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Bivariate Analysis of a School-based Sense of Coherence Intervention on Oral Health-related Quality of Life of Adolescents in Malaysia

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ABSTRACT

Objectives: This study aimed to investigate the effect of a school-based SOC intervention on adolescents' oral health-related quality of life (OHRQoL). Materials and Methods: A quasi-experimental study was conducted among 442 secondary school students aged 14 years from eight schools in Hulu Langat, Selangor, who were assigned to intervention and control groups. Data were collected at baseline and three months post-intervention using validated instruments for SOC (SOC-13) and OHRQoL (CPQ 11-14). Bivariate analyses, including paired and independent t-tests, were performed to assess within-group and between-group differences. Results: Changes in SOC scores were not statistically significant in either group over the study period. However, the intervention group demonstrated significant improvements in OHRQoL domains, particularly functional limitation ($p<0.01$), emotional wellbeing ($p<0.01$), and social wellbeing ($p<0.01$), with a greater magnitude of change compared with the control group. Conclusions: The SOC-based intervention demonstrated early improvement in adolescents' OHRQoL despite minimal short-term changes in SOC. These findings suggest that psychosocial-based oral health interventions may yield measurable quality-of-life benefits before detectable changes in underlying psychological constructs. A longer intervention period is likely required to strengthen SOC and sustain behavioural outcomes.

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1. INTRODUCTION

Malaysia has seen significant improvements in general health indicators over recent decades through robust public health initiatives. In oral health, national programmes such as the incremental school dental service (SDS) have played a key role in reducing the incidence of dental caries among children and adolescents. However, important gaps remain in oral health behaviours and self-care practices. According to the National Health and Morbidity Survey (NHMS) 2017, 99.8% of 12-year-old schoolchildren required reinforcement in oral hygiene instruction (MOH, 2017). Notably, despite the longstanding implementation of the SDS, many schoolchildren and adolescents continue to display unhealthy oral health behaviours that hinder their personal development. Evidence from the National Health and Morbidity Survey-Adolescent Health Survey 2022 (NHMS-AHS 2022) further highlights this issue, revealing that nearly 30.5% of adolescents refrain from smiling due to dental conditions (IPH 2022).

Children and adolescents in Malaysia continue to face oral health challenges that may jeopardise their wellbeing, and could impact the country's future healthcare expenditure, potentially the much-needed funds from oral health promotion for future generations (Jevdjevic & Listl, 2025; WHO, 2025). Furthermore, as Malaysia's population ages, the risks associated with poor oral health are likely to increase, particularly because many children and adolescents lack essential skills to prevent oral disease (Mohamad Anuar et al., 2025). These findings underscore the need for child and adolescent-focused oral health strategies that prioritise adolescents' lived experiences, such as oral health-related quality of life (OHRQoL) (Chimbinha et al., 2023). OHRQoL refers to the impact of oral conditions on an individual's daily functioning and wellbeing, particularly those aspects of life they value. These impacts must be sufficiently severe and frequent to influence an individual's perception of their overall quality of life (Marshman & Robinson, 2007). Measuring OHRQoL among adolescents enables stakeholders to assess the extent to which oral health strategies support adolescents' psychological, social, and functional development, as highlighted in recent studies (Alvarez-Azaustre et al., 2021; Chimbinha et al., 2023; Rincón et al., 2025).

The Malaysian National Oral Health Plan (NOHP) 2022-2030, in response to concerns about adolescent oral health, calls for stronger action to improve oral health practices among schoolchildren and adolescents (MOH, 2024). These actions align with the health-related Sustainable Development Goals (SDGs) (Peres et al., 2019; WHO, 2022). However, the biomedical (curative) approach delivered through SDS alone is insufficient to achieve sustainable behavioural change in this population (Engel, 1977; Baker et al., 2010; Ab Mumin et al., 2021). Psychological approaches, such as salutogenic strategies, may therefore offer a more effective way to improve adolescents' oral health behaviour (Antonovsky, 1996; Nammontri et al., 2013; Elyassi et al., 2015).

Numerous studies have highlighted the importance of OHRQoL and its association with overall quality of life, extending beyond clinical indicators to include the psychological and social consequences of impaired oral health (Gomes et al., 2018). In this context, Wilson and Cleary (1995) proposed a theoretical model that integrates the traditional biomedical view of health with psychological frameworks, emphasising functional capacity and overall well-being. In this model, individual and environmental factors, such as personal beliefs, social support, and emotional resilience, shape both health and quality of life. Sense of coherence (SOC), a central construct of the salutogenic concept, has been widely applied in sociological studies to explain how individuals maintain well-being despite challenging or adverse circumstances (Antonovsky, 1987, 1996). SOC is a psychological construct that influences how individuals cope with

stress and manage life's challenges, playing a key role in both general health and oral health. It comprises three components: comprehensibility, manageability, and meaningfulness. SOC has been shown to impact a wide range of health and oral health outcomes, making it a key factor in shaping OHRQoL (Gururatana et al., 2014; Gururatana, 2015). Related to this, Baker et al (2010) conducted an empirical study and identified a positive psychosocial determinant of oral health behaviours among Malaysian adolescents.

