

# Effects of a Gratitude–Promoting Program on Purpose in Life and Heart Rate Variability among Vulnerable Thai Youth: A Quasi–Experimental Study

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**Abstract:** Purpose in life plays a crucial role in positive youth development. However, limited evidence exists on interventions that simultaneously foster psychological purpose and physiological regulation among vulnerable youth. This quasi-experimental study examined the effect of a gratitude-promoting program on purpose in life and heart rate variability among vulnerable Thai youths. Initially, 60 vulnerable Thai youth aged 18–24 years were enrolled through simple random sampling from two informal education schools in Southern Thailand. Due to unstable living conditions, the final analysis included 37 participants (21 in the control group; 16 in the experimental group). The study was conducted from July to September 2022. The experimental group received a 10-week gratitude-promoting program in addition to the routine education, while the control group received routine education only. Outcome measures included the Purpose in Life Scale for Thai Adolescents and heart rate variability, measured using a Polar H10 chest strap monitor. Data were analyzed using generalized estimating equations.

Results from the adjusted generalized estimating equations model indicated significant group-by-time interaction effects at all follow-up assessments, with greater improvements in purpose in life in the experimental group. In contrast, the control group showed a decline in week 22. For heart rate variability, interaction effects were time-specific, and the mean heart rate decreased significantly in week 22. Indicators of heart rate variability, including the percentage of successive normal-to-normal intervals, differences more than 50 milliseconds, and the root mean square of successive differences, increased significantly in week 10. These findings suggest that gratitude-based interventions may enhance psychological well-being and physiological regulation among vulnerable youth. Nursing professionals can integrate this intervention into routine holistic health promotion for vulnerable youth to enhance purpose in life, emotional regulation, and wellness. However, before integration into health promotion practices by nurses, more research with larger sample sizes, a greater number of clusters, and more rigorous study designs is recommended.

**Keywords:** Adolescents, Gratitude, Heart rate variability, Nursing, Purpose in life, Thailand, Vulnerable youth, Wellness

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## Introduction

Adolescence is a critical developmental period indicated by rapid biological, psychological, cognitive, and social changes that present both opportunities for growth<sup>1</sup> and increased vulnerability to risk.<sup>2</sup> Globally

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and in Thailand, the setting for this study, many youth face health problems, violence, mental health challenges, and socioeconomic adversity, which may compromise development, particularly among vulnerable groups.<sup>4</sup> Adolescence and emerging adulthood involve significant neurodevelopmental changes, including maturation of the prefrontal cortex that supports executive functioning and goal-directed behavior.<sup>5–8</sup> Adverse environments, such as family instability and insecure living conditions, may disrupt these processes, increasing the risk of cognitive, behavioral, and psychosocial difficulties.<sup>3,9–11</sup> This highlights the need for protective developmental assets.

Purpose in life (PIL), defined as a stable intention to pursue meaningful goals beyond the self,<sup>12</sup> is associated with goal-directed behavior, emotional regulation, and well-being.<sup>12–13</sup> However, vulnerable youth often lack opportunities to develop it. Gratitude may foster purpose by enhancing connectedness, meaning-making, and positive appraisal.<sup>14–16</sup> In Thai culture, gratitude is embedded in values of respect, reciprocity, and responsibility and is linked to greater well-being,<sup>17–20</sup> suggesting a culturally relevant mechanism for promoting purpose.

Heart rate variability (HRV) is a physiological marker of autonomic function and flexibility, reflecting brain–heart interactions.<sup>21</sup> Emotional regulation, in contrast, is a multidimensional psychological construct assessed through psychological measures. Although higher HRV is associated with better emotional regulation and well-being,<sup>22</sup> it is not a direct measure but a complementary physiological correlate of regulatory capacity.

Interventions targeting emotional regulation may improve both psychological outcomes and autonomic functioning.<sup>23–26</sup> Accordingly, changes in HRV may reflect enhanced autonomic regulation associated with intervention effects. However, as the relationship between HRV and emotional regulation is not one-to-one, HRV is interpreted as an indirect indicator alongside psychological measures.

Nurses play a significant role in promoting well-being among vulnerable youth, particularly in fostering PIL. Nursing interventions that facilitate meaning-making and emotional regulation may reduce the long-term impact of psychosocial hardship. Despite growing interest in gratitude, PIL, and physiological regulation, limited nursing evidence has examined whether grounded gratitude–promoting interventions can enhance both PIL and autonomic regulation among vulnerable youth. Most studies have focused on general youth populations and have described psychological outcomes in isolation.<sup>12,17–20</sup> This quasi-experimental study examined the effects of a culturally grounded gratitude–promoting program on PIL and HRV among vulnerable Thai youth, aiming to generate evidence for holistic nursing interventions that support both psychological well-being, including the spiritual dimension, and autonomic regulation in this population.

## **Literature Review and Conceptual Framework**

Purpose in life is an asset that supports meaningful goal pursuits, psychological well-being, and adaptive functioning, particularly among vulnerable youth facing socioeconomic and psychosocial challenges.<sup>11</sup> A well-developed sense of purpose enables them to navigate life with direction and a sense of contribution beyond the self, contributing to moral awareness, psychological well-being, and spiritual fulfillment.<sup>17–20,27</sup>

Within a positive psychology framework, gratitude has been indicated as a promising pathway for cultivating purpose.<sup>14</sup> It fosters positive appraisal, strengthens interpersonal relationships, and enhances a sense of connectedness, all of which contribute to meaning-making processes. In the Thai cultural context, gratitude embodies values of respect, reciprocity, and responsibility, making it a culturally

relevant pathway for promoting purpose among Thai youth. Building on this cultural foundation, the present gratitude-promoting program was developed based on the substantive theory, *Living Life with Wisdom for Oneself and Others*, developed by the first author through grounded theory research conducted over more than ten years.<sup>28</sup> This substantive theory integrates the principles of the Sufficiency Economy Philosophy (SEP) and the guidance of Prince Mahidol Adulyadej of Thailand as described in *Our Soul is for the Benefit of Mankind*. Within this framework, gratitude is conceptualized as a positive passion and a way of living grounded in moderation, reasonableness, self-immunity, morality, and concern for the well-being of others.<sup>28</sup>

This substantive theory identifies four gratitude pathways through which PIL may be strengthened. Gratitude toward oneself fosters self-worth, emotional regulation, and hopefulness; gratitude toward parents and significant others nurtures respect, emotional security, and reciprocal care; gratitude toward friends strengthens interpersonal connectedness and social support; and gratitude toward society and the environment enhances altruistic meaning, social contribution, and a sense of belonging to the larger community.<sup>28</sup> Collectively, these experiences enable vulnerable youth to perceive their lives as meaningful, valuable, and goal-directed. By fostering self-awareness, connectedness, compassionate relationships, and contribution to others, gratitude-based living promotes meaning-making processes and strengthens PIL among vulnerable Thai youth.<sup>15-20,29</sup> Furthermore, increased gratitude and PIL may positively influence autonomic nervous system regulation, as evidenced by enhanced heart rate variability (HRV).

In this study, HRV is included as a physiological indicator of autonomic nervous system function.<sup>21</sup> Heart rate variability is commonly assessed using time-domain indices derived from electrocardiographic R-R interval data, comprising the standard deviation of normal-to-normal intervals (SDNN), root mean

square of successive differences (RMSSD), and the percentage of successive normal-to-normal intervals differing by more than 50 milliseconds (pNN50). SDNN reflects overall variability in cardiac activity, whereas RMSSD and pNN50 capture short-term beat-to-beat variability and are widely interpreted as indicators of parasympathetic activity. Prior research has shown that higher RMSSD and pNN50 values are associated with greater parasympathetic regulation and more adaptive autonomic patterns.<sup>22</sup> Accordingly, HRV is conceptualized in this study as a physiological correlate of autonomic flexibility and processes related to emotional regulation, rather than a direct measure of emotional regulation itself. Evidence suggests that interventions targeting emotional regulation and positive psychological processes, such as mindfulness-based approaches, can enhance HRV.<sup>23-26</sup> Gratitude practices, which involve reflection, emotional awareness, and positive reappraisal, may similarly support adaptive physiological responses. In this context, gratitude may foster PIL and contribute to improvements in autonomic regulation, as reflected in HRV.

Accordingly, the gratitude-promoting program was hypothesized to influence both psychological (PIL), including its spiritual dimension, and physiological (HRV) outcomes among vulnerable youth. This integrated approach offers a conceptual framework for examining gratitude as a central mechanism connecting emotional, cognitive, and physiological developments.

## **Study Aim and Hypothesis**

This study aimed to examine the effect of a gratitude-promoting program on PIL and HRV among vulnerable Thai youth. The primary outcomes concern PIL and HRV indices, including SDNN, RMSSD, and pNN50. The hypothesis was that participants in the experimental group would demonstrate a significant increase in PIL and improvement in HRV (SDNN, RMSSD, and pNN50) following the intervention,

compared to their baseline level and to the control group.

## **Methods**

**Design:** This study used a quasi-experimental, two-parallel group, pre-test, and post-test design, and this report adheres to the Transparent Reporting of Quasi-experimental with non-randomized evaluations (TREND Statement).

**Sampling and Settings:** Two non-formal and informal education (NFE) centers located in urban areas of southern Thailand and administered by the Office of the Non-formal and Informal Education (ONIE) were purposively selected, based on predefined eligibility criteria. In Thailand, NFE follows the national curriculum administered by the ONIE and is designed to provide alternative educational opportunities for youth who have discontinued formal schooling.<sup>29</sup> The participants in this study were students enrolled in these selected centers.

