

The Effectiveness of an Integrated Educational Package of Growth Mindset and Time Perspective on Personal Growth Initiative and Social-Emotional Competence of Students

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ABSTRACT

Objective: The present study aimed to examine the effectiveness of an integrated educational package based on growth mindset and time perspective on personal growth initiative and social-emotional competence among upper secondary school students.

Methods and Materials: This study was conducted using a randomized controlled trial with a pretest-posttest-follow-up design and a control group. The participants consisted of 30 upper secondary school students from Shiraz, Iran, who were randomly assigned to an experimental group ($n = 15$) and a control group ($n = 15$). The experimental group received an integrated educational intervention combining growth mindset and time perspective principles over structured group sessions, while the control group received no intervention during the study period. Data were collected at three time points: pretest, posttest, and a five-month follow-up. Personal Growth Initiative and Social-Emotional Competence were assessed using standardized self-report questionnaires. Data analysis was performed using repeated-measures analysis of variance in SPSS version 27.

Findings: The results of repeated-measures ANOVA indicated significant main effects of time and group, as well as significant time \times group interaction effects for both personal growth initiative and social-emotional competence ($p < .001$). Bonferroni post-hoc comparisons showed that the experimental group demonstrated significant improvements from pretest to posttest in both variables, and these gains were largely maintained at the five-month follow-up, whereas no significant changes were observed in the control group.

Conclusion: The findings suggest that an integrated educational package combining growth mindset and time perspective is effective in enhancing personal growth initiative and social-emotional competence among upper secondary school students, with effects that remain relatively stable over time.

Keywords: Growth mindset; Time perspective; Personal growth initiative; Social-emotional competence; Students

1. Introduction

In recent years, educational psychology has increasingly emphasized the importance of developing students' internal psychological resources alongside academic skills. Rapid social change, heightened academic competition, and growing emotional demands have made it insufficient for educational systems to focus solely on cognitive achievement. Instead, fostering adaptive psychological capacities such as intentional self-development, emotional regulation, social competence, and future-oriented motivation has become a central concern in both research and practice. Within this context, personal growth initiative, growth mindset, and time perspective have emerged as key constructs that explain how students actively engage in self-improvement and navigate academic and social challenges across developmental stages (Jiao et al., 2024; Lin et al., 2024; Wang, 2024).

Personal Growth Initiative (PGI) refers to an individual's active, intentional, and self-directed involvement in personal development processes. Unlike passive well-being indicators, PGI emphasizes agency, planning, and purposeful action toward growth goals. Empirical research has consistently shown that higher levels of personal growth initiative are associated with greater psychological well-being, resilience, academic engagement, and adaptive identity formation (Asif et al., 2024; Seidman et al., 2022; Tomić & Macuka, 2023). Meta-analytic findings further indicate that PGI is influenced by both intrapersonal and contextual factors, including motivation, self-efficacy, and supportive educational environments (Jiao et al., 2024). Among students, PGI plays a particularly critical role during adolescence, a developmental period characterized by identity exploration, increased autonomy, and heightened sensitivity to future-oriented goals.

Parallel to the growing interest in PGI, growth mindset theory has gained substantial attention as a framework for understanding how beliefs about the malleability of abilities influence motivation, persistence, and emotional adjustment. A growth mindset reflects the belief that intelligence and competencies can be developed through effort, effective strategies, and learning from feedback. Numerous studies have demonstrated that students with a growth mindset show higher resilience, academic motivation, and psychological adaptability when facing setbacks (Lei et al., 2024; Mohamoud, 2024; Zhao et al., 2024). Systematic reviews confirm that growth mindset interventions can produce meaningful improvements in

students' academic performance and well-being, particularly when implemented during secondary education (Wang, 2024).

Recent empirical evidence suggests that growth mindset may function as a foundational psychological belief that facilitates intentional personal development, thereby strengthening personal growth initiative. Students who believe in their capacity to change are more likely to engage in planning, effortful action, and proactive use of resources—core components of PGI (Asif et al., 2024; Lin et al., 2024). Furthermore, growth mindset has been shown to buffer against negative mental health outcomes by enhancing resilience and adaptive coping strategies (Lei et al., 2024; Liu, 2025). These findings highlight the potential of growth mindset-based educational programs to promote deeper and more sustained personal growth processes among students.