Considering these psychosocial perspectives, it is essential to understand how adolescents' SOC influences their experiences and the interpretation of oral health outcomes in daily life (Baker et al., 2010). Although these findings did not immediately highlight the SOC-based programme in Malaysian schools, the potential benefit of strengthening SOC levels for adolescent oral health outcomes has been explored in Thailand (Nammontri et al., 2013) and Brazil (Tomozani et al., 2019); however, its effectiveness in Malaysia remains unclear. Given Malaysia's distinctive cultural, educational, and socioeconomic context, investigating this intervention is both timely and necessary. Therefore, this study aims to investigate the impact of a SOC-based intervention on SOC levels and oral health-related quality of life (OHRQoL) among Malaysian secondary schoolchildren.

2. MATERIALS AND METHODS

2.1 Study Design

This study employed a school-based quasi-experimental design with matched pairs of schools allocated at the cluster level to intervention and control groups. Clusters comprised public secondary schools in Hulu Langat District. Study subjects were selected using predefined inclusion and exclusion criteria at two levels: school and participant. Eligible schools were daily coeducational public secondary schools that received SDS. Eligible participants were Form Two students who were medically fit, able to read and understand Malay, and had provided parental consent. Students with chronic medical conditions or physical disabilities were excluded.

2.2 Sampling

The sample size was calculated using G*Power 3.1 (Faul et al., 2007). With $\alpha = 0.05$ and power = 0.95, the initial estimated sample size was 210. Considering a design effect of 1.5 for cluster sampling and an additional 20% dropout rate, the final required sample size was 378 participants. Therefore, 189 students were required in each arm to participate in the study.

A two-stage stratified sampling approach was employed. In the first stage, twenty-four eligible schools were ranked according to their academic performance and enrolment size. The schools were matched by academic performance and location. Four matched pairs of schools (eight schools) were selected, and the remaining sixteen schools were excluded. In the second stage, each matched pair was randomly assigned to either the intervention or control group using a computer-generated sequence.

Within the selected schools, teachers were contacted to facilitate class selection and student recruitment. All participating students were confirmed to have consented to the programme and had received incremental dental care from the local school dental team before the study's implementation. The overall sampling and allocation are illustrated in Figure 1.