Following center selection, cluster-level assignment was conducted using a lottery method to determine which center would serve as the experimental group and which center as the control group. Participants were not randomly assigned. Because the intervention was assigned at the cluster level while outcomes were analyzed at the individual level, the potential intra-cluster correlation was considered in the analysis. Generalized estimating equations (GEE) were employed to account for the correlated nature of the data within clusters. However, as only two clusters were included, the ability to fully account for cluster-level variability may be limited.

A total of 60 vulnerable Thai youth aged 18–24 years were recruited from selected clusters. Vulnerability was defined based on sociodemographic and structural disadvantages that limit educational opportunities and long-term developmental outcomes.<sup>11</sup> The sample size was estimated based on a previous study conducted among Thai adolescents using

a meaning-centered framework.<sup>17</sup> Although the primary outcome in that study was wellness rather than PIL or HRV, the intervention characteristics, theoretical foundation, and cultural context were comparable to the present study. The reported effect size (1.17) was deemed excessively large. Therefore, a more conservative effect size of 0.80 (large, according to Cohen's criteria)<sup>30</sup> was applied. With a significance level of  $\alpha = 0.05$  and a power of 0.80, a minimum of 25 participants per group was required. To account for potential attrition during the 34-week follow-up, an additional 20% was added, yielding 30 participants in each of the experimental and control groups. The sample size calculation did not account for a design effect, which may have underestimated the required sample size.

In this study, vulnerability was defined using two inclusion criteria: 1) enrollment in a non-formal education program, indicating educational vulnerability due to discontinuation of formal primary education before completion, and 2) low socioeconomic status, defined as a monthly household income of no more than 6,500 Thai Baht (approximately 200 USD).

In addition, five additional inclusion criteria were applied: 1) a normal body mass index (BMI) of 18.5–24.9 kg/m<sup>2</sup>; 2) no physical disabilities or health conditions requiring ongoing treatment; 3) no history of cardiovascular or neurological disorders, or use of medications affecting the autonomic nervous system; 4) no participation in other holistic health promotion programs; and 5) ability to communicate in Thai. Additional criteria for HRV measurement included: obtaining at least six hours of sleep, abstaining from smoking for at least two hours, abstaining from alcohol and caffeine for at least six hours, and avoiding heavy exercise for at least 24 hours before assessment.

Individuals with high perceived stress were excluded from the study. Stress levels were assessed using the Thai version of the Perceived Stress Scale (PSS-10), originally developed by Cohen<sup>31</sup> and validated in Thai by Wongpakaran and Wongpakaran.<sup>32</sup>

Following established scoring protocols, participants with a total score of 27 or higher on a scale of 0–40 were excluded from participation to ensure the stability of baseline physiological measurements.

Two participants from the control group withdrew before the intervention period to join another activity, resulting in 28 participants in the control group at baseline. Throughout the follow-up period, participant attrition occurred in both groups. By Week 10, the experimental group had decreased to 18 participants, while the control group consisted of 21 participants. At the Week 22 and Week 34 assessments, the experimental group further declined

to 16 participants, whereas the control group remained stable at 21 participants (**Figure 1**). Blinding of participants and intervention providers was not feasible because of the nature of the intervention, as participants were aware of their group allocation.

Attrition was primarily attributed to school graduation, discontinuation of attendance, and relocation due to temporary employment, reflecting the characteristic instability of living conditions among vulnerable youth populations. This reduction in the sample size may affect statistical power and should be considered when interpreting the final findings.

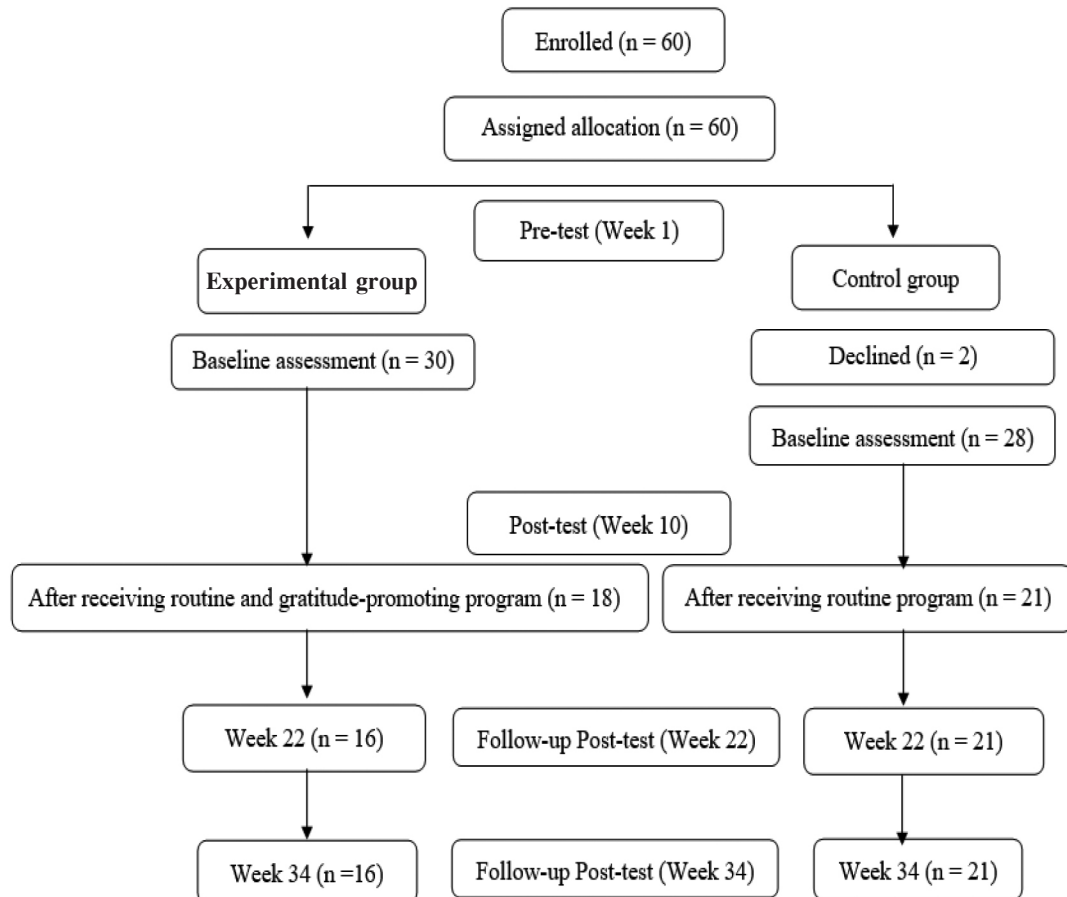


Figure 1. Flow-chart of the study

**Ethical Considerations:** The study received approval from the Center for Social and Behavioral Sciences Institutional Review Board, Prince of Songkla University (Ref no: PSU IRB 2022–LL–Nur–012, 30 May 2022) and was conducted in accordance with established ethical principles. Permission to conduct the study was also obtained from the directors of the participating NFE centers prior to recruitment and data collection. Participation was entirely voluntary, and participants could withdraw at any time without impact. Potential participants were initially informed about the study by their teachers, and those who expressed interest then received a clear verbal and written explanation of the study objectives, procedures, potential risks and benefits, and their rights. The researchers obtained written informed consent from all participants before data collection. Participant confidentiality was protected throughout the study. All data were stored securely in locked cabinets and password-protected computers accessible only to the research team. Potential risks were minimal and mainly related to possible emotional discomfort. Participants received a small token of appreciation (100 Thai Baht; approximately 3.50 USD) for their time.

**Instruments:** Three data collection instruments and the experimental program were used.

*A Demographic Characteristics Questionnaire* was developed by the researchers and has ten items on age, sex, blood pressure, religion, living arrangement, occupation, family relationship, history of drug use, congenital disease, and having a support system.

*The Purpose in Life Scale for Thai Adolescents (PILTA)* was previously developed by the first author and team.<sup>33</sup> Permission to use and modify the scale was obtained before the study. The PILTA consists of 55 positively worded items across seven dimensions: connectedness (7 items), gratitude (4 items), meaning of life (10 items), self-worth (13 items), self-belief (10 items), goal orientation (7 items), and determination (4 items). Responses are ranked on a 4-point Likert

scale (1 = strongly disagree to 4 = strongly agree), with higher scores indicating a greater sense of PIL. An example item is “I live my life with purpose.” In this study, the scale demonstrated high internal consistency (Cronbach’s  $\alpha = 0.96$ ).

*Polar H10 Chest Strap:* Short-term HRV ( $\leq 5$  minutes), assesses autonomic nervous system function,<sup>34</sup> and was measured using a Polar H10 chest strap and validated against electrocardiography.<sup>35</sup> Data were collected using Polar Flow and Kubios HRV Premium software (version 3.5). Time-domain indicators, including SDNN, RMSSD, and pNN50, were calculated for analysis.

**Experimental instrument: the Gratitude-Promoting Program**

The program, the Heart of Modern Thai Youths Filled with the 4Gs, was developed to promote PIL among vulnerable Thai youth. The 4Gs represent four domains of gratitude: gratitude toward the self, parents and significant others, friends, and society and the environment. The program was developed based on the substantive theory, Living Life with Wisdom for Oneself and Others (described above), together with suitable empirical literature.<sup>17–20,28,36–37</sup> Content validity and feasibility were evaluated by five experts in spirituality, child development, and research methodology.

