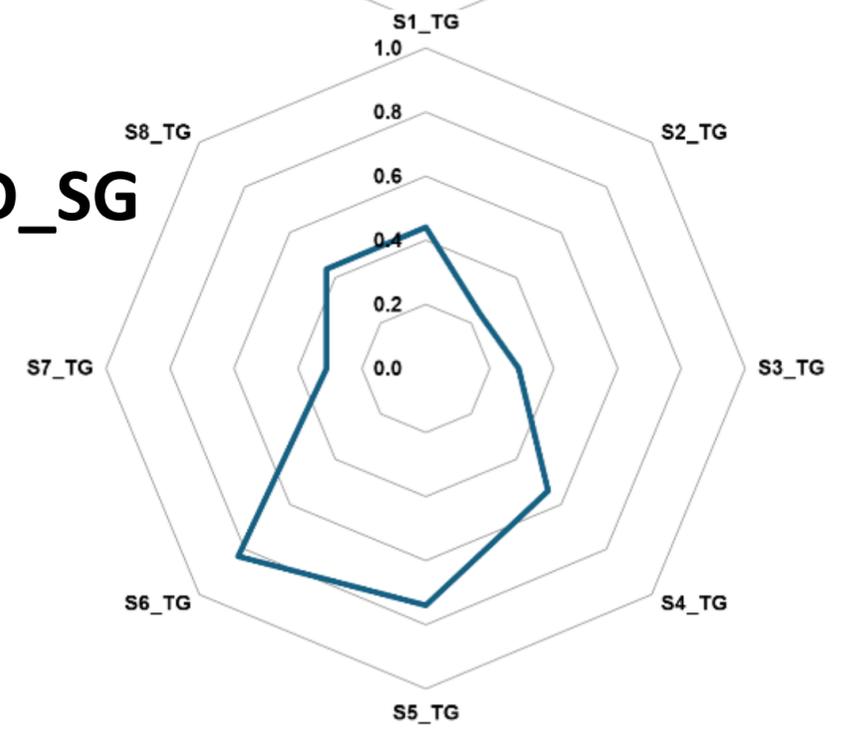
POMS-esteem_TG



POMS-esteem_SG



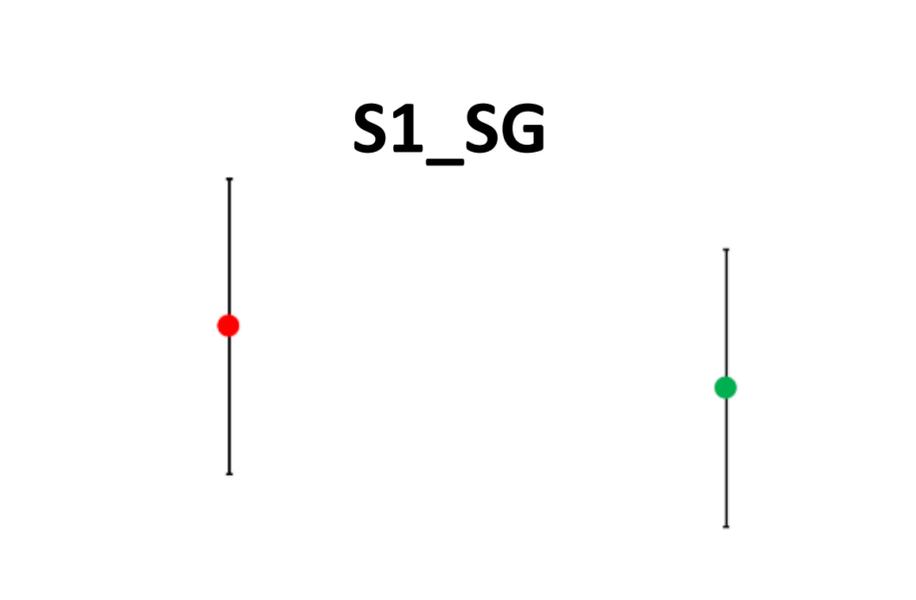