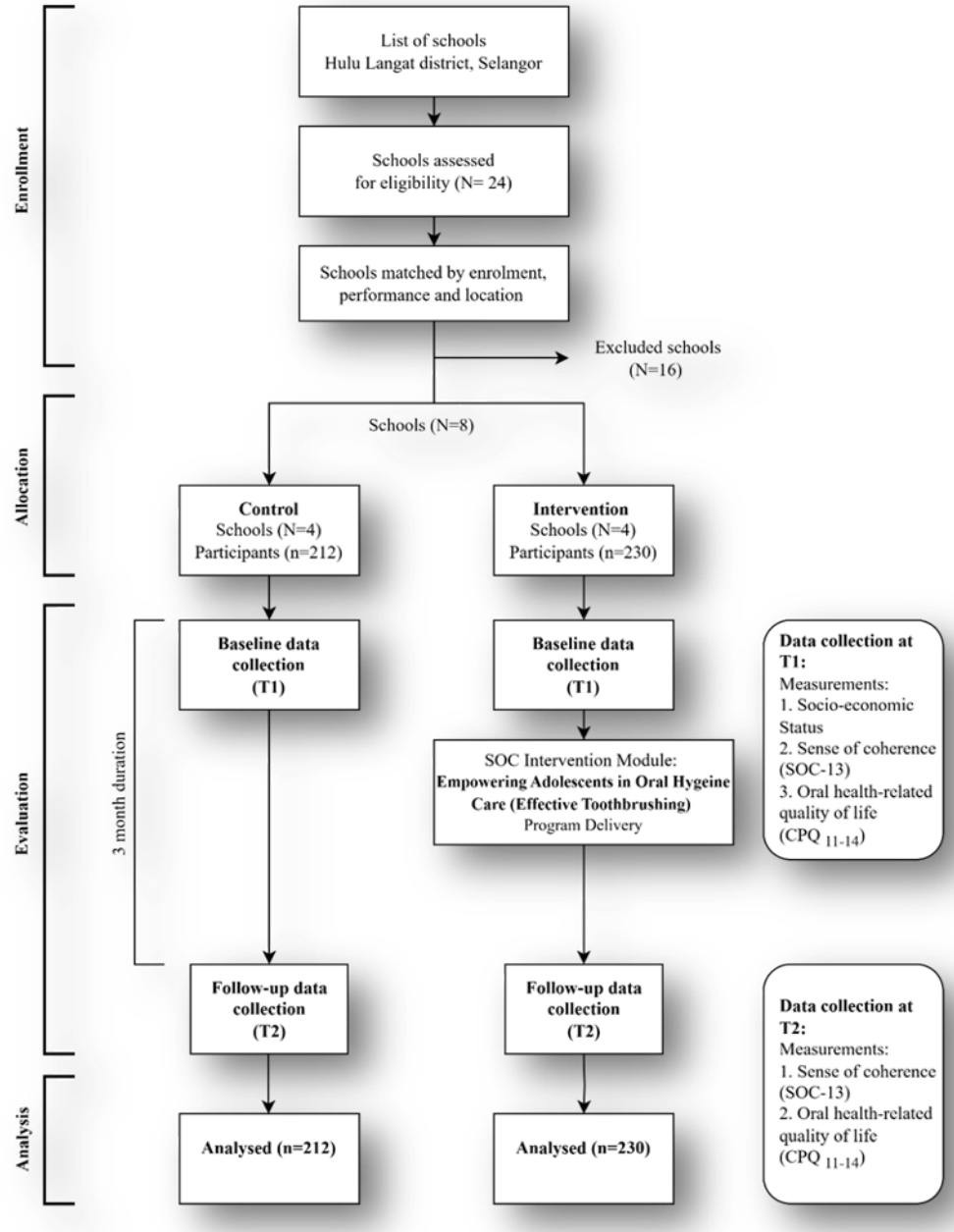


Fig. 1. Participant flow in the quasi-experimental study design and data collection process.

2.3 Intervention

The intervention group received a SOC-based oral health programme specifically designed for Form Two school adolescents, focusing on strengthening their sense of coherence by improving their knowledge and skills in effective toothbrushing. A team of subject-matter experts and the researcher curated the module before on-site data collection.

Table 1 outlines the intervention module content, which comprises three sessions aimed at enhancing the SOC components: comprehensibility, manageability, and meaningfulness, enabling students to manage their lives through proper oral hygiene practices. The module provides a structured teaching and learning plan with clear objectives and engaging activities, including talks, multimedia presentations, hands-on demonstrations, interactive learning tasks, group discussions, and reflective exercises to enhance students' learning experience, skill development, and understanding of the benefits of oral hygiene care through effective toothbrushing.

Figure 2 illustrates "The Salutogenic Smile: A 3-Session Oral Health Journey," which outlines the structured, sense of coherence (SOC)-based intervention module implemented in this study. The diagram shows the progression of the programme across three consecutive sessions delivered on a single day: Session 1 ("Healthy Smile," targeting comprehensibility), Session 2 ("Create your Smile," targeting manageability), and Session 3 ("Be the Reason to Smile," targeting meaningfulness). For each stage, the figure details the specific aims, hands-on activities (such as brushing exercises on typodonts, plaque disclosure, and the "Contagious Smile" game), and the targeted positive psychological behaviours, including self-efficacy and self-actualisation. Furthermore, the figure presents the logistical framework of the intervention, highlighting that each 40-60 minute session was delivered to groups of 35-40 participants, who were subdivided into smaller clusters of 6-8 students to optimize engagement and practical learning. During programme delivery, the main researcher led the sessions with assistance from the teacher and non-technical assistants. Students received worksheets to complete during each session, wich encouraged engagement and reinforced comprehension. They were required to complete all three sessions that day. An evaluation form was distributed at the final session to collect participants' feedback.

Table 1. SOC-Based Oral Health Intervention Module Outline.