The program provides a blend of group and individual activities and was conducted over ten weeks, comprising 10 sessions, each lasting 90–120 minutes. It is structured into four sequential components: 1) nurturing calmness, 2) cultivating four aspects of gratitude and connectedness towards the self and others, 3) practicing and reflecting on gratitude in daily life, and 4) consolidating learning to enhance purpose.<sup>12,18–20,28</sup> Across sessions, participants engaged in activities that promoted mindfulness, reflection, and prosocial engagement. Detailed session-by-session techniques are provided in **Appendix, Table A1**.

**Data Collection:** The study was conducted from July to September 2022, and follow-up procedures

were carried out twice, in December 2022 and March 2023. The research team consisted of two researchers and three trained research assistants (RAs). The first author was responsible for implementing the gratitude program for participants in the intervention group. The second author supervised the quality control procedures of the HRV measurements and ensured adherence to the study protocol. The RAs received training on study procedures, questionnaire administration, and standardized HRV measurement procedures under the supervision of researchers and an HRV measurement expert.

Two RAs administered the questionnaires and conducted HRV measurements at baseline and post-intervention. The other RA was not involved in the program intervention but administered the questionnaires and conducted HRV measurements during the two follow-up assessments. This approach may have facilitated reducing potential assessment bias by the researchers.

**Data collection process:** At Week 1, both groups were assessed for demographic characteristics, completed the PILTA, and had their HRV recorded as baseline pre-test measurements by two trained research assistants. From Weeks 1 to 10, the experimental group participated in the 10-week program delivered by the first author. At Week 10 (immediately post-intervention), PIL and HRV were measured in both groups by the same trained research assistants who conducted the baseline assessments. At Week 22 (three months post-intervention) and Week 34 (six months post-intervention), PIL and HRV were reassessed in both groups by another trained research assistant. In addition, all participants continued to receive the routine educational program provided by the two NFE Centers.

**Data Analysis:** Categorical variables were described as frequencies and percentages, while continuous variables were described as mean  $\pm$  standard deviation (SD) or median (interquartile range),

depending on their distribution. Group differences at baseline were analyzed using independent-samples t-tests or Mann-Whitney U tests for continuous variables, and chi-square or Fisher's exact tests for categorical variables.

To examine the intervention effects over time, GEE with an appropriate correlation structure was applied to account for repeated measures. All models were adjusted for potential confounders, including age, sex, blood pressure, religion, living arrangement, occupation, family relationship, history of drug use, support system, and congenital disease. These covariates were included in both the PIL and HRV models to control for their potential influence on the outcomes and to ensure more accurate estimation of the intervention effects. Results were reported as regression coefficients ( $\beta$ ), 95% confidence intervals (CIs), and p-values. Longitudinal changes in PIL and HRV at baseline and at Weeks 10, 22, and 34 were further analyzed using GEE modeling with time, group, and time  $\times$  group interaction terms to account for within-subject correlations. Within-group comparisons (baseline vs. follow-up time points), between-group differences were estimated within the GEE framework. All analyses were completed using SPSS version 31 (IBM Corp., Armonk, NY, USA) and Stata/MP version 16 (StataCorp LLC, College Station, TX, USA), with a significance level set at 0.05.

## **Results**

### **Participant characteristics**

The participants comprised 37 vulnerable Thai youth, including 21 in the control group and 16 in the experimental group. Overall, baseline characteristics were largely comparable between groups. Nevertheless, sex distribution revealed a borderline difference ( $p = 0.06$ ), whereas living arrangements differed significantly between groups ( $p = 0.04$ ) (Table 1).

**Table 1.** Comparison of participants' demographic characteristics at baseline between groups (N = 37)

| Variables               | Control Group<br>(n = 21) | Experimental Group<br>(n = 16) | p-value            |
|-------------------------|---------------------------|--------------------------------|--------------------|
| Age (median (IQR))      | 20 (18.00 – 23.00)        | 19 (18.00 – 21.50)             | 0.33 <sup>a</sup>  |
| Sex                     |                           |                                | 0.06 <sup>b*</sup> |
| Male                    | 10 (47.62)                | 12 (75.00)                     |                    |
| Female                  | 11 (52.38)                | 3 (18.75)                      |                    |
| Others (gay, lesbian)   | –                         | 1 (6.25)                       |                    |
| Blood pressure (mmHg)   |                           |                                | 0.55 <sup>b</sup>  |
| Systolic                |                           |                                |                    |
| < 120                   | 13 (61.91)                | 11 (68.75)                     |                    |
| 120 – 129               | 3 (14.29)                 | 3 (18.75)                      |                    |
| 130 – 139               | 3 (14.29)                 | 0 (0.00)                       |                    |
| > 140                   | 2 (9.52)                  | 2 (12.50)                      |                    |
| Diastolic               |                           |                                |                    |
| < 80                    |                           |                                |                    |
| 80 – 84                 |                           |                                |                    |
| 85 – 89                 |                           |                                |                    |
| > 90                    |                           |                                |                    |
| Religion                |                           |                                | 0.41 <sup>b</sup>  |
| Buddhism                | 16 (76.19)                | 13 (81.25)                     |                    |
| Islam                   | 5 (23.81)                 | 2 (12.50)                      |                    |
| Irreligion              | –                         | 1 (6.25)                       |                    |
| Living with             |                           |                                | 0.04 <sup>b*</sup> |
| Parents                 | 15 (71.43)                | 7 (43.75)                      |                    |
| Single parent           | 2 (9.52)                  | 7 (43.75)                      |                    |
| Living alone            | 2 (9.52)                  | 1 (6.25)                       |                    |
| Cousin and relatives    | 0 (0.00)                  | 1 (6.25)                       |                    |
| Others, such as friends | 2 (9.52)                  | –                              |                    |
| Occupation              |                           |                                | 0.11 <sup>b</sup>  |
| Farmer                  | 1 (4.76)                  | 1 (6.25)                       |                    |
| Trading careers         | 7 (33.33)                 | 2 (12.50)                      |                    |
| Unskilled workers       | 2 (9.52)                  | 7 (43.75)                      |                    |
| Employees               | 1 (4.76)                  | 1 (6.25)                       |                    |
| No occupation           | 10 (47.62)                | 5 (31.25)                      |                    |
| Family relationship     |                           |                                | 1.00 <sup>b</sup>  |
| Good                    | 18 (85.71)                | 14 (87.50)                     |                    |
| Not very good           | 3 (14.29)                 | 2 (12.50)                      |                    |
| History of drug use     |                           |                                | 0.82 <sup>c</sup>  |
| Use                     | 10 (47.62)                | 7 (43.75)                      |                    |
| Never use               | 11 (52.38)                | 9 (56.25)                      |                    |
| Congenital disease      |                           |                                | 1.00 <sup>b</sup>  |
| Yes                     | 3 (14.29)                 | 3 (18.75)                      |                    |
| No                      | 18 (85.71)                | 13 (81.25)                     |                    |
| Having a support system |                           |                                | 0.46 <sup>b</sup>  |
| Yes                     | 17 (80.95)                | 11 (68.75)                     |                    |
| No                      | 4 (19.05)                 | 5 (31.25)                      |                    |

Note. Statistical significance (p-value ≤0.05)

Values are presented as n (%) or median (IQR).

<sup>a</sup>Mann–Whitney U test; <sup>b</sup>Fisher's exact test; <sup>c</sup>Chi-square test.

**Effect of the Gratitude-Promoting Program**

A total of 37 participants were included in the analysis. The effects of the gratitude-promoting program on PIL are presented in **Tables 2-4** and **Figure 2**. At baseline, the control group had a higher mean PIL score than the experimental group. Over time, PIL scores declined in the control group, and the experimental group demonstrated a steady increase.

Results from the adjusted GEE model presented in **Table 3** indicated a significant main effect of group membership, with the experimental group having lower baseline PIL scores than the control group ( $\beta = -14.28$ ,  $p = 0.035$ ). A significant effect of time was observed in the experimental group, with increased PIL scores

across all follow-up points, and the control group showed a significant decrease at Week 22 compared to baseline ( $\beta = -10.63$ ,  $p = 0.002$ ).

Significant Group  $\times$  Time interaction effects were found in Weeks 10, 22, and 34, indicating differential changes in PIL scores between groups over time. Post hoc comparisons based on estimated marginal means (EMMs) (**Table 4**) demonstrated that the experimental group had significantly higher adjusted mean PIL scores than the control group at all follow-up time points. These findings indicate that the gratitude-promoting program was effective in improving PIL among vulnerable Thai youths.

**Table 2.** Descriptive statistics of purpose in life scores in the control and experimental groups at baseline and follow-up assessments

| Group             | Control (n = 21)   | Experimental (n = 16) |
|-------------------|--------------------|-----------------------|
| Week 1 (Baseline) | 190.81 $\pm$ 14.30 | 181.75 $\pm$ 16.65    |
| Week 10           | 186.14 $\pm$ 17.41 | 191.44 $\pm$ 17.82    |
| Week 22           | 179.65 $\pm$ 16.73 | 192.87 $\pm$ 17.61    |
| Week 34           | 188.14 $\pm$ 15.81 | 195.20 $\pm$ 21.14    |

Note. Values are presented as mean  $\pm$  standard deviation (SD).

Baseline = Week 1; follow-up assessments were conducted at Weeks 10, 22, and 34.