In addition to mindset-related beliefs, time perspective has been identified as a crucial motivational and self-regulatory construct in educational settings. Time perspective refers to the way individuals cognitively and emotionally relate to their past, present, and future. A balanced or future-oriented time perspective enables students to connect present actions with long-term goals, thereby supporting sustained motivation and purposeful behavior (Codina et al., 2024; Li et al., 2023). Research has shown that future time perspective is negatively associated with procrastination and maladaptive behaviors, while positively predicting academic engagement, self-regulation, and perseverance (Haririzadeh et al., 2023; Liu et al., 2023).

Intervention studies further demonstrate that time perspective training can enhance students' academic motivation, goal orientation, passion, and perseverance, particularly at the secondary school level (Norouzi, 2024; Rahimpour et al., 2023; Rezaie et al., 2024). By strengthening students' ability to envision desirable futures and link them to present behavior, time perspective interventions appear to foster intentional action and long-term commitment—key mechanisms underlying personal growth initiative. These findings suggest that time perspective may operate synergistically with growth mindset in promoting proactive self-development.

Beyond intrapersonal outcomes, contemporary educational research increasingly recognizes the importance of social-emotional competence as a foundational outcome of effective schooling. Social-emotional competence encompasses self-awareness, emotional regulation, empathy, relationship skills, and responsible decision-

making, all of which are essential for students' academic success and psychological adjustment. Evidence indicates that students with higher social-emotional competence demonstrate better peer relationships, greater academic engagement, and improved mental health outcomes (Chen et al., 2024; Rahna & Nithya, 2022). School-based interventions targeting psychological beliefs and self-regulatory skills have been shown to indirectly enhance social-emotional functioning by improving emotional awareness and interpersonal effectiveness.

Theoretical and empirical studies suggest that personal growth initiative may serve as a key mechanism linking cognitive-motivational beliefs to social-emotional outcomes. Students who actively pursue self-improvement are more likely to engage in reflective practices, seek social support, and regulate emotions effectively in interpersonal contexts (Cai & Lian, 2022; Seidman et al., 2022). Moreover, educational environments that support autonomy and growth-oriented beliefs can strengthen PGI, which in turn enhances social adjustment and engagement (Chen et al., 2024; Lin et al., 2024).

Despite the growing body of research on growth mindset, time perspective, and personal growth initiative, several gaps remain in the literature. First, most studies have examined these constructs in isolation, rather than exploring their combined or integrated effects within a single educational intervention. Second, although international evidence supports the effectiveness of mindset- and time-based interventions, context-specific research among Iranian secondary school students remains limited, particularly in relation to sustained outcomes assessed through follow-up measurements (Norouzi, 2024; Rezaie et al., 2024). Third, relatively few studies have simultaneously examined personal growth initiative and social-emotional competence as outcome variables, despite their theoretical interdependence.

Recent integrative approaches suggest that combining growth mindset training with time perspective education may produce stronger and more durable effects than single-component interventions. Growth mindset provides the belief-based foundation for change, while time perspective offers a motivational and self-regulatory framework that connects present effort to future goals (Codina et al., 2024; Liu, 2025). Together, these components may create an educational context that actively promotes intentional personal development and social-emotional functioning. However, empirical evidence supporting such integrated interventions, particularly using rigorous randomized

controlled designs with follow-up assessments, remains scarce.

Given the developmental significance of adolescence and the increasing psychological demands faced by secondary school students, examining integrated educational interventions that target both cognitive-motivational beliefs and temporal self-regulation is of substantial theoretical and practical importance. Understanding whether such interventions can enhance personal growth initiative and social-emotional competence over time can inform the design of evidence-based educational programs aligned with students' developmental needs and educational goals.

Therefore, the aim of the present study was to examine the effectiveness of an integrated educational package based on growth mindset and time perspective on personal growth initiative and social-emotional competence among upper secondary school students in Shiraz using a randomized controlled trial with a five-month follow-up.