Session (Title)	**1 (Healthy Smile)**	**2 (Create your Smile)**	**3 (Be the Reason to Smile)**
Aim	To enhance students' self-esteem, knowledge, and awareness of good oral hygiene practices for a healthy smile	To boost students' self-awareness, self-esteem, and self-efficacy in performing toothbrushing effectively for optimal oral hygiene	To strengthen students' self-esteem, self-efficacy, and self-actualisation in socialising with their smiles
Objectives	1. Value the importance of good oral hygiene for a healthy smile (including clean teeth, tongue, and gums) 2. Identify the appropriate equipment used for proper toothbrushing 3. Demonstrate proper toothbrushing method	1. Analyse personal need for effective toothbrushing 2. Apply appropriate tools to perform effective toothbrushing 3. Adjust technique for effective personal toothbrushing	1. Demonstrate confidence in smiling as a result of good oral hygiene 2. Use a Duchenne smile to share the enjoyment with peers in the program
SOC Component	Comprehensibility	Manageability	Meaningfulness
Content	Explain ideas or concepts	Apply ideas and analyse actions in achieving effective toothbrushing	Value the smile from good oral hygiene
Psychological behaviour (main)	Self-awareness, Self-confidence, Self-esteem	Self-awareness, Self-esteem, Self-efficacy	Self-esteem, Self-efficacy, Self-actualisation
Activities	- Dental Health Talk - Hands-on toothbrushing exercise on the model - Reflection	- Assessing the plaque distribution areas - Hands-on toothbrushing exercises Reflection	- Discussion - The game “Contagious Smile” - Reflection - Program evaluation
Mode	- Participatory, interactive, and practical-		
Entry behaviour	Recognise the importance of oral hygiene	Identify the tools and techniques for proper toothbrushing	Recognise the importance of oral hygiene for a healthy smile
Terminal behaviour	- Accurately enter details of the tools and techniques for proper toothbrushing on the worksheet - Demonstrate correct handling and brushing technique on a typodont	Demonstrate effective toothbrushing by using a disclosing agent to reveal plaque and repeating the brushing process until the teeth are visibly clean	Demonstrate the ability to smile confidently among peers in the program



Fig. 2. The overview of the implementation of the SOC-based intervention for adolescents.

2.4 Data Collection Procedures

All students who provided consent were recruited in the classroom and completed a pre-intervention questionnaire. Baseline data (T1) were collected for both the intervention and control groups before the implementation of the SOC-based programme. The intervention group then received the SOC-based module, while the control group received no intervention.

Three months after the baseline assessment, all participants were asked to complete the same questionnaire again to obtain post-intervention data (T2). Thus, data for both groups were collected at two time points: baseline (T1) and three months post-intervention (T2), as shown in Figure 1.

A self-administered questionnaire was used to collect demographic data at T1, while SOC level and OHRQoL were assessed at both time points (T1 and T2). Socioeconomic status (Knorst et al., 2021) was assessed using a structured questionnaire with predefined response options covering parents' education (Navarro-Carrillo et al., 2020), household income (Wuollet et al., 2018), and household crowding (Reiss et al., 2019; Rauber et al., 2021; Reynolds-Salmon et al., 2024). In addition, the study adapted the questionnaire from Nomantri et al. (2013), comprising 59 items assessing socioeconomic status (9 items), Sense of Coherence (13 items), and Oral Health-Related Quality of Life through the Child Perception Questionnaire (CPQ 11-14) (37 items).

The Sense of Coherence (SOC-13) scale consists of 13 items, rated on a 7-point Likert scale, with total scores ranging from 13 to 91; higher scores indicate a stronger sense of coherence. The scale comprises three components: meaningfulness (items 1, 4, 7, and 12), comprehensibility (items 2, 6, 8, 9, and 11), and manageability (items 3, 5, 10, and 13). Items 1, 2, 3, 7, and 10 are reverse-scored to ensure consistent direction of responses (Antonovsky, 1987).

Oral health-related quality of life was measured using the CPQ 11-14 questionnaire, which comprises four domains: oral symptoms (6 items), functional limitation (9 items), emotional well-being (9 items), and social well-being (13 items). A five-point Likert scale was used to assess the study outcome (Nammontri et al., 2013). The total score across the four subdomains ranged from 37 to 185, with higher scores indicating poorer oral health, greater treatment need, or greater discomfort.

2.5 Data Analysis

Data were analysed using IBM SPSS version 26. Descriptive statistics summarised demographic characteristics. Baseline comparisons between groups were conducted using independent t-tests and chi-square tests. Within-group changes from pre- to post-intervention were analysed using paired t-tests. Between-group differences in mean changes were assessed using independent t-tests. Statistical significance was set at $p < 0.05$.

2.6 Ethical Approval

This study was approved by the Ethics Committee of Universiti Teknologi MARA and conducted in accordance with the Declaration of Helsinki under registration number REC/12/2021 (MR/924). Additional approvals were obtained from the Ministry of Education Malaysia (KPM. 600-3/2/3-eras (13471)), the Selangor State Education Department (JPNS.SPD 600-1/1/2 JLD.24 (21)), and the Hulu Langat District Education Office (PPDHL.SPD.100-3/31 (65)).