**Table 3.** Adjusted GEE analysis of group, time, and interaction effects on purpose in life scores

| Parameter                         | $\beta$ | Robust S.E. | z     | p-value                | 95% CI           |
|-----------------------------------|---------|-------------|-------|------------------------|------------------|
| Intercept                         | 190.84  | 3.00        | 63.61 | < 0.001 <sup>***</sup> | [184.95, 196.72] |
| Group (Experiment vs. Control)    | -14.28  | 6.77        | -2.11 | 0.035 <sup>*</sup>     | [-27.56, -1.00]  |
| Time (Ref: Week 1)                |         |             |       |                        |                  |
| Week 10                           | -5.11   | 3.26        | -1.57 | 0.117                  | [-11.50, 1.28]   |
| Week 22                           | -10.63  | 3.40        | -3.12 | 0.002 <sup>#</sup>     | [-17.29, -3.96]  |
| Week 34                           | -3.11   | 2.67        | -1.16 | 0.245                  | [-8.35, 2.13]    |
| Interaction (Group $\times$ Time) |         |             |       |                        |                  |
| Experiment Group $\times$ Week 10 | 14.80   | 4.09        | 3.62  | < 0.001 <sup>***</sup> | [6.78, 22.82]    |
| Experiment Group $\times$ Week 22 | 19.17   | 3.88        | 4.95  | < 0.001 <sup>***</sup> | [11.58, 26.76]   |
| Experiment Group $\times$ Week 34 | 16.85   | 3.83        | 4.39  | < 0.001 <sup>***</sup> | [9.34, 24.37]    |

Abbreviations:  $\beta$ , regression coefficient; SE, standard error; CI, confidence interval.

Note:  $\beta$  coefficients are adjusted for age, sex, blood pressure, religion, living arrangement, occupation, family relationship, history of drug use, support system, and congenital disease.

<sup>#</sup> $p < 0.01$ , significant difference from baseline.

<sup>\*</sup> $p < 0.05$  and <sup>\*\*\*</sup> $p < 0.001$ , significant difference between-group difference.

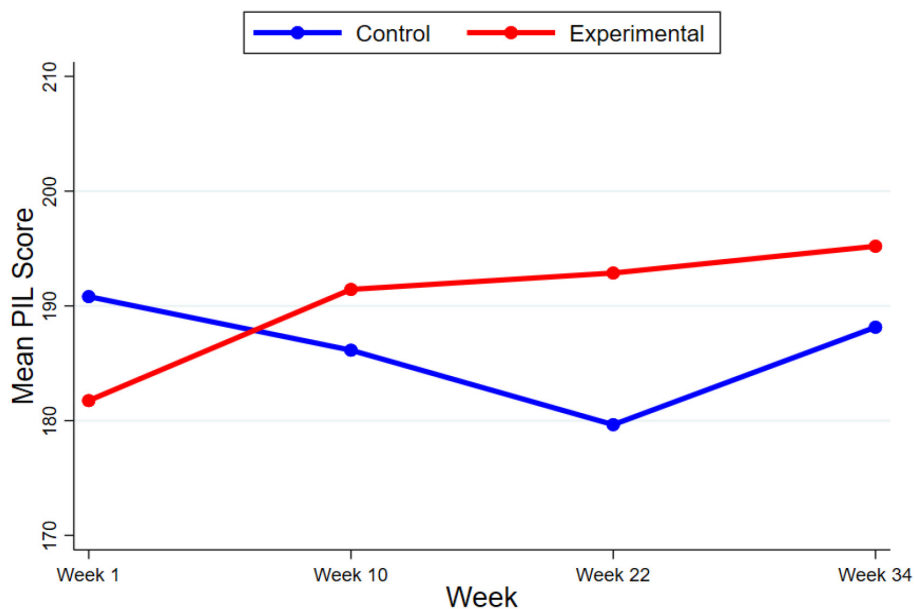
**Table 4.** Adjusted marginal effects and Bonferroni-adjusted pairwise comparisons of purpose in life scores over time based on the GEE model adjusted for potential confounders

| Time    | Between groups                    |         |           | Within groups                     |                     |           |                                   |                       |           |
|---------|-----------------------------------|---------|-----------|-----------------------------------|---------------------|-----------|-----------------------------------|-----------------------|-----------|
|         | Adjusted Marginal Effect [95% CI] | p-value | Cohen's d | Control                           |                     |           | Experiment                        |                       |           |
|         |                                   |         |           | Adjusted Marginal Effect [95% CI] | p-value             | Cohen's d | Adjusted Marginal Effect [95% CI] | p-value               | Cohen's d |
| Week 1  | -14.28<br>[-27.56, -1.00]         | 0.035*  | -0.63     |                                   |                     |           |                                   |                       |           |
| Week 10 | -0.52<br>[-12.39, 13.42]          | 0.973   | 0.01      | -5.11<br>[-11.50, 1.28]           | 0.117               | -0.21     | 9.69<br>[4.84, 14.54]             | <0.001 <sup>###</sup> | 0.39      |
| Week 22 | 4.89<br>[-9.72, 19.50]            | 0.512   | 0.17      | -10.63<br>[-17.29, -3.96]         | 0.002 <sup>##</sup> | -0.46     | 8.55<br>[4.85, 12.24]             | <0.001 <sup>###</sup> | 0.35      |
| Week 34 | 2.57<br>[-11.00, 16.14]           | 0.710   | 0.10      | -3.10<br>[-8.35, 2.13]            | 0.245               | -0.12     | 13.74<br>[8.11, 19.37]            | <0.001 <sup>###</sup> | 0.58      |

Note. Estimates were adjusted for age, sex, blood pressure, religion, living arrangement, occupation, family relationship, history of drug use, support system, and congenital disease.

## $p < 0.01$  and ### $p < 0.001$ , significant difference from baseline.

\* $p < 0.05$ , significant between-group difference.

**Figure 2.** The changes in mean scores of purpose in life between groups at baseline (week 1), post-test (week 10), follow-up 1 (week 22), and follow-up 2 (week 34)

Difference between baseline (week 1) and subsequent time-point: \* $p < 0.05$

### Effect of the Gratitude-Promoting Program on Heart Rate Variability

Changes in HRV and HR are presented in **Tables 5–7** and **Figure 3**. Overall, HRV indices in the experimental group showed an increasing trend over time, whereas the control group demonstrated less consistent changes. Mean heart rate decreased in both groups. A significant Group  $\times$  Time interaction indicated that the pattern of HR change over time differed between the groups. Model-based pairwise comparisons with Bonferroni adjustment further suggest that the greatest between-group difference was observed at Week 22.

For HRV parameters, SDNN showed neither a significant main effect of Time nor a significant Group  $\times$  Time interaction ( $p > 0.05$ ), indicating no overall temporal change or differential pattern between groups. In contrast, RMSSD and pNN50 demonstrated significant Group  $\times$  Time interactions at Week 10, indicating greater improvements in the experimental group than in the control group at this time point. These findings suggest that the gratitude-promoting program contributed to improvements in selected HRV parameters, particularly in early follow-up.

**Table 5.** Descriptive statistics of mean HR and HRV indices in the groups at baseline and follow-up assessments

| Parameter     | Time    | Control group<br>(n = 15) | Experimental group<br>(n = 16) |
|---------------|---------|---------------------------|--------------------------------|
| Mean HR (bpm) | Week 1  | 84.77 $\pm$ 7.26          | 88.42 $\pm$ 7.68               |
|               | Week 10 | 91.20 $\pm$ 11.11         | 85.97 $\pm$ 12.15              |
|               | Week 22 | 90.14 $\pm$ 9.11          | 85.34 $\pm$ 9.92               |
|               | Week 34 | 87.34 $\pm$ 12.99         | 83.85 $\pm$ 7.76               |
| SDNN (ms)     | Week 1  | 28.76 $\pm$ 9.86          | 30.10 $\pm$ 11.82              |
|               | Week 10 | 24.21 $\pm$ 8.17          | 30.14 $\pm$ 15.85              |
|               | Week 22 | 23.98 $\pm$ 8.59          | 32.59 $\pm$ 14.80              |
|               | Week 34 | 28.08 $\pm$ 13.30         | 35.97 $\pm$ 14.67              |
| pNN50 (%)     | Week 1  | 6.94 $\pm$ 7.38           | 7.03 $\pm$ 8.06                |
|               | Week 10 | 3.39 $\pm$ 4.31           | 12.16 $\pm$ 15.31              |
|               | Week 22 | 3.35 $\pm$ 6.27           | 9.40 $\pm$ 13.31               |
|               | Week 34 | 6.58 $\pm$ 8.31           | 9.57 $\pm$ 10.50               |
| RMSSD (ms)    | Week 1  | 26.81 $\pm$ 10.04         | 25.23 $\pm$ 10.53              |
|               | Week 10 | 19.32 $\pm$ 9.03          | 31.04 $\pm$ 19.45              |
|               | Week 22 | 20.60 $\pm$ 10.62         | 25.40 $\pm$ 13.75              |
|               | Week 34 | 22.57 $\pm$ 12.44         | 30.43 $\pm$ 15.68              |

Note. HR = Heart rate, bpm = Beats per minute; HRV = Heart rate variability; SDNN = Standard deviation of normal-to-normal intervals, ms = milliseconds; RMSSD = Root mean square of successive differences; pNN50 = Percentage of successive normal-to-normal intervals differing by more than 50 milliseconds; Values are presented as mean  $\pm$  standard deviation (SD); Baseline = Week 1; follow-up assessments were conducted at Weeks 10, 22, and 34.