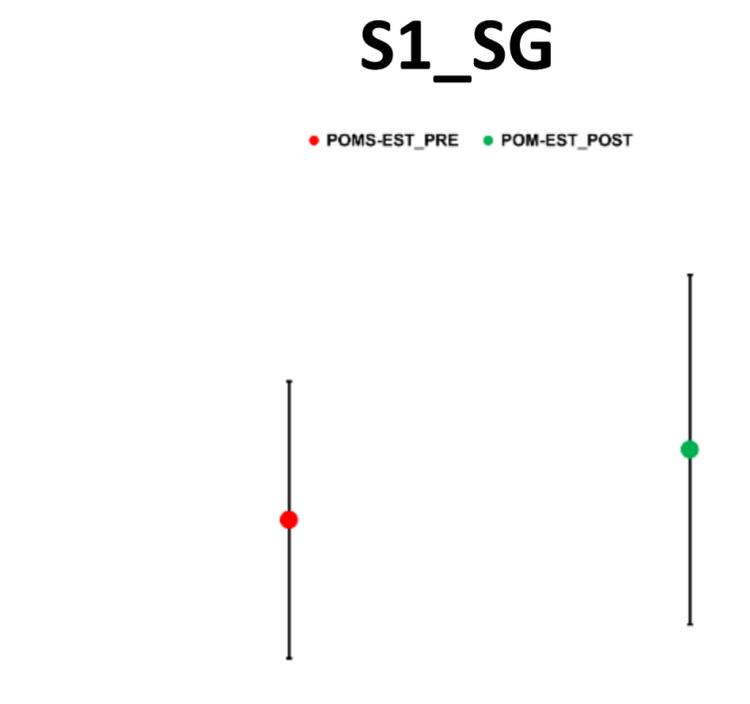
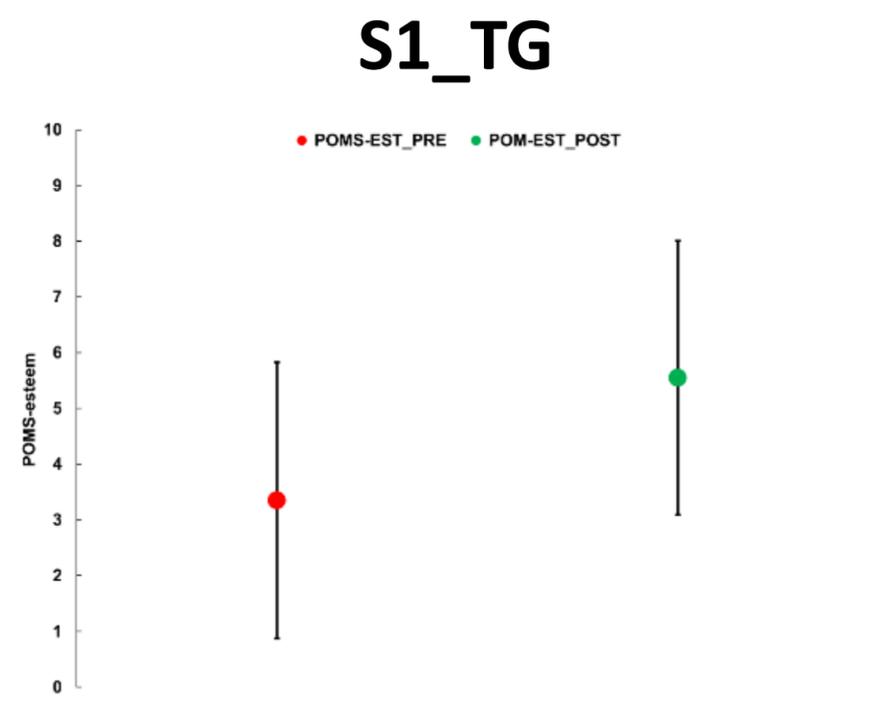
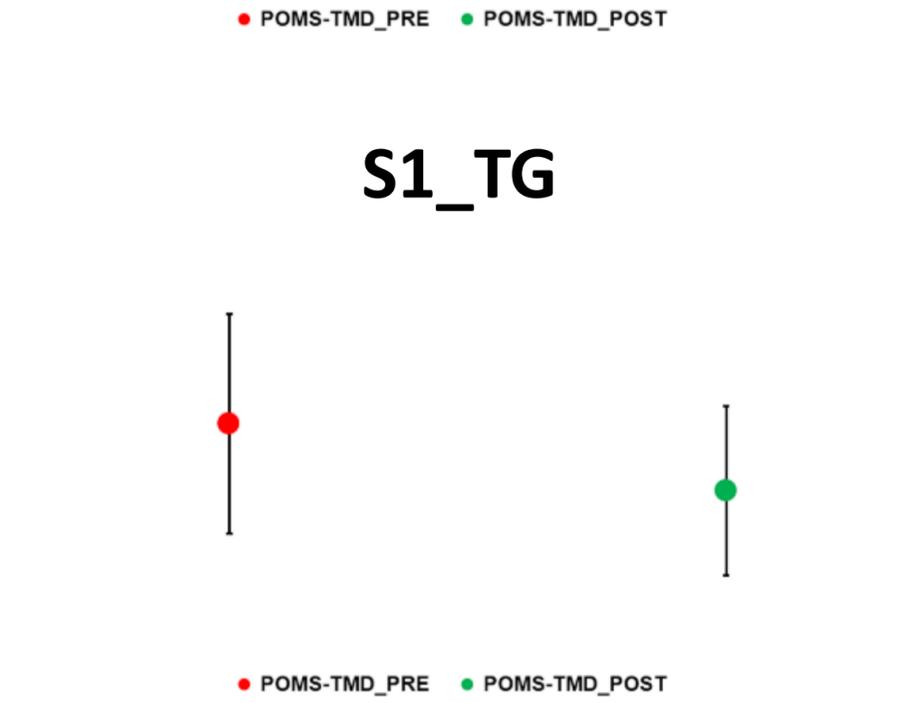