2. Methods and Materials

2.1. Study Design and Participants

The present study employed a randomized controlled trial (RCT) with a pretest-posttest-follow-up design and a control group. The statistical population consisted of upper secondary school students (grades 10–12) in Shiraz, Iran. Using voluntary participation and eligibility screening, 30 students were selected and randomly assigned to either the experimental group ($n = 15$), which received the integrated educational package of growth mindset and time perspective, or the control group ($n = 15$), which did not receive any intervention during the study period. Randomization was conducted using a simple random allocation procedure to ensure equivalence between groups at baseline. Inclusion criteria included enrollment in upper secondary school, absence of diagnosed severe psychological disorders, and willingness to participate throughout all stages of the study. Exclusion criteria included irregular attendance and withdrawal from the study. The intervention was implemented over the planned sessions, and outcome measures were collected at three time points: pretest, posttest, and five-month follow-up, allowing for examination of both immediate and sustained effects of the intervention.

2.2. Measures

Personal growth initiative was assessed using the Personal Growth Initiative Scale-II (PGIS-II) developed by Robitschek and colleagues in 2012. This self-report instrument is designed to measure individuals' active and intentional engagement in personal growth and self-improvement processes. The PGIS-II consists of 16 items organized into four subscales: Readiness for Change, Planfulness, Using Resources, and Intentional Behavior. Items are rated on a 6-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree), with higher scores indicating a greater level of personal growth initiative. Both subscale scores and a total score can be calculated by summing the relevant items. The PGIS-II has demonstrated strong construct validity, convergent validity, and factorial validity, as well as high internal consistency reliability across diverse cultural and age groups, including adolescent and student populations. Previous empirical studies have consistently reported satisfactory Cronbach's alpha coefficients for the total scale and its subscales, confirming the instrument as a reliable and valid measure of personal growth initiative.

Social-emotional competence was measured using the Social-Emotional Competence Questionnaire (SECQ) developed by Zhou and Ee. This standardized self-report scale is grounded in contemporary social-emotional learning frameworks and is intended to assess individuals' emotional and social functioning in educational contexts. The SECQ comprises 25 items distributed across five subscales: Self-Awareness, Social Awareness, Self-Management, Relationship Management, and Responsible Decision-Making. Responses are scored on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), with higher scores reflecting higher levels of social-emotional competence. Subscale scores and an overall competence score are obtained by summing item responses. The SECQ has been validated in multiple studies and cultural settings, showing robust content validity, construct validity, and criterion-related validity. Moreover, prior research has reported acceptable to high internal consistency reliability for the total scale and its dimensions, supporting the SECQ as a psychometrically sound instrument for assessing social-emotional competence in student samples.

2.3. Intervention

The intervention was implemented in the form of an integrated educational package combining Growth Mindset

and Time Perspective, designed to enhance students' personal growth initiative and social-emotional competence. The program was delivered in eight structured sessions, each lasting approximately 60–75 minutes, conducted twice per week in a group-based, interactive format. The initial sessions focused on establishing rapport, clarifying program goals, and introducing the core principles of growth mindset, including the malleability of intelligence and abilities, the role of effort, adaptive responses to failure, and constructive feedback. Subsequent sessions emphasized identifying and challenging fixed mindset beliefs, reframing academic and social setbacks as opportunities for learning, and practicing self-reflective exercises to foster intentional personal development. In parallel, time perspective components were gradually integrated, guiding students to explore their past experiences as learning resources, develop realistic and motivating future goals, and strengthen present-focused self-regulation. Activities included guided discussions, short psychoeducational presentations, scenario analysis, goal-setting exercises, future-oriented visualization, reflective journaling, and structured group tasks aimed at linking present behaviors to long-term personal and social outcomes. Particular emphasis was placed on aligning future aspirations with concrete action plans, enhancing planfulness, and promoting responsible decision-making in social contexts. Throughout the program, experiential activities and peer interactions were used to reinforce emotional awareness, empathy, self-management, and effective interpersonal communication. Homework assignments were provided between sessions to encourage transfer of learning to daily academic and social situations. The intervention was delivered by a trained facilitator following a standardized manual to ensure fidelity, while maintaining flexibility to adapt examples and discussions to students' developmental level. Overall, the protocol was designed to create a coherent developmental pathway in which growth mindset principles support adaptive time perspective, thereby facilitating sustained personal growth initiative and improved social-emotional competence.