3. RESULT

3.1 Demographic Characteristics of Study Participants

Table 2 presents the demographic characteristics of the participants, comparing the control group (n = 212) and the intervention group (n = 230). Most participants were 14 years old, with a slightly higher proportion of females in each group. There were no statistically significant differences between the groups in gender (p=0.826), age (p=0.179), number of bedrooms in the house (p=0.522), household income (p=0.311), or parent education levels (p=0.105). However, significant baseline differences were observed in the parents' relationship with the child (p=0.028), the number of family members living in the house (p=0.009), household crowding (p=0.028), and ethnicity (p<0.001), with the intervention group comprising a significantly higher proportion of Malay participants (98.3%) compared to the control group (69.3%).

Table 2. Demographic Characteristic of Participants.

Variables	Category	Control (n=212)		Intervention (n=230)		Statistic, p-value
		Frequency	(%)	Frequency	(%)	
Parents						
Relationship with the child	Father	80	37.7	108	47.0	7.813[b], 0.028
	Mother	130	60.4	122	53.0	
	Grandfather	1	0.5	-	-	
	Grandmother	1	0.5	-	-	
	Other	2	0.9	-	-	
Number of family members living in the house	2	2	0.9	2	0.9	12.870[a], 0.009
	3	14	6.6	10	4.3	
	4	49	23.1	32	13.9	
	5	73	34.4	71	30.9	
	Other	74	34.9	115	50.0	
Number of bedrooms in the house	1	-	-	-	-	2.252[a], 0.522
	2	26	12.3	20	8.7	
	3	105	49.5	119	51.7	
	4	61	28.8	72	31.3	
	Other	20	9.4	20	8.7	
Household crowding		1.60[a]	0.511[b]	1.70[a]	0.541[b]	-2.202[c], 0.028
Household Income (RM)	<3,000	56	26.4	40	17.4	8.246[a], 0.311
	3001-5000	37	17.5	39	17.0	
	5001-7000	27	12.7	35	15.2	
	7001-9000	27	12.7	33	14.3	
	9001-11000	16	7.5	24	10.4	
	11001-13000	6	2.8	13	5.7	
	13001-15000	10	4.7	10	4.3	
	>15001	33	15.6	36	15.7	
Parent Education	No formal education	4	1.9	1	.4	9.103[a], 0.105
	Primary school	8	3.8	4	1.7	
	Secondary school (SPM / O Level or equivalent)	86	40.6	86	37.4	
	Form 6 / Matriculation / Diploma	25	11.8	45	19.6	
	Degree	66	31.1	76	33.0	

Variables	Category	Control (n=212)		Intervention (n=230)		Statistic, p-value
		Frequency	(%)	Frequency	(%)	
	Master/PhD	23	10.8	18	7.8	
Participants						
Gender	Male	99	46.7	105	45.7	0.049[a], 0.826
	Female	113	53.3	125	54.3	
Age	13 years old	1	0.5	3	1.3	3.643[b], 0.179
	14 years old	211	99.5	227	98.7	
Ethnic	Malay	147	69.3	226	98.3	80.619[b], <0.001
	Chinese	30	14.2	1	0.4	
	Indian	28	13.2	1	0.4	
	Others	7	3.3	2	0.9	

Note:
[a]Chi-square test
[b]Fisher-exact test
[c]Independent sample t-test

3.2 Baseline Comparison of The SOC and OHRQoL Scores Between Groups

Table 3 presents the baseline comparison of SOC and oral health-related quality of life (OHRQoL) scores between the control and intervention groups. At baseline, there were no significant differences between the groups in the Total SOC score (p=0.371) or any of its individual domains (comprehensibility, manageability, and meaningfulness), nor was there a significant difference in the total OHRQoL score (p=0.478). However, within the OHRQoL sub-domains, the intervention group reported significantly higher mean scores for oral health symptoms (p=0.006) and emotional wellbeing (p=0.007) compared to the control group prior to the intervention.

Table 3. Baseline Comparison of SOC and OHRQoL Between Groups.