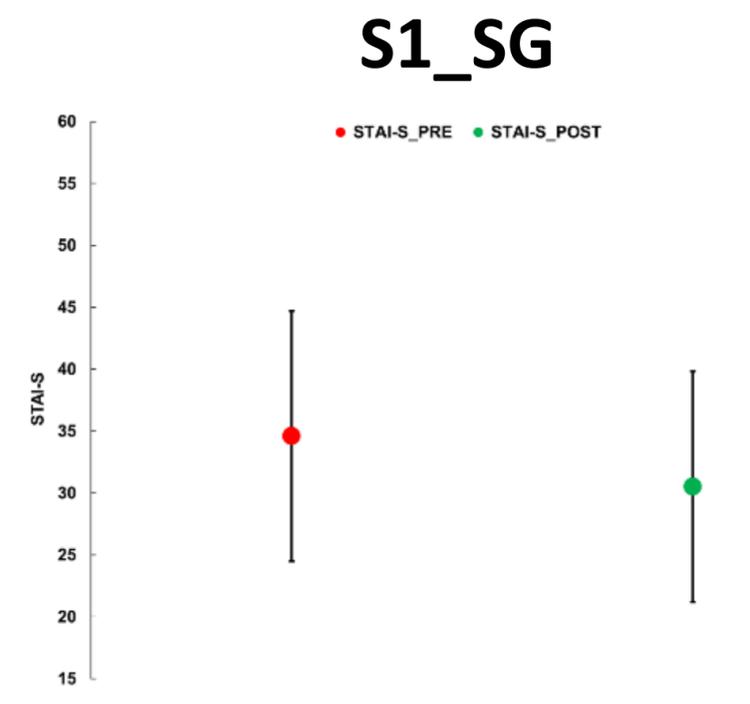
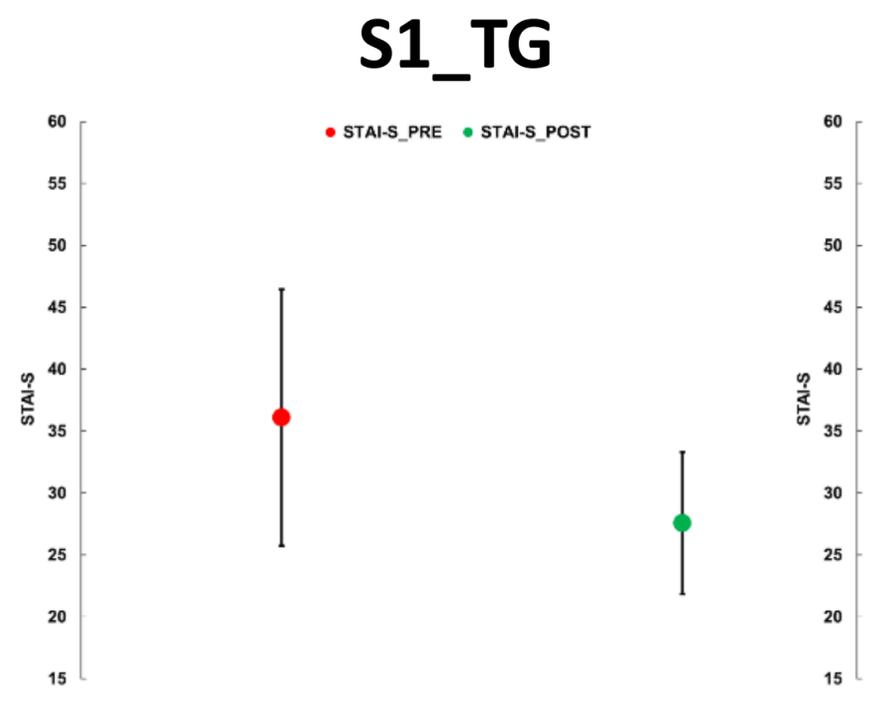
POMS-TMD_SG