**Table 6.** Unadjusted GEE analysis of group, time, and interaction effects mean HR and HRV indices

| Parameter                      | $\beta$ | Robust SE | z     | p-value               | 95% CI          |
|--------------------------------|---------|-----------|-------|-----------------------|-----------------|
| <b>Mean HR (bpm)</b>           |         |           |       |                       |                 |
| Intercept                      | 84.63   | 1.85      | 45.78 | <0.001 <sup>***</sup> | [81.00, 88.25]  |
| Group (Experiment vs. Control) | 3.30    | 2.69      | 1.23  | 0.220                 | [-1.97, 8.57]   |
| Time (Ref: Week 1)             |         |           |       |                       |                 |
| Week 10                        | 6.27    | 3.93      | 1.60  | 0.110                 | [-1.43, 13.98]  |
| Week 22                        | 5.81    | 2.90      | 2.00  | 0.045 <sup>*</sup>    | [0.13, 11.49]   |
| Week 34                        | 2.66    | 3.50      | 0.76  | 0.446                 | [-4.19, 9.52]   |
| Interaction (Group x Time)     |         |           |       |                       |                 |
| Experiment Group x Week 10     | -8.06   | 5.22      | -1.54 | 0.123                 | [-18.29, 2.17]  |
| Experiment Group x Week 22     | -8.36   | 4.05      | -2.06 | 0.039 <sup>*</sup>    | [-16.30, -0.42] |
| Experiment Group x Week 34     | -6.68   | 4.38      | -1.53 | 0.127                 | [-15.27, 1.90]  |
| <b>SDNN (ms)</b>               |         |           |       |                       |                 |
| Intercept                      | 28.89   | 2.60      | 11.11 | <0.001 <sup>***</sup> | [23.80, 33.99]  |
| Group (Experiment vs. Control) | 1.21    | 3.84      | 0.31  | 0.754                 | [-6.32, 8.73]   |
| Time (Ref: Week 1)             |         |           |       |                       |                 |
| Week 10                        | -4.62   | 3.51      | -1.32 | 0.188                 | [-11.50, 2.26]  |
| Week 22                        | -4.86   | 3.35      | -1.45 | 0.148                 | [-11.43, 1.72]  |
| Week 34                        | -0.85   | 4.76      | -0.18 | 0.858                 | [-10.17, 8.47]  |
| Interaction (Group x Time)     |         |           |       |                       |                 |
| Experiment Group x Week 10     | 5.01    | 5.56      | 0.90  | 0.368                 | [-5.89, 15.92]  |
| Experiment Group x Week 22     | 7.74    | 5.43      | 1.42  | 0.154                 | [-2.91, 18.38]  |
| Experiment Group x Week 34     | 6.72    | 6.48      | 1.04  | 0.300                 | [-5.99, 19.43]  |
| <b>pNN50 (%)</b>               |         |           |       |                       |                 |
| Intercept                      | 7.03    | 1.95      | 3.61  | <0.001 <sup>***</sup> | [3.21, 10.85]   |
| Group (Experiment vs. Control) | 0.001   | 2.74      | 0.00  | 1.000                 | [-5.37, 5.37]   |
| Time (Ref: Week 1)             |         |           |       |                       |                 |
| Week 10                        | -3.69   | 2.51      | -1.47 | 0.142                 | [-8.61, 1.23]   |
| Week 22                        | -3.58   | 2.74      | -1.30 | 0.192                 | [-8.96, 1.80]   |
| Week 34                        | -0.51   | 2.80      | -0.18 | 0.856                 | [-5.99, 4.97]   |
| Interaction (Group x Time)     |         |           |       |                       |                 |
| Experiment Group x Week 10     | 9.09    | 4.55      | 2.00  | 0.046 <sup>*</sup>    | [0.17, 18.01]   |
| Experiment Group x Week 22     | 5.94    | 4.43      | 1.34  | 0.180                 | [-2.75, 14.64]  |
| Experiment Group x Week 34     | 3.33    | 4.09      | 0.82  | 0.414                 | [-4.67, 11.34]  |
| <b>RMSSD (ms)</b>              |         |           |       |                       |                 |
| Intercept                      | 26.72   | 2.55      | 10.48 | <0.001 <sup>***</sup> | [21.73, 31.72]  |
| Group (Experiment vs. Control) | -1.50   | 3.58      | -0.42 | 0.676                 | [-8.52, 5.52]   |
| Time (Ref: Week 1)             |         |           |       |                       |                 |
| Week 10                        | -7.39   | 3.71      | -1.99 | 0.047 <sup>#</sup>    | [-14.66, -0.11] |
| Week 22                        | -6.12   | 3.75      | -1.63 | 0.102                 | [-13.47, 1.22]  |
| Week 34                        | -4.30   | 4.06      | -1.06 | 0.289                 | [-12.25, 3.64]  |

**Table 6.** Unadjusted GEE analysis of group, time, and interaction effects mean HR and HRV indices (Cont.)

| Parameter                  | $\beta$ | Robust SE | z     | p-value            | 95% CI         |
|----------------------------|---------|-----------|-------|--------------------|----------------|
| Interaction (Group x Time) |         |           |       |                    |                |
| Experiment Group x Week 10 | 13.20   | 6.19      | 2.13  | 0.033 <sup>*</sup> | [1.07, 25.32]  |
| Experiment Group x Week 22 | 6.67    | 5.56      | 1.20  | 0.231              | [-4.24, 17.57] |
| Experiment Group x Week 34 | 9.51    | 6.17      | 10.48 | 0.123              | [-2.58, 21.59] |

Note. GEE = Generalized estimating equation; HR = Heart rate, bpm = Beats per minute; HRV = Heart rate variability;  $\beta$  = Regression coefficient; SE = Standard error; CI = Confidence interval; SDNN = Standard deviation of normal-to-normal intervals, ms = milliseconds; pNN50 = Percentage of successive normal-to-normal intervals differing by more than 50 milliseconds; RMSSD = Root mean square of successive differences  
<sup>#</sup> $p < 0.05$ , significant difference from baseline.

<sup>\*</sup> $p < 0.05$  and <sup>\*\*\*</sup>  $< 0.001$ , significant between-group difference

**Table 7.** Unadjusted marginal effect and Bonferroni-adjusted pairwise comparisons of mean HR and HRV indices over time based on unadjusted GEE model

|                      | Between groups                     |                    |              | Within groups                            |                    |              |                                          |                 |              |
|----------------------|------------------------------------|--------------------|--------------|------------------------------------------|--------------------|--------------|------------------------------------------|-----------------|--------------|
|                      | <i>Unadjusted</i>                  | <i>p</i> -value    | Cohen's<br>d | Control                                  |                    | Cohen's<br>d | Experiment                               |                 | Cohen's<br>d |
|                      | <i>Marginal Effect</i><br>[95% CI] |                    |              | <i>Adjusted Marginal Effect</i> [95% CI] | <i>p</i> -value    |              | <i>Adjusted Marginal Effect</i> [95% CI] | <i>p</i> -value |              |
| <b>Mean HR (BPM)</b> |                                    |                    |              |                                          |                    |              |                                          |                 |              |
| Week 1               | 3.30<br>[-1.97, 8.57]              | 0.220              | 0.34         |                                          |                    |              |                                          |                 |              |
| Week 10              | -4.76<br>[-12.81, 3.29]            | 0.246              | -0.50        | 6.27<br>[-1.43, 13.98]                   | 0.110              | 0.65         | -1.78<br>[-8.52, 4.95]                   | 0.604           | -0.19        |
| Week 22              | -5.06<br>[-11.63, 1.50]            | 0.130              | -0.53        | 5.81<br>[0.13, 11.49]                    | 0.045 <sup>#</sup> | 0.60         | -2.55<br>[-8.10, 3.00]                   | 0.367           | -0.27        |
| Week 34              | -3.39<br>[-10.80, 4.03]            | 0.370              | -0.35        | 2.66<br>[-4.19, 9.52]                    | 0.446              | 0.28         | -4.02<br>[-9.20, 1.15]                   | 0.128           | -0.42        |
| <b>SDNN (ms)</b>     |                                    |                    |              |                                          |                    |              |                                          |                 |              |
| Week 1               | 1.21<br>[-6.32, 8.73]              | 0.754              | 0.10         |                                          |                    |              |                                          |                 |              |
| Week 10              | 6.22<br>[-2.43, 14.86]             | 0.159              | 0.51         | -4.62<br>[-11.50, 2.26]                  | 0.188              | -0.38        | 0.39<br>[-8.07, 8.85]                    | 0.928           | 0.03         |
| Week 22              | 8.94<br>[0.64, 17.24]              | 0.035 <sup>*</sup> | 0.74         | -4.86<br>[-11.43, 1.72]                  | 0.148              | -0.40        | 2.88<br>[-5.49, 11.25]                   | 0.500           | 0.24         |
| Week 34              | 7.92<br>[-1.63, 17.47]             | 0.104              | 0.65         | -0.85<br>[-10.17, 8.47]                  | 0.858              | -0.07        | 5.87<br>[-2.77, 14.50]                   | 0.183           | 0.48         |
| <b>pNN50 (%)</b>     |                                    |                    |              |                                          |                    |              |                                          |                 |              |
| Week 1               | 0.001<br>[-5.37, 5.37]             | 1.000              | <0.001       |                                          |                    |              |                                          |                 |              |
| Week 10              | 9.09<br>[1.45, 16.74]              | 0.020 <sup>*</sup> | 0.95         | -3.69<br>[-8.61, 1.23]                   | 0.142              | -0.38        | 5.41<br>[-2.03, 12.84]                   | 0.154           | 0.56         |
| Week 22              | 5.95<br>[-1.03, 12.92]             | 0.095              | 0.62         | -3.58<br>[-8.96, 1.80]                   | 0.192              | -0.37        | 2.37<br>[-4.46, 9.20]                    | 0.497           | 0.25         |
| Week 34              | 3.34<br>[-3.19, 9.86]              | 0.316              | 0.35         | -0.51<br>[-5.99, 4.97]                   | 0.856              | -0.05        | 2.83<br>[-3.01, 8.66]                    | 0.343           | 0.29         |