Element/Domain		Control	Intervention	p-value
		Mean (SD)	Mean (SD)	
SOC	Comprehensibility	20.56 (5.49)	19.83 (4.57)	0.133
	Manageability	15.94 (5.54)	15.96 (4.46)	0.971
	Meaningfulness	18.91 (4.06)	18.57 (4.21)	0.388
	Total SOC	55.41 (13.21)	54.36 (11.22)	0.371
OHRQoL	Oral Health Symptoms	11.82(3.10)	12.65 (3.20)	0.006
	Functional Limitations	15.20 (4.62)	15.46 (3.89)	0.534
	Emotional Wellbeing	20.42 (8.05)	22.44 (7.55)	0.007
	Social Wellbeing	21.91 (7.27)	22.16 (6.84)	0.709
	Total OHRQoL	69.35 (18.88)	72.71 (17.16)	0.478

3.3 Within-group Pre-post Changes in SOC and OHRQoL Scores

Table 4 evaluates the within-group pre- and post-intervention changes for both SOC and OHRQoL outcomes. Neither group demonstrated statistically significant changes in Total SOC or its subdomains over the study period. In contrast, significant improvements were observed in OHRQoL. The intervention group showed a significant reduction in scores (indicating improvement) for functional limitations (p=0.005), emotional wellbeing (p=0.001), social wellbeing (p<0.001), and total OHRQoL (p<0.001), with small effect sizes (Cohen's d) ranging from 0.20 to 0.34. The control group also experienced significant, though smaller, improvements in social wellbeing (p=0.006) and the total OHRQoL score (p=0.044).

Table 4. Within-Group Pre- Post Changes in SOC and OHRQoL.

Outcome	Element/Domain	Group	Pre-test Mean (SD)	Post-test Mean (SD)	Mean change	p-value	Effect size (d)
SOC	Comprehensibility	Intervention	19.83 (4.57)	19.85 (4.40)	0.02	0.938	0.00
		Control	20.56 (5.49)	20.50 (4.95)	-0.06	0.822	0.02
	Manageability	Intervention	15.96 (4.46)	16.07 (4.37)	0.11	0.652	0.03
		Control	15.94 (5.54)	16.01 (5.02)	0.07	0.784	0.01
	Meaningfulness	Intervention	18.57 (4.21)	18.93 (3.83)	0.36	0.084	0.11
		Control	18.91 (4.06)	18.83 (3.91)	-0.08	0.727	0.02
	Total SOC	Intervention	54.36 (11.22)	54.86 (10.79)	0.50	0.360	0.06
		Control	55.41 (13.21)	55.34 (12.47)	-0.07	0.907	0.00
OHRQoL	Oral Health Symptoms	Intervention	12.65 (3.20)	12.45 (3.35)	-0.20	0.306	0.07
		Control	11.82 (3.10)	11.83 (3.48)	0.01	0.940	0.00
	Functional Limitations	Intervention	15.46 (3.89)	14.77 (3.98)	-0.69	0.005**	0.20
		Control	15.20 (4.62)	14.81 (4.55)	-0.39	0.163	0.09
	Emotional Wellbeing	Intervention	22.44 (7.55)	21.21 (8.06)	-1.23	0.001**	0.22
		Control	20.42 (8.05)	20.06 (8.80)	-0.36	0.389	0.06
	Social Wellbeing	Intervention	22.16 (6.84)	20.37 (6.75)	-1.79	0.000**	0.34
		Control	21.91 (7.27)	20.82 (7.20)	-1.09	0.006**	0.20
	Total OHRQoL	Intervention	72.71 (17.16)	68.80 (17.68)	-3.91	0.000**	0.31
		Control	69.35 (18.88)	67.52 (20.12)	-1.83	0.044*	0.20

**p < 0.01, *p < 0.05

Effect size (Cohen's d) are interpreted as small (0.2), medium (0.5), and large (0.8)

3.4 Between- group Comparison of Mean Scores Changes

Table 5 presents the between-group comparison of mean changes from pre- to post-intervention. Independent t-tests showed no statistically significant differences between the control and intervention groups in the mean changes for any SOC domain or the Total SOC score. Similarly, although negative values indicated within-group improvements in OHRQoL, the mean changes for oral health symptoms, functional limitations, emotional wellbeing, social wellbeing, and total OHRQoL (p=0.090) did not differ significantly between the two groups. The effect sizes for all between-group mean change comparisons were extremely small, ranging from 0.000 to 0.007.

Table 5. Between- Group Comparison of Mean Changes.