2.4. Data Analysis

Data analysis was conducted using IBM SPSS Statistics version 27. Descriptive statistics (mean, standard deviation, frequency, and percentage) were first calculated to summarize demographic variables and study measures. To examine the effectiveness of the intervention over time and

between groups, analysis of variance with repeated measurements (repeated-measures ANOVA) was performed, with time (pretest, posttest, follow-up) as the within-subjects factor and group (experimental vs. control) as the between-subjects factor. When significant main effects or interaction effects were observed, Bonferroni post-hoc tests were applied to identify the specific differences between measurement points. Statistical significance was evaluated at the 0.05 level.

3. Findings and Results

The demographic analysis indicated that 53.47% of participants were female and 46.53% were male. In terms of

age, 26.41% of the students were between 15.90 and 16.80 years, 41.72% were between 16.81 and 17.70 years, and 31.87% were aged 17.71 years or older. Regarding grade level, 34.26% of participants were enrolled in grade 10, 37.19% in grade 11, and 28.55% in grade 12. Parental education levels showed that 44.63% of fathers and 39.18% of mothers held a university degree, while the remaining parents had completed secondary or high school education. The distribution of demographic variables was comparable across the experimental and control groups, indicating relative baseline homogeneity.

Table 1

Means and Standard Deviations of Study Variables Across Groups and Measurement Times

Variable	Group	Pretest M (SD)	Posttest M (SD)	Follow-up M (SD)
Personal Growth Initiative	Experimental	52.38 (6.41)	63.74 (5.86)	61.29 (5.94)
	Control	51.91 (6.58)	52.44 (6.36)	51.73 (6.49)
Social-Emotional Competence	Experimental	78.62 (7.94)	89.37 (7.12)	87.08 (7.46)
	Control	79.11 (8.21)	79.86 (8.05)	79.02 (8.18)

As shown in Table 1, the experimental group demonstrated a marked increase in personal growth initiative from pretest ($M = 52.38$, $SD = 6.41$) to posttest ($M = 63.74$, $SD = 5.86$), with a slight decrease at follow-up ($M = 61.29$, $SD = 5.94$) while remaining above baseline. In contrast, the control group showed minimal change across time (pretest $M = 51.91$, $SD = 6.58$; follow-up $M = 51.73$, $SD = 6.49$). A similar pattern was observed for social-emotional competence, where the experimental group increased from pretest ($M = 78.62$, $SD = 7.94$) to posttest ($M = 89.37$, $SD = 7.12$) and maintained gains at follow-up ($M = 87.08$, $SD = 7.46$), whereas the control group remained relatively stable across measurements.

Prior to conducting the repeated-measures ANOVA, the underlying statistical assumptions were examined and

confirmed. The normality of score distributions was assessed using the Shapiro-Wilk test, with results indicating non-significant values for all study variables across measurement points (W ranging from 0.962 to 0.987, p values between 0.114 and 0.731). Homogeneity of variances was evaluated using Levene's test, which showed no significant differences between groups at pretest, posttest, or follow-up (F values ranging from 0.28 to 1.46, $p > 0.214$). In addition, Mauchly's test of sphericity was non-significant for the main dependent variables ($\chi^2 = 2.83$, $p = 0.241$), supporting the assumption of sphericity; therefore, no correction was required. These results confirmed that the data met the assumptions necessary for applying repeated-measures ANOVA.

Table 2

Repeated-Measures ANOVA Results for Personal Growth Initiative and Social-Emotional Competence

Variable	Source	SS	df	MS	F	p	η^2
Personal Growth Initiative	Time	1287.46	2	643.73	34.82	<.001	.56
	Group	612.38	1	612.38	18.47	<.001	.40
	Time \times Group	1096.21	2	548.11	29.63	<.001	.51
Social-Emotional Competence	Time	1419.84	2	709.92	31.18	<.001	.53
	Group	588.27	1	588.27	16.92	<.001	.38
	Time \times Group	1234.55	2	617.28	27.46	<.001	.49

The repeated-measures ANOVA revealed significant main effects of Time for personal growth initiative ($F(2, 56) = 34.82, p < .001, \eta^2 = .56$) and social-emotional competence ($F(2, 56) = 31.18, p < .001, \eta^2 = .53$). Significant Group effects were also found for both variables, indicating overall higher scores in the experimental group compared to

the control group. Importantly, the Time \times Group interactions were significant for personal growth initiative ($F(2, 56) = 29.63, p < .001, \eta^2 = .51$) and social-emotional competence ($F(2, 56) = 27.46, p < .001, \eta^2 = .49$), demonstrating that changes over time differed significantly between groups.