 behavioral sciences
 

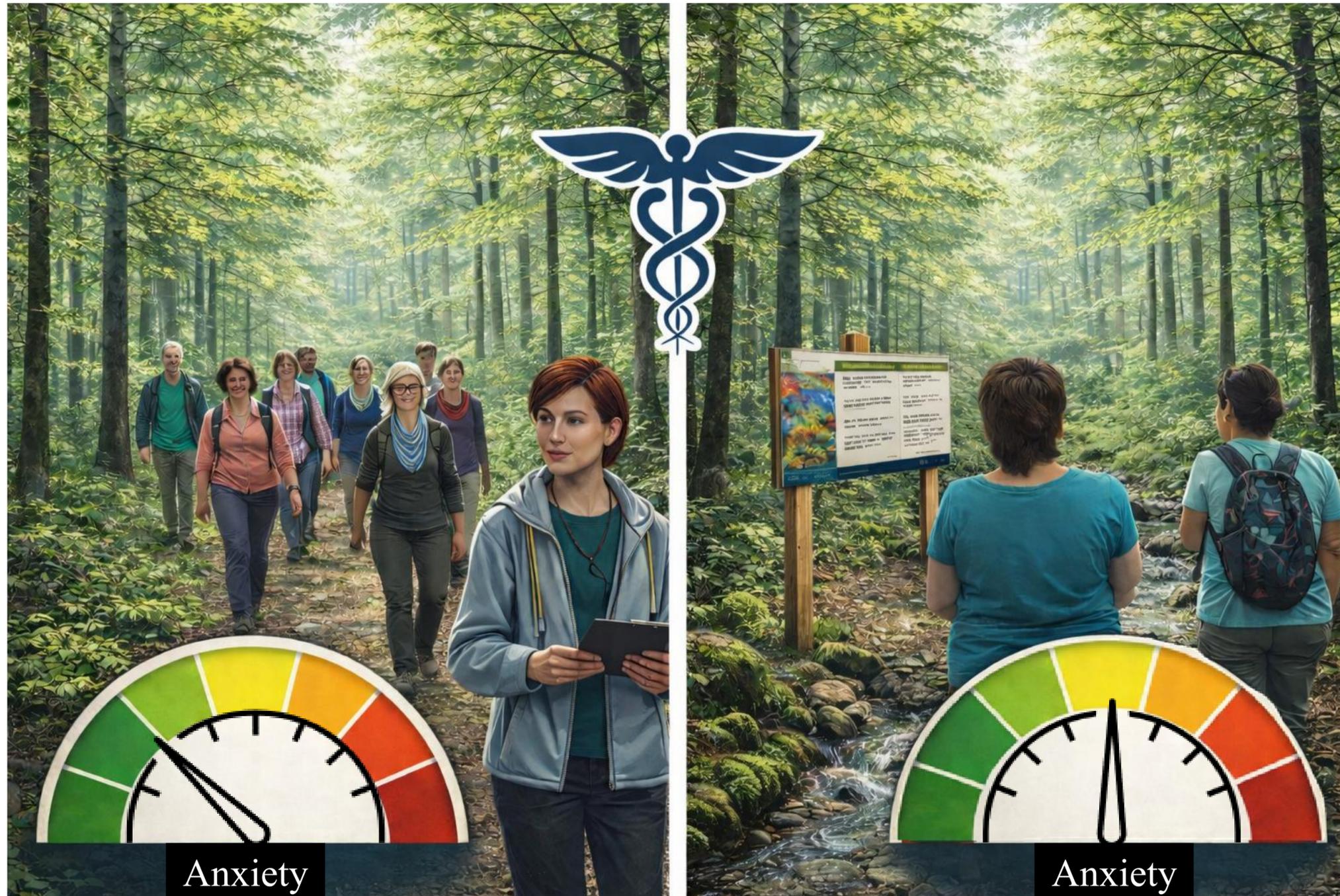
Article
Therapist-Guided Versus Self-Guided Forest Immersion: Comparative Efficacy on Short-Term Mental Health and Economic Value
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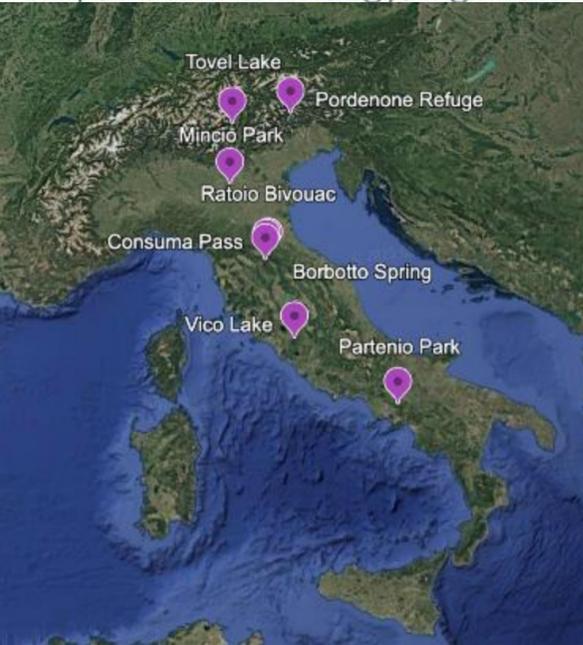