Outcome	Element/Domain	Control Mean Change (SD)	Intervention Mean Change (SD)	p-value	Effect size (d)
SOC	Comprehensibility	-0.06	0.02	0.831	0.000
	Manageability	0.07	0.11	0.906	0.000
	Meaningfulness	-0.08	0.36	0.143	0.005
	Total SOC	-0.07	0.50	0.471	0.001
OHRQoL	Oral Health Symptoms	0.01	-0.20	0.426	0.001
	Functional Limitations	-0.39	-0.69	0.423	0.001
	Emotional Wellbeing	-0.36	-1.23	0.121	0.005
	Social Wellbeing	-1.09	-1.79	0.177	0.004
	Total OHRQoL	-1.83	-3.91	0.090	0.007

*$p < 0.05$

4. DISCUSSION

This study is among the first to implement and evaluate a SOC-based intervention programme aimed at enhancing SOC levels among Malaysian school adolescents. The demographic profile revealed several statistically significant differences between the control and intervention groups, particularly in ethnicity, household composition, and household crowding. These variations reflect underlying social determinants of health, which influence health behaviours, access to care, and perceived quality of life (Marmot, 2005; Solar & Irwin, 2010). Such contextual differences should therefore be considered when interpreting intervention outcomes. Despite these variations, baseline comparisons of SOC and OHRQoL demonstrated general equivalence in SOC domains between groups, indicating comparable levels of psychosocial resilience before the intervention. However, significant differences were observed in selected OHRQoL domains, particularly oral health symptoms and emotional well-being, where the intervention group reported poorer baseline status. This may indicate a greater potential for improvement, consistent with regression-to-the-mean effects often seen in quasi-experimental designs (Barnett et al., 2005). Compared with the study by Nammontri et al. (2013), which focused on SOC intervention among Thai schoolchildren, the present study found that Malaysian school adolescents have lower SOC levels, with a total mean score of 54.36 (SD 11.22). This discrepancy is especially evident in the meaningfulness dimension, a key component of the SOC framework that drives individual motivation (Antonovsky, 1979). Accordingly, this underscores the relevance of SOC-based interventions for enhancing oral health practices in this population.

Within-group analysis indicated that SOC remained largely unchanged in both groups over the three-month follow-up period. This finding is consistent with the theoretical proposition that SOC is a relatively stable construct, shaped by long-term life experiences rather than short-term interventions (Antonovsky, 1987; Eriksson & Lindström, 2006). Although a slight increase in the meaningfulness component was observed in the intervention group, it did not reach statistical significance, suggesting that sustained exposure may be required to strengthen this dimension. In contrast, significant improvements were observed in multiple domains of OHRQoL, particularly in the intervention group. Functional limitation, emotional well-being, and social well-being demonstrated statistically significant reductions, indicating

improved quality of life. These findings align with previous research demonstrating that school-based interventions can produce measurable improvements in adolescents' perceived health and wellbeing, even within relatively short follow-up periods (Patton et al., 2016; Sawyer et al., 2012). Interestingly, the control group also exhibited modest improvements in certain domains, particularly social wellbeing and total OHRQoL. This may reflect external influences such as routine school dental services, increased awareness following baseline assessment, or natural developmental changes during adolescence (Viner et al., 2012). However, the magnitude of improvement was consistently greater in the intervention group, suggesting an added benefit of the SOC-based programme.

Between-group comparisons of mean changes showed a consistent pattern: the intervention group showed greater improvements across most OHRQoL domains than the control group. Although these differences did not reach statistical significance for all outcomes, the direction and magnitude of change suggest a meaningful clinical trend. The largest improvements were observed in emotional well-being and social well-being, which are closely linked to adolescents' psychosocial functioning. These findings are supported by broader health literature indicating that interventions targeting self-efficacy, social interaction, and emotional regulation can positively influence quality-of-life outcomes among young people (Bandura, 2013; WHO, 2021). For SOC, between-group differences in mean change scores were minimal, further reinforcing the notion that SOC is less responsive to short-term intervention effects. Systematic reviews have shown that although SOC is associated with health behaviours and outcomes, changes in SOC typically require prolonged, repeated exposure to supportive environments and experiences (Eriksson & Lindström, 2006; Mittelmark et al., 2022).

Although statistically significant differences were not detected at the SOC level between the intervention and control groups, the upward trends observed in SOC elements affirm the module's relevance and suggest potential benefits that may emerge over a longer evaluation period. Alongside noticeable improvements in OHRQoL domains following the intervention, these findings have important implications for school-based health education policy, as OHRQoL measures are useful for understanding how oral conditions and interventions affect children's and adolescents' daily lives (Rauber et al., 2021; Sischo & Broder, 2011; Thomson & Broder, 2018). Specifically, integrating psychosocial frameworks such as SOC could enrich and strengthen existing oral health programmes (Baker et al, 2010; Nazari et al., 2025). The research findings provide cautious support for the development and implementation of school-based oral health intervention programmes grounded in the salutogenic approach, as the intervention showed modest improvements in the selected OHRQoL domain and slight positive changes in meaningfulness and total SOC, enabling students to cultivate their sense of coherence. This initiative is expected to enhance not only physical oral health outcomes but also broader aspects of psychological well-being. The findings also provide partial support for the important role of SOC in assessing adolescents' health status and reducing health-risk behaviours in schools (da-Silva-Domingues et al., 2022). Integrating an SOC-based module into school settings, therefore, represents a strategic advancement for both health and education policy, offering a structured approach to strengthening adolescents' psychosocial resources. The potential of such a module to shape the future direction of school-based adolescent programmes positions it as a cornerstone of health-promoting initiatives. However, effective implementation will require strategic modifications and targeted revisions to existing school health, educational, and national oral health policies.