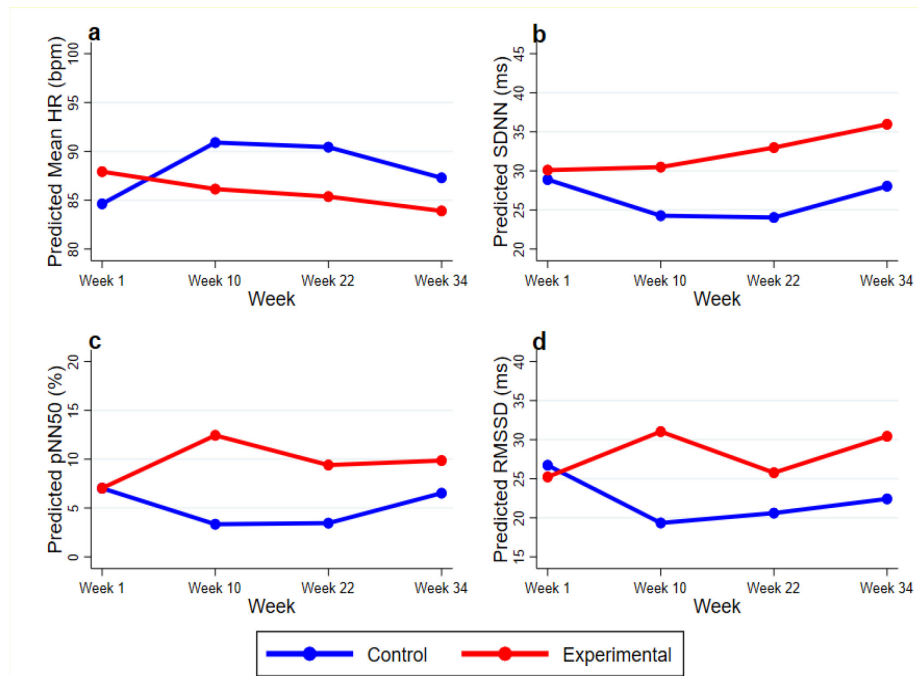
**Table 7.** Estimated marginal means and Bonferroni-adjusted pairwise comparisons of mean HR and HRV indices over time based on unadjusted GEE model (Cont.)

|                   | Between groups                            |         |              | Within groups                                   |         |              |                                                    |         |              |
|-------------------|-------------------------------------------|---------|--------------|-------------------------------------------------|---------|--------------|----------------------------------------------------|---------|--------------|
|                   | Unadjusted<br>Marginal Effect<br>[95% CI] | p-value | Cohen's<br>d | Control<br>Adjusted Marginal<br>Effect [95% CI] | p-value | Cohen's<br>d | Experiment<br>Adjusted Marginal<br>Effect [95% CI] | p-value | Cohen's<br>d |
| <b>RMSSD (ms)</b> |                                           |         |              |                                                 |         |              |                                                    |         |              |
| Week 1            | -1.50<br>[-8.52, 5.52]                    | 0.676   | -0.12        |                                                 |         |              |                                                    |         |              |
| Week 10           | 11.70<br>[1.54, 21.86]                    | 0.024*  | 0.91         | -7.39<br>[-14.66, -0.11]                        | 0.047#  | -0.58        | 5.81<br>[-3.89, 15.51]                             | 0.240   | 0.45         |
| Week 22           | 5.17<br>[-3.15, 13.49]                    | 0.223   | 0.40         | -6.12<br>[-13.47, 1.22]                         | 0.102   | -0.48        | 0.54<br>[-7.51, 8.60]                              | 0.895   | 0.04         |
| Week 34           | 8.01<br>[-1.59, 17.61]                    | 0.102   | 0.63         | -4.30<br>[-12.25, 3.64]                         | 0.289   | -0.34        | 5.20<br>[-3.90, 14.30]                             | 0.262   | 0.41         |

Note. GEE = Generalized estimating equation; Cohen's d = Effect size; CI = Confidence interval; HR = Heart rate, bpm = Beats per minute; HRV = Heart rate variability; SDNN = Standard deviation of normal-to-normal intervals, ms = milliseconds; pNN50 = Percentage of successive normal-to-normal intervals differing by more than 50 milliseconds; RMSSD = Root mean square of successive differences

#p < 0.05, significant difference from baseline.

\*p < 0.05, significant between-group difference



**Figure 3.** Changes in heart rate and heart rate variability parameters over time estimated using generalized estimating equations; (a) mean heart rate (beats per minute), (b) SDNN: standard deviation of normal-to-normal intervals in milliseconds, (c) pNN50: percentage of successive normal-to-normal intervals differing by more than 50 milliseconds, (d) RMSSD: root mean square of successive differences in milliseconds

## Discussion

This study examined the effect of a gratitude-promoting program on PIL and heart rate variability among 37 vulnerable Thai youth aged 24–18 years. The findings demonstrated that the culturally grounded gratitude-promoting program improved both PIL and HRV among participants, consistent with the study hypotheses.

These results support the role of gratitude in promoting both psychological and physiological well-being. The improvement in PIL supports the theoretical proposition that gratitude facilitates meaning-making processes and reinforces goal-directed orientation.<sup>38–39</sup> In the Thai cultural context, gratitude is deeply embedded in societal and spiritual values, nurturing connectedness and responsibility toward others. This culturally grounded process may contribute to a stronger sense of purpose, consistent with prior evidence suggesting a positive correlation between gratitude, meaning in life, PIL, and psychological well-being.<sup>17,20</sup>

Beyond psychological outcomes, the findings suggest that gratitude practices may influence autonomic regulation. Improvements in HRV, particularly RMSSD and pNN50, indicate increased parasympathetic activity and are generally associated with greater autonomic flexibility, which is associated with emotional regulation capacity.<sup>21–22</sup> However, HRV should be interpreted as a physiological correlate of autonomic and emotional regulation processes rather than a direct measure of emotional regulation itself.<sup>21–22</sup> In contrast, SDNN reflects overall HRV and is influenced by both sympathetic and parasympathetic activity.<sup>21</sup> The absence of significant change in SDNN may suggest that the intervention did not produce measurable changes in global autonomic variability, whereas effects were primarily observed in short-term, parasympathetic-related indices (RMSSD and pNN50).<sup>21,26</sup>

Further, as different HRV indices represent distinct aspects of autonomic function, they may

respond to interventions at different rates, contributing to variability in outcomes.<sup>21,26</sup> The observed pattern suggests that intervention effects may emerge gradually, consistent with previous mindfulness-based intervention studies demonstrating improvement in HRV following repeated practice over time.<sup>25–26</sup> Variability in later measurements may also reflect individual differences in intervention engagement or contextual factors during the study period. Sustained engagement in gratitude practices may therefore be important for supporting autonomic regulation and strengthening PIL over time.<sup>22,25,27</sup>

The effectiveness of the program may be explained by several key mechanisms. The intervention emphasizes reflective and experiential gratitude practices, including self-reflection and meaningful interpersonal interaction. These pathways tend to reinforce personal values and support meaning-making, which are central to the development of PIL and wellness.<sup>20</sup> From a physiological perspective, improvement in HRV is associated with functional connectivity, particularly within networks involving the prefrontal cortex and the limbic system region that are involved in emotional regulation.<sup>40</sup> The concurrent improvements in PIL and HRV underscore the potential of gratitude-based interventions for psychological and physiological domains.

## Limitations and Recommendations

This study extends the current literature by providing evidence from vulnerable youth in a Southeast Asian context and highlights the value of culturally grounded approaches in promoting holistic well-being. Despite these contributions, several limitations should be considered. First, attrition occurred in both groups due to graduation, discontinuation of school attendance, and temporary employment, which may have introduced attrition bias and affected the generalizability of the results. Because the analysis was conducted using complete cases, the true intervention effects may have

been overestimated or underestimated. Second, the study design involved cluster-level assignment with analysis at the individual level. Although GEE were applied to account for intra-cluster correlation, the small number of clusters and inclusion of only two study sites may limit the robustness of the estimates and increase the risk of confounding by location-specific characteristics. In addition, the sample size was not adjusted for the design effect, which may have resulted in an underestimation of the required sample size. Third, the gratitude-promoting program was culturally grounded in Thai sociocultural and spiritual values. While this strengthens contextual relevance, it may limit transferability to other cultural settings without appropriate adaptation. Finally, although efforts were made to minimize bias, the lack of full blinding may have introduced potential bias. Future research with larger sample sizes, a greater number of clusters, and more rigorous study designs is recommended.

## **Conclusions and Implications for Nursing Practice**

This study highlights the effectiveness of a cultural gratitude-promoting program in cultivating positive psychological effects among vulnerable Thai youth. Involvement in the program resulted in a significantly higher level of PIL and increased HRV, suggesting its potential as a valuable intervention for promoting well-being among vulnerable populations. The findings highlight the merit of enhancing PIL, an essential concept in positive psychology that supports positive youth development and provides valuable implications for the nursing profession and allied health practices.

Health professionals, particularly nurses working in schools, youth mental health centers, and community settings, can integrate gratitude-promoting programs into routine care, such as reflective practices that enhance self-connectedness, as well as guided expressions of gratitude and interpersonal appreciation. Integrating this program into routine practice for

vulnerable youth is therefore recommended, as it aligns with holistic, person-centered care and may support long-term well-being by promoting sustained engagement that supports the development and maintenance of a sense of PIL over time.