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COMBINING THE SHORT-TERM EFFECTS ON ANXIETY (STAI), TOTAL MOOD DISTURBANCE (POMS-TMD) AND SELF-ESTEEM (POMS-esteem), ALONG WITH LITERATURE-BASED PERSISTENCE (3 h → ~1 week)

*(Effects **not** additive: account for mutual correlations.
Included only statistically significant effects)*

Method in brief

- Forest Therapy Program for stabilization (persistence) of effects (STAI-S → STAI-T + stable POMS-TMD & self-esteem) → 25 sessions/year;
- From $\Delta(\text{STAI-T})$ and $\Delta(\text{POMS_TMD})$ to $\Delta(\text{QALY})$ [Quality-Adjusted Life Years]
- Conversion $\Delta(\text{QALY}) \rightarrow \text{€ per person per year}$

- **Annual economic value per person of therapist-guided sessions = € 4,000 – € 10,000**
- **Annual economic value per person of self-guided sessions * = € 2,500 – € 6,000**
- **Annual cost per person (psychotherapist fee) ≈ € 500 (25 sessions / year)**
- **Annual net savings with guided sessions ≈ €3,500 – €9,500**
- **Net annual savings with self-guided sessions * ≈ €2,500 – €6,000**

* *Overestimated: participants assisted for driving on the route and stopping times*

Therapist-Guided vs Self-Guided Forest Immersion

Therapist-Guided (TG)

Delivery

Verbal guidance by clinician/psychotherapist

Self-Guided (SG)

Delivery

Same instructions read by participants along trail

Short-term outcomes (pre-post, same site & time)

TG effects

↓ STAI-S (state anxiety)
↑ POMS Self-Esteem
↓ POMS Total Mood Disturbance
↓ variability → emotional stabilization (occasionally)

SG effects

Benefits present but generally smaller across anxiety, self-esteem, and TMD.
Less evidence of variance reduction

Economic value (program projection)

TG ≈ 1.7× higher annual per-person QALY-based value than SG
Recommended inclusion in healthcare protocols

