

Trajectories of Cognitive Reappraisal and Expressive Suppression as Predictors and Outcomes of Adolescent Risk Behaviors: Evidence from a Ghanaian Longitudinal Study

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Abstract

This longitudinal study examined the developmental trajectories of emotion regulation strategies cognitive reappraisal and expressive suppression and their predictive effects on adolescent risk behaviors over a 24-month period. The sample comprised 900 adolescents from both public and private schools in Ghana, assessed at three time points: baseline (T1), 12 months (T2), and 24 months (T3). Findings revealed that cognitive reappraisal, an adaptive strategy involving reframing emotional experiences, increased significantly over time (T1: M = 3.45; T2: M = 3.61; T3: M = 3.72), while expressive suppression, a maladaptive strategy characterized by inhibiting emotional expression, decreased (T1: M = 2.89; T2: M = 2.76; T3: M = 2.63). Longitudinal path analyses showed that higher cognitive reappraisal at T1 and T2 predicted reduced engagement in risk behaviors such as substance use, aggression, and risky sexual activity across subsequent time points (T1 to T2: $\beta = -0.24$, $p = 0.004$; T2 to T3: $\beta = -0.27$, $p = 0.002$). Conversely, greater expressive suppression predicted increased risk behaviors over time (T1 to T2: $\beta = 0.31$, $p = 0.001$; T2 to T3: $\beta = 0.29$, $p = 0.003$). Cross-lagged panel analysis further demonstrated bidirectional influences: effective emotion regulation at earlier time points predicted fewer risk behaviors later, while engagement in risk behaviors predicted subsequent declines in emotion regulation abilities (T1 to T2: $\beta = 0.15$, $p = 0.031$; T2 to T3: $\beta = 0.18$, $p < 0.05$). These results underscore the dynamic interplay between emotion regulation and adolescent risk behavior, highlighting cognitive reappraisal's protective role and the risks associated with expressive suppression. The findings suggest that interventions fostering adaptive emotion regulation skills may be critical for reducing risk behaviors and promoting healthier adolescent development.

KEYWORDS: Emotion regulation, cognitive reappraisal, expressive suppression, adolescent risk behaviors, cross-lagged analysis, predictive effects.

1.0 INTRODUCTION

Adolescence represents a pivotal stage in human development, marked by profound biological, psychological, and social transformations (Owusu & Essel, 2017; Ferrier et al., 2020). Globally, researchers have increasingly focused on emotion regulation as a central component of adolescent development, recognizing its critical role in shaping psychosocial adjustment, mental health, and behavior patterns (Zimmermann & Iwanski, 2014; Betancourt et al., 2013; Ferrier et al., 2020). The ability to regulate emotions adaptively influences how adolescents respond to stress, build relationships, and make decisions factors that in turn affect their vulnerability to risk behaviors such as substance use, aggression, and unsafe sexual activity (Compas et al., 2017). In high-income countries, empirical evidence suggests that poor emotion regulation is a consistent predictor of engagement in externalizing and internalizing risk behaviors (Silk et al., 2023; Ferrier et al., 2020). However, much of this literature is rooted in Western, individualistic contexts, often neglecting how these dynamics unfold in diverse cultural and socioeconomic environments. There remains a significant gap in knowledge regarding how emotion regulation develops over time in low- and middle-income countries (LMICs) and more importantly, how it predicts behavioral outcomes within these underrepresented contexts.

In Africa, where over 60% of the population is under the age of 25 (Ferrier et al., 2020), understanding adolescent emotion regulation is not only a developmental concern but also a public health imperative. Despite the continent's youth bulge, research on socioemotional competencies remains sparse and unevenly distributed, with a heavy focus on mental illness and trauma rather than strengths-based developmental pathways (Zimmermann & Iwanski, 2014; Sims et al., 2024). Studies on emotion regulation trajectories, particularly using robust psychometric assessments and predictive models, are limited. This dearth of research is even more pronounced in sub-Saharan Africa, where adolescent health interventions often lack culturally grounded psychological insights.

In Ghana, adolescents face a myriad of psychosocial stressors from academic pressures and family disruptions to growing exposure to social media and urban violence. While national surveys highlight rising trends in adolescent substance use, school dropout, and early sexual activity (Ghana Statistical Service [GSS], 2021), the psychological mechanisms underpinning this risk behaviors remain poorly understood. There is a pressing need for empirically validated tools to assess emotion regulation in Ghanaian adolescents and for models that can explain how these emotional processes predict high-risk behaviors over time. Emotion regulation is a foundational aspect of adolescent development, influencing a wide spectrum of behavioral, emotional, and cognitive outcomes (Betancourt et al., 2013; Sims et al., 2024). However, despite the global recognition of its significance, context-specific assessments and longitudinally-informed models of emotion regulation remain underdeveloped in many low- and middle-income countries (LMICs), particularly in sub-Saharan Africa (Betancourt et al., 2013; Cortina et al., 2012). Most of the extant research in this area has been conducted in high-income Western contexts, where cultural norms surrounding emotional expression, parenting practices, and adolescent autonomy differ markedly from those in African settings (World Health Organization [WHO], 2021; Cole &

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Tan, 2017; Ferrier et al., 2020). This lack of culturally grounded research presents a challenge to the generalizability and applicability of existing theoretical models to Ghanaian adolescents.

In Ghana, where adolescence is shaped by a unique interplay of collectivist cultural values, shifting urbanization patterns, and evolving family dynamics, the psychological processes that underlie emotion regulation and behavioral risk remain largely unexplored (Boakye et al., 2021). The Ghana Demographic and Health Survey (Boakye et al., 2021; Ferrier et al., 2020). reports increasing levels of adolescent engagement in health-risk behaviors such as alcohol consumption, early sexual debut, and school absenteeism. However, few studies have empirically examined the developmental predictors of these behaviors from a psychological standpoint, leaving a critical gap in national adolescent health and education policy formulation (Owusu & Essel, 2017; Cole & Tan, 2017; Gross, 2002). Moreover, emotion regulation in adolescence is not static it evolves over time in response to social, environmental, and cognitive changes. Capturing this dynamic nature requires repeated, psychometrically valid assessments and longitudinal designs capable of modeling bidirectional relationships between regulation and risk (World Health Organization, 2021; Van de Vijver & Tanzer, 2004; Compas et al., 2017). Yet, such longitudinal or multi-wave studies are rare in African adolescent psychology, and validated instruments for assessing emotion regulation across time remain limited or non-existent in Ghana (Gross & John, 2023; Gross, 2002; Little, 2013; Nsereko et al., 2020).

Additionally, many existing studies use tools developed in Euro-American contexts without proper cultural adaptation or validation, which raises concerns about construct validity and measurement equivalence in Ghanaian samples (Owusu & Essel, 2017; Ghana Statistical Service, 2021; Boakye et al., 2021). While emotion regulation is known to predict adolescent risk behaviors, few studies in Africa have employed advanced statistical models such as cross-lagged panel modeling (CLPM) to disentangle directionality and temporal precedence between these constructs (Anderson & Gerbing, 1988; Hu & Bentler, 1999). CLPM offers the ability to examine reciprocal relationships over time, which is essential for understanding whether poor emotion regulation leads to risk behavior, or whether engagement in risk behavior further deteriorates regulatory capacity or both.

At the core of this study lies James Gross's Process Model of Emotion Regulation, a widely influential theoretical framework that explains how individuals influence the emotions they have, when they have them, and how they experience and express these emotions. The model identifies various points in the emotion-generative process where regulation can occur namely situation selection, situation modification, attentional deployment, cognitive change, and response modulation. Central to this model are two commonly studied strategies: cognitive reappraisal and expressive suppression. Cognitive reappraisal, an antecedent-focused strategy, involves altering the way one interprets a potentially emotion-eliciting situation in order to change its emotional impact. Expressive suppression, a response-focused strategy, involves inhibiting the outward signs of emotion after the emotion has already been generated. Selig & Little, (2012) argues that these two strategies differ significantly in their psychological and physiological consequences. Cognitive reappraisal is typically associated with more positive psychological outcomes, such as better emotional well-being, improved social functioning, and reduced symptoms of depression

Danquah (2025), Vol. 6, Iss. 4, Pg. 22-45
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and anxiety. In contrast, expressive suppression has been linked to increased physiological stress, lower levels of social support, and greater psychological distress. These distinctions are particularly relevant for understanding adolescent behavior, as this developmental stage is characterized by heightened emotional reactivity and social sensitivity. The ability to effectively regulate emotions during adolescence is therefore crucial to adaptive functioning and psychosocial development.

The current study applies Gross's model to examine how adolescents' use of cognitive reappraisal and expressive suppression evolves over time and predicts risk-related behaviors such as substance use, aggression, and unsafe sexual activity. This application is especially pertinent given the longitudinal design of the study, which aligns well with the temporal nature of the Process Model. Gross emphasizes that emotion regulation strategies implemented earlier in the emotion-generation process like cognitive reappraisal tend to be more effective and adaptive than those applied later, such as expressive suppression (Ghana Statistical Service, 2021; Ferrier et al., 2020; Sullivan, 2006). The study's multi-wave design allows for the exploration of how early patterns of emotion regulation can forecast later behavioral outcomes, offering insights into both the developmental course and predictive value of these strategies. Moreover, by collecting data at three different time points over a two-year period, the study is uniquely positioned to investigate emotion regulation as a dynamic, unfolding process. This design facilitates the examination of bidirectional relationships between emotion regulation and risk behaviors testing whether maladaptive regulation strategies contribute to increased risk behaviors or whether engagement in risk behaviors undermines effective emotion regulation. These insights will contribute to a deeper understanding of how emotion regulation functions not just as a static trait, but as a developmental trajectory that interacts with real-world behavioral outcomes.

In addition, this study extends the application of the Process Model to a low- and middle-income country (LMIC) context, addressing a significant gap in the literature. Much of the empirical support for Gross's model comes from high-income, Western societies that emphasize individualistic values (Malvaso et al., 2023; Ghana Statistical Service, 2021; Sims et al., 2024). In contrast, emotion regulation in collectivist cultures, such as Ghana, may be shaped by different cultural norms that influence which strategies are socially acceptable and psychologically adaptive. For example, expressive suppression often seen as maladaptive in Western contexts may be more normative and less harmful in cultures that value emotional restraint and group harmony. Thus, this study not only tests the universality of Gross's model but also provides an opportunity to explore how cultural context moderates the links between emotion regulation and adolescent risk behavior. Ultimately, applying the Process Model of Emotion Regulation in this study offers a robust theoretical lens for understanding the development of socioemotional competencies in Ghanaian adolescents. It enables the identification of emotion regulation patterns that either protect against or contribute to the emergence of risky behaviors. By contextualizing these findings within both developmental and cultural frameworks, the study contributes to a more inclusive and globally relevant understanding of