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## **Author Contributions**

Conceptualization, Method and design: KB, DA  
Data collection: KB, DA  
Data analysis and interpretation: DA  
Drafting, editing, revising, and final approval of the manuscript: KB, DA

## **Declaration regarding Conflict of Interest**

The authors declare no conflicts of interest.

## **Declaration of AI used for Scientific Writing**

The authors used ChatGPT and Gemini to support grammar verification and English clarity in this manuscript and assume full responsibility for the final edition.

## **References**

1. World Health Organization. Adolescent health: an overview [Internet]. [cited 2026 Mar 25]. Available from: <https://www.who.int/health-topics/adolescent-health>

2. World Health Organization. Mental health of adolescents [Internet]. 2025 Sept 1 [cited 2026 Mar 25]. Available from: <https://www.who.int/news-room/fact-sheets/detail/adolescent-mental-health>
3. Arora SK, Shah D, Chaturvedi S, Gupta P. Defining and measuring vulnerability in young people. *Indian J Community Med.* 2015;40(3):193–7. doi: 10.4103/0970-0218.158868.
4. UNICEF, Institute for Population and Social Research, Burnet Institute. Strengthening mental health and psychosocial support systems and services for children and adolescents in East Asia and the Pacific: Thailand country report. UNICEF; 2022. 2022 [cited 2026 Mar 25]. Available from: <https://www.unicef.org/thailand/media/8871/file/MHPSS%20Report%202022.pdf>
5. Insel C, Cohen AO. More than just a phase: adolescence as a window into how the brain generates behavior. *Curr Dir Psychol Sci.* 2025;34(3):149–56. doi: 10.1177/09637214251313733.
6. Larsen B, Luna B. Adolescence as a neurobiological critical period for the development of higher-order cognition. *Neurosci Biobehav Rev.* 2018;94:179–95. doi: 10.1016/j.neubiorev.2018.09.005.
7. Caballero A, Granberg R, Tseng KY. Mechanisms contributing to prefrontal cortex maturation during adolescence. *Neurosci Biobehav Rev.* 2016;70:4–12. doi: 10.1016/j.neubiorev.2016.05.013.
8. Peters KZ, Naneix F. The role of dopamine and endocannabinoid systems in prefrontal cortex development: adolescence as a critical period. *Front Neural Circuits.* 2022;16:939235. doi: 10.3389/fncir.2022.939235.
9. Feghali R, El-Hachem C, Bakhos G, Zarzour M, Bou Khalil R. The impact of economic crisis on the mental health of children and adolescents: a systematic review. *Asian J Psychiatr.* 2025;110:104613. doi:10.1016/j.ajp.2025.104613
10. Koyama Y, Isumi A, Fujiwara T. Timing of exposure to household poverty and adolescent mental health problems. *Epidemiol Psychiatr Sci.* 2025;34:e22. doi: 10.1017/S2045796025000162.
11. Renner HM, Rowland B, Hutchinson D, Toumbourou JW. Profiling vulnerability in youth and predicting educational attainment in young adulthood. *J Adolesc.* 2026;98(1):82–94. doi: 10.1002/jad.70042.
12. Damon W, Menon J, Bronk KC. The development of purpose during adolescence. *Appl Dev Sci.* 2003;7(3): 119–28. doi: 10.1207/s1532480xads0703\_2.
13. Fang L, Allan A, Dickson JM. Purpose in life and associated cognitive and affective mechanisms. *J Happiness Stud.* 2024;25:63. doi: 10.1007/s10902-024-00771-6.
14. Emmons RA, McCullough ME. Counting blessings versus burdens: an experimental investigation of gratitude and subjective well-being in daily life. *J Pers Soc Psychol.* 2003;84(2):377–89. doi: 10.1037//0022-3514.84.2.377.
15. Duprey EB, McKee LG, O’Neal CW, Algie SB, Campos B. Stressors, resources, and mental health among Latino adolescents: the role of gratitude. *J Appl Dev Psychol.* 2020;70:101191. doi:10.1016/j.appdev.2020.101191.
16. Kearns PO, Schaffer EB. Saying thanks and meaning it: expressing gratitude for social gain. *Int J Psychol.* 2023;58(4):293–8. doi: 10.1002/ijop.12910.
17. Balthip K, Pasri P, Suwanphahu B, McSherry W, Kritpracha C. Effect of a purpose in life program on the wellness of Southern Thai adolescents. *J Health Res.* 2022;36(2): 265–74. doi: 10.1108/JHR-04-2020-0102.
18. Balthip K, Suwanphahu B, McSherry W. Achieving fulfilment in life: cultivating the mindset of gratitude among Thai adolescents. *SAGE Open.* 2022;12(1):1–12. doi: 10.1177/21582440211070791.
19. Balthip, K, Pasri P, Nudla P. Living life for others: purpose in life among Thai nursing students. *Collegian.* 2022;29(3):343–9. doi: 10.1016/j.colegn.2021.09.008.
20. Balthip K, Phoomchaiya S, Nudla P, Suwanruangsri S, Sathirapanya C, Buathong N. Effect of life purpose program on the wellness of juvenile delinquents with a history of alcohol use detained at the juvenile detention center: a quasi-experimental study. *Belitung Nurs J.* 2025;11(4):384–93. doi: 10.33546/bnj.3795.
21. Shaffer F, Ginsberg JP. An overview of heart rate variability metrics and norms. *Front Public Health.* 2017;5:258. doi: 10.3389/fpubh.2017.00258.
22. Segerstrom SC, Nes LS. Heart rate variability reflects self-regulatory strength, effort, and fatigue. *Psychol Sci.* 2007;18(3):275–81. doi: 10.1111/j.1467-9280.2007.01888.x.

23. Kanter G, Komesu YM, Qaedan F, Jeppson PC, Dunivan GC, Cichowski SB, et al. Mindfulness-based stress reduction as a novel treatment for interstitial cystitis/bladder pain syndrome: a randomized controlled trial. *Int Urogynecol J*. 2016;27(11):1705–11. doi: 10.1007/s00192-016-3022-8.
24. Khoury B, Sharma M, Rush SE, Fournier C. Mindfulness-based stress reduction for healthy individuals: a meta-analysis. *J Psychosom Res*. 2015;78(6):519–28. doi: 10.1016/j.jpsychores.2015.03.009.
25. Kirk U, Axelsen JL. Heart rate variability is enhanced during mindfulness practice: a randomized controlled trial involving a 10-day online-based mindfulness intervention. *PLoS One*. 2020;15(12):e0243488. doi: 10.1371/journal.pone.0243488.
26. Rådmark L, Sidorchuk A, Osika W, Niemi M. A systematic review and meta-analysis of the impact of mindfulness based interventions on heart rate variability and inflammatory markers. *J Clin Med*. 2019;8(10):1638. doi: 10.3390/jcm8101638.
27. Kim ES, Chen Y, Nakamura JS, Ryff CD, VanderWeele TJ. Sense of purpose in life and subsequent physical, behavioral, and psychosocial health: an outcome-wide approach. *Am J Health Promot*. 2022;36(1):137–47. doi: 10.1177/089011712111038545.
28. Balhith K. Enhancing purpose in life for adolescents: concept and application. Bangkok: Siam Printing; 2023 (in Thai).
29. Department of Learning Encouragement (DOLE). Mission and functions of the Office of Non-Formal and Informal Education [Internet]. Thailand: Ministry of Education; [cited 2025 Dec 26]. Available from: [https://dole.go.th/dole2024/?page\\_id=19759](https://dole.go.th/dole2024/?page_id=19759) (in Thai).
30. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. Lawrence Erlbaum Associates; 1988.
31. Cohen S. Perceived stress in a probability sample of the United States. In: Spacapan S, Oskamp S, editors. *The social psychology of health. The Claremont Symposium on Applied Social Psychology*. Sage; 1988. p.31–67.
32. Wongpakaran N, Wongpakaran T. The Thai version of the PSS-10: an investigation of its psychometric properties. *Biopsychosoc Med*. 2010;4:6. doi: 10.1186/1751-0759-4-6.
33. Balhith K, Suwanphahu B, Laimek S. Development of a purpose in life scale for Thai adolescents: a mixed method study. *Kasetsart J Soc Sci*. 2022;43(3):561–8. doi: 10.34044/j.kjss.2022.43.3.04.
34. Salahuddin L, Cho J, Jeong MG, Kim D. Ultra short term analysis of heart rate variability for monitoring mental stress in mobile settings. *Annu Int Conf IEEE Eng Med Biol Soc*. 2007;2007:4656–9. doi: 10.1109/IEMBS.2007.4353378.
35. Schaffarczyk M, Rogers B, Reer R, Gronwald T. Validity of the Polar H10 sensor for heart rate variability analysis during resting state and incremental exercise in recreational men and women. *Sensors (Basel)*. 2022;22(17):6536. doi: 10.3390/s22176536.
36. Noor NM, Abdul Rahman ND, Mohamad Zahari MIA. Gratitude, gratitude intervention and well-being in Malaysia. *J Behav Sci*. 2018;13(2):1–18. Available from: <https://so06.tci-thaijo.org/index.php/IJBS/article/view/123509>
37. Harvard Medical School. Giving thanks can make you happier [Internet]. 2021 Aug 14 [cited 2026 Mar 25]. Available from: <https://www.health.harvard.edu/healthbeat/giving-thanks-can-make-you-happier>
38. Li Y, Liu S, Li D, Yin H. How trait gratitude influences adolescent subjective well-being? Parallel-serial mediating effects of meaning in life and self-control. *Behav Sci (Basel)*. 2023;13(11):902. doi: 10.3390/bs13110902.
39. Zhao H, Zhang M, Li Y, Wang Z. The effect of growth mindset on adolescents' meaning in life: the roles of self-efficacy and gratitude. *Psychol Res Behav Manag*. 2023;16:4647–64. doi: 10.2147/PRBM.S428397.
40. Schumann A, de la Cruz F, Köhler S, Brotte L, Bär KJ. The influence of heart rate variability biofeedback on cardiac regulation and functional brain connectivity. *Front Neurosci*. 2021;15:691988. doi: 10.3389/fnins.2021.691988.