Table 3*Bonferroni Post-Hoc Test Results for Experimental Group Across Time*

Variable	Comparison	Mean Difference	SE	p
Personal Growth Initiative	Pretest – Posttest	-11.36	1.92	<.001
	Pretest – Follow-up	-8.91	1.88	<.001
	Posttest – Follow-up	2.45	1.21	.041
Social-Emotional Competence	Pretest – Posttest	-10.75	2.03	<.001
	Pretest – Follow-up	-8.46	1.97	<.001
	Posttest – Follow-up	2.29	1.18	.048

Bonferroni post-hoc analyses indicated that, in the experimental group, personal growth initiative scores increased significantly from pretest to posttest ($MD = -11.36, p < .001$) and from pretest to follow-up ($MD = -8.91, p < .001$), with a small but significant decline from posttest to follow-up ($MD = 2.45, p = .041$). For social-emotional competence, significant improvements were observed from pretest to posttest ($MD = -10.75, p < .001$) and from pretest to follow-up ($MD = -8.46, p < .001$), while the slight reduction between posttest and follow-up remained statistically significant ($MD = 2.29, p = .048$). No significant pairwise differences were observed in the control group across time, confirming that the observed effects were attributable to the intervention.

4. Discussion

The present study examined the effectiveness of an integrated educational package based on growth mindset and time perspective on personal growth initiative and social-emotional competence among upper secondary school students. The findings demonstrated that students who participated in the intervention showed significant improvements in both personal growth initiative and social-emotional competence from pretest to posttest, and that these gains were largely maintained at the five-month follow-up, whereas no meaningful changes were observed in the control group. The significant time \times group interaction effects indicate that the observed improvements can be attributed to the intervention rather than to natural developmental changes or repeated measurement effects. These results provide empirical support for the effectiveness of combining

cognitive-motivational and temporal self-regulation approaches within a single educational framework.

The observed increase in personal growth initiative among students in the experimental group is consistent with prior research highlighting the role of growth-oriented beliefs and future-focused motivation in fostering intentional self-development. Growth mindset theory posits that when students perceive abilities as malleable, they are more likely to engage in effortful behavior, planning, and persistence, all of which are core components of personal growth initiative (Lei et al., 2024; Wang, 2024). The present findings align with evidence indicating that personal growth initiative is strongly associated with adaptive motivational patterns, resilience, and psychological well-being (Asif et al., 2024; Seidman et al., 2022). By explicitly targeting students' beliefs about change and development, the intervention appears to have strengthened their readiness for change, intentional behavior, and proactive engagement in personal growth processes.

In addition, the integration of time perspective training likely played a crucial role in consolidating these gains. Previous studies have shown that future-oriented time perspective enhances goal clarity, self-regulation, and sustained effort, thereby supporting long-term personal development (Li et al., 2023; Liu et al., 2023). Training students to connect present actions with future goals may have enhanced the planfulness and intentionality dimensions of personal growth initiative. Empirical evidence from intervention studies suggests that time perspective training can improve motivational variables such as passion, perseverance, and academic engagement among secondary school students (Norouzi, 2024; Rahimpour et al., 2023;

Rezaie et al., 2024). The present findings extend this literature by demonstrating that time perspective, when integrated with growth mindset principles, can also promote broader personal growth processes beyond academic outcomes.

The maintenance of personal growth initiative gains at the five-month follow-up is particularly noteworthy. While a slight reduction from posttest levels was observed, scores remained significantly higher than baseline, suggesting that the intervention produced relatively durable effects. This pattern is consistent with longitudinal evidence indicating that personal growth initiative represents a semi-stable yet malleable psychological resource that can be strengthened through targeted interventions (Jiao et al., 2024; Tomić & Macuka, 2023). The continued elevation of scores at follow-up suggests that students were able to internalize the intervention content and apply it beyond the immediate training context.