The divergence between SOC and OHRQoL findings highlights an important conceptual distinction. SOC represents a deeper psychosocial orientation encompassing an individual's capacity to understand, manage, and find meaning in life events, whereas OHRQoL reflects more immediate, experience-based

perceptions of health. This relationship can be interpreted through the framework of the Wilson and Cleary model**,** which links biological and clinical variables to overall quality of life through intermediate domains such as functional status and individual perceptions (Wilson & Cleary, 1995). According to this model, changes in perceived quality of life may occur earlier than changes in underlying psychological constructs, particularly in response to behavioural or educational interventions. In the present study, the structured and participatory nature of the SOC-based module likely enhanced engagement, self-awareness, and behavioural confidence, thus improving functional and psychosocial aspects of oral health. These experiential gains may precede measurable changes in SOC, which typically evolve over a longer period.

From a public health perspective, these findings support the integration of psychosocial approaches into school-based oral health programmes. While traditional dental services often focus on clinical outcomes, greater integration of strategies that promote motivation, self-efficacy, and social interaction may lead to more comprehensive improvements in adolescents' well-being (Petersen, 2003; Watt, 2005, 2012). However, the absence of significant changes in SOC highlights the need for longer-term intervention strategies. Sustained and repeated exposure, reinforcement activities, and integration into the school curriculum are essential for facilitating meaningful development of psychosocial resilience. Additionally, family- and community-level influences should be considered, as SOC among adolescents is shaped within broader social contexts (Braun-Lewensohn et al., 2022; Mittelmark, 2016; Mittelmark et al., 2022). Future research should also adopt methodological approaches that account for clustering effects and baseline differences, while incorporating longitudinal follow-up designs, to further clarify how psychosocial interventions influence both behaviour and quality of life over time. Taken together, the findings indicate that the SOC-based intervention produced early improvements in oral health-related quality of life, particularly in functional and psychosocial domains, despite limited short-term changes in SOC. This pattern aligns with theoretical expectations that experiential and behavioural outcomes may respond more rapidly to intervention than underlying psychosocial constructs.

5. LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

This study reinforces the critical role of psychosocial empowerment in oral health interventions, highlighting SOC-based approaches as a pathway to developing resilient, health-capable adolescents with lifelong skills. However, several limitations should be considered when interpreting the findings. First, the quasi-experimental design limits the ability to establish causal relationships between the SOC-based intervention and the observed outcomes. As group allocation was conducted at the school level rather than through full individual randomisation, unmeasured contextual factors may have influenced the observed outcomes.

Second, a three-month follow-up period may not be sufficient to capture sustained behavioural changes or long-term psychosocial development related to SOC. Changes in psychological constructs and health behaviours often require extended reinforcement and longer observation. Therefore, the short follow-up may have limited the detection of more substantial effects. In addition, the use of a self-reported questionnaire may have introduced response bias, including social desirability and recall bias, as participants may have provided responses they perceived as favourable rather than accurately reflecting their experiences or behaviours. Although schools were used as cluster units during sampling, analyses were conducted at the individual level without explicit adjustment for intra-cluster correlation, which should be considered when interpreting the precision of the estimated effects.

Despite these limitations, the study provides valuable preliminary evidence on the role of SOC in promoting oral health among adolescents. Future studies should use randomised controlled designs, longer follow-up periods, and include objective oral health indicators to strengthen causal inferences and more comprehensively evaluate the effectiveness of SOC-based interventions among school adolescents in Malaysia.

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CONFLICT OF INTEREST STATEMENT

The authors declare that there is no conflict of interest - personal, commercial, or financial - associated with the conduct or publication of this research.

AUTHORS' CONTRIBUTIONS

Maiyazurah Abdul Aziz conducted the research, drafted and refined the manuscript. Nawwal Alwani Mohd Radzi reviewed the content, oversaw the refinement process, provided critical revisions, and approved the final manuscript for submission.

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6. APPENDIX

A. About the Authors

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