## Appendix

**Appendix, Table A1** Overview of the Gratitude–Promoting Program: structure, activities, and homework

| Step/Session/Objectives                                                                                                          | Key activities                                                                                                                                                                                                                                                                                       | Homework                                                                                                                                                                               |
|----------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Step: 1</b><br><b>Session: 1–10</b><br>Duration: 2 hours<br>Objective: Nurturing calmness                                     | – Sessions began with a brief meditation to promote mindfulness and calmness.<br>– Activities included deep listening and meaningful communication to foster kindness and respect.<br>– Sessions concluded with both verbal and journaling reflection to enhance self-awareness and personal growth. | None                                                                                                                                                                                   |
| <b>Step: 2</b><br><b>Session: 2</b><br>Duration: 1.5 hours<br>Objective: Nurturing love, connectedness, and gratitude to oneself | Participants identified five positive qualities about themselves and wrote five expressions of self-gratitude.                                                                                                                                                                                       | Participants recorded three positive actions each day and three expressions of self-gratitude each night before bedtime for one week. <sup>37</sup>                                    |
| <b>Step: 2</b><br><b>Session: 3</b><br>Duration: 1.5 hours<br>Objective: Nurturing gratitude to parents or significant people    | Participants wrote a letter to significant others describing how that person had positively influenced their lives; referred to as “A Letter to a Loved and Benevolent Person.”                                                                                                                      | Participants recalled three positive experiences received from significant others and wrote three expressions of gratitude each night before bedtime for one week. <sup>37</sup>       |
| <b>Step: 2</b><br><b>Session: 4</b><br>Duration: 1.5 hours<br>Objective: Nurturing gratitude to friends                          | Participants draw a picture of a good friend, referred to as “My Best Friend.”                                                                                                                                                                                                                       | Participants recalled three positive experiences received from friends and wrote three expressions of gratitude each night before bedtime for one week. <sup>37</sup>                  |
| <b>Step: 2</b><br><b>Session: 5</b><br>Duration: 1.5 hours<br>Objective: Nurturing gratitude to society and the environment      | Participants show appreciation toward society and the environment by responding to the prompt, “As a youth, how can you care for your society and the environment?<br>Please write five activities you can do for your school.” Each participant then performed one activity for their school.       | Participants recalled three positive experiences related to society and the environment and wrote three expressions of gratitude each night before bedtime for one week. <sup>37</sup> |

**Appendix, Table A1** Overview of the Gratitude–Promoting Program: structure, activities, and homework (Cont.)

| Step/Session/Objectives                                                                                                                 | Key activities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Homework                                                                                                                                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Step: 3</b><br><b>Session: 6–9</b><br>Duration: 1.5 hours/session<br>Objective: Practicing and reflecting on gratitude in daily life | <ul style="list-style-type: none"> <li>– Participants drew a picture of the most important person or aspect in their lives.</li> <li>– Participants identified activities grounded in moral values and virtues to carry out for themselves and others.</li> <li>– Participants practiced these activities in daily life and recorded their actions (at home or in other settings).</li> <li>– Participants shared their experiences and met weekly for group reflection and discussion.</li> </ul> | Participants recalled meaningful experiences <sup>36</sup> and wrote three expressions of gratitude each night before bedtime for four weeks. <sup>37</sup> |
| <b>Step: 4</b><br><b>Session: 10</b><br>Duration: 2 hours<br>Objective: Consolidating learning to enhance purpose                       | <ul style="list-style-type: none"> <li>– Participants created bracelets using colored beads to represent personally meaningful actions.</li> <li>– Each bead color symbolizes a specific action (e.g., love or connectedness, physical activity, and positive relationships).</li> <li>– Participants shared the meanings of their bracelets with group members.</li> </ul>                                                                                                                        | Participants continued to recall meaningful experiences and wrote three expressions of gratitude each night before bedtime.                                 |

## ผลของโปรแกรมการสร้างเสริมความกตัญญูต่อเป้าหมายชีวิตและความแปรปรวนของอัตราการเต้นของหัวใจในเยาวชนไทยกลุ่มเปราะบาง : การวิจัยกึ่งทดลอง

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**บทคัดย่อ:** เป้าหมายชีวิตมีบทบาทสำคัญในการพัฒนาเยาวชนเชิงบวก อย่างไรก็ตาม หลักฐานเชิงประจักษ์เกี่ยวกับโปรแกรมที่สร้างเสริมเยาวชนเชิงบวกทั้งด้านจิตสังคม และด้านสรีรวิทยาในเยาวชนกลุ่มเปราะบางยังมีจำกัด ดังนั้น การวิจัยกึ่งทดลองครั้งนี้จึงมีวัตถุประสงค์เพื่อศึกษาผลของโปรแกรมการสร้างเสริมความกตัญญูต่อเป้าหมายชีวิตและความแปรปรวนของอัตราการเต้นของหัวใจในเยาวชนไทยกลุ่มเปราะบางทั้งนี้ในระยะแรก เยาวชนไทยกลุ่มเปราะบาง อายุ 18–24 ปี จำนวน 60 คน เข้าร่วมการศึกษา โดยคัดเลือกด้วยวิธีการสุ่มอย่างง่ายจากโรงเรียนการศึกษานอกระบบ จำนวน 2 แห่ง ในภาคใต้ของประเทศไทย แต่เนื่องจากผู้เข้าร่วมมีสภาพความเป็นอยู่ที่ไม่มั่นคง จึงมีผู้เข้าร่วมการศึกษาที่สามารถนำข้อมูลมาวิเคราะห์ขั้นสุดท้าย จำนวน 37 คน (กลุ่มควบคุม 21 คน และกลุ่มทดลอง 16 คน) การศึกษาดำเนินการระหว่างเดือนกรกฎาคม ถึง กันยายน พ.ศ. 2565 กลุ่มทดลองได้รับโปรแกรมการสร้างเสริมความกตัญญู เป็นระยะเวลา 10 สัปดาห์ ร่วมกับการศึกษาแบบปกติ ขณะที่กลุ่มควบคุมได้รับการศึกษาแบบปกติเพียงอย่างเดียว การประเมินผลลัพธ์ ประกอบด้วย แบบประเมินเป้าหมายชีวิตสำหรับวัยรุ่นไทย และการวัดความแปรปรวนของอัตราการเต้นของหัวใจด้วยอุปกรณ์วัดหน้าอก Polar H10 และวิเคราะห์ข้อมูลด้วยวิธีสมการประมาณค่าทั่วไป

ผลการศึกษาจากแบบจำลองสมการประมาณค่าทั่วไปที่มีการปรับค่าปัจจัยร่วม พบว่า มีปฏิสัมพันธ์ระหว่างกลุ่มและช่วงเวลาอย่างมีนัยสำคัญทางสถิติในทุกช่วงของการติดตามผล โดยกลุ่มทดลองมีระดับเป้าหมายชีวิตเพิ่มขึ้นมากกว่ากลุ่มควบคุม และกลุ่มควบคุมมีแนวโน้มระดับเป้าหมายชีวิตลดลงในสัปดาห์ที่ 22 สำหรับความแปรปรวนของอัตราการเต้นของหัวใจ พบว่า ผลของปฏิสัมพันธ์ขึ้นอยู่กับช่วงเวลา โดยอัตราการเต้นของหัวใจเฉลี่ยลดลงอย่างมีนัยสำคัญในสัปดาห์ที่ 22 และตัวชี้วัดความแปรปรวนของอัตราการเต้นของหัวใจ ได้แก่ ร้อยละของความแตกต่างระหว่างช่วงเวลาการเต้นของหัวใจปกติที่ต่อเนื่องกันมากกว่า 50 มิลลิวินาที และค่ารากที่สองของค่าเฉลี่ยกำลังสองของความแตกต่างระหว่างช่วงเวลาการเต้นของหัวใจที่ต่อเนื่องกัน เพิ่มขึ้นอย่างมีนัยสำคัญในสัปดาห์ที่ 10 ผลการศึกษาแสดงให้เห็นว่าโปรแกรมการสร้างเสริมความกตัญญู อาจช่วยสร้างเสริมสุขภาวะด้านจิตสังคม และการกำกับการทำงานทางสรีรวิทยาในเยาวชนกลุ่มเปราะบางได้ พยาบาลวิชาชีพสามารถนำโปรแกรมดังกล่าวไปบูรณาการในการสร้างเสริมสุขภาวะแบบองค์รวมสำหรับเยาวชนกลุ่มเปราะบางเพื่อเสริมสร้างเป้าหมายชีวิต การกำกับการอารมณ์ และสุขภาวะโดยรวม อย่างไรก็ตาม ก่อนนำไปใช้เป็นแนวปฏิบัติในการสร้างเสริมสุขภาพควรศึกษาวิจัยเพิ่มเติมในกลุ่มตัวอย่างและจำนวนคลัสเตอร์มากขึ้น รวมทั้งรูปแบบการวิจัยที่มีความเข้มแข็งทางระเบียบวิธีมากยิ่งขึ้น

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