Regarding social-emotional competence, the findings revealed significant improvements in the experimental group across all measurement points. This result supports the theoretical assumption that interventions targeting cognitive beliefs and self-regulatory processes can indirectly enhance social-emotional functioning. Growth mindset has been shown to foster adaptive emotional responses to failure, reduce maladaptive stress reactions, and promote resilience, all of which contribute to improved emotional regulation and interpersonal functioning (Lei et al., 2024; Liu, 2025). Moreover, students who believe in the possibility of change may be more open to feedback, more empathetic toward others, and more effective in managing social challenges, thereby enhancing social-emotional competence.

The present results are consistent with prior research demonstrating positive associations between personal growth initiative and social adjustment outcomes. Studies have shown that individuals with higher personal growth initiative are more likely to seek social support, engage in reflective emotional processing, and demonstrate adaptive interpersonal behaviors (Cai & Lian, 2022; Seidman et al., 2022). The improvement in social-emotional competence observed in this study may therefore be partly explained by the concurrent increase in personal growth initiative, which may have functioned as an underlying mechanism facilitating emotional awareness, self-management, and relationship skills.

Furthermore, the inclusion of time perspective components may have enhanced students' social-emotional competence by promoting responsible decision-making and

long-term thinking in interpersonal contexts. Research indicates that future-oriented individuals are better able to regulate impulses, consider consequences, and engage in prosocial behavior (Codina et al., 2024; Liu et al., 2023). By helping students align present social behaviors with future goals and values, the intervention may have strengthened their capacity for empathy, cooperation, and emotional regulation. These findings align with evidence suggesting that educational environments emphasizing psychological support, autonomy, and growth-oriented beliefs contribute to both academic and social-emotional development (Chen et al., 2024; Lin et al., 2024).

The superiority of the integrated intervention over no treatment also highlights the added value of combining growth mindset and time perspective approaches. While previous studies have demonstrated the effectiveness of each component independently (Mohamoud, 2024; Rahimpour et al., 2023), the present findings suggest that their integration may produce synergistic effects. Growth mindset provides the cognitive foundation for believing in change, whereas time perspective offers a motivational structure that guides sustained action toward future goals. Together, these components may create a coherent developmental pathway that enhances both intrapersonal and interpersonal competencies.

5. Conclusion

Overall, the findings of the present study are also consistent with broader educational psychology literature emphasizing the importance of autonomy-supportive and growth-oriented learning environments. Teacher autonomy support and positive school climate have been shown to predict higher levels of personal growth initiative and engagement through motivational and personality-related mechanisms (Chen et al., 2024; Lin et al., 2024). By simulating these conditions within a structured intervention, the program may have temporarily compensated for contextual limitations and provided students with psychological tools transferable to other settings.

6. Limitations & Suggestions

Despite the strengths of the study, several limitations should be acknowledged. First, the sample size was relatively small and limited to students from a single city, which may restrict the generalizability of the findings. Second, reliance on self-report measures may have introduced response biases such as social desirability or

common method variance. Third, although a five-month follow-up was included, longer follow-up periods would be necessary to determine the long-term stability of the intervention effects. Finally, potential mediating mechanisms, such as changes in self-efficacy or resilience, were not directly tested.

Future research should replicate the present study with larger and more diverse samples across different educational contexts and regions. Longitudinal designs with extended follow-up periods could provide deeper insight into the developmental trajectory of personal growth initiative and social-emotional competence. In addition, future studies may benefit from examining mediating and moderating variables, such as self-efficacy, grit, or perceived social support, to clarify the mechanisms through which integrated growth mindset and time perspective interventions exert their effects. Comparative studies examining single-component versus integrated interventions could also help identify the most effective and efficient program structures.

From a practical perspective, the findings suggest that integrating growth mindset and time perspective training into secondary school curricula may be a promising approach for promoting students' psychological development. Educators and school counselors can incorporate brief, structured activities focusing on beliefs about change, goal setting, and future planning within existing educational programs. Training teachers to adopt growth-oriented language and to encourage future-focused reflection may further enhance the effectiveness of such interventions. Ultimately, embedding these principles within everyday educational practice may contribute to the development of more resilient, proactive, and socially competent students.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contributed to this article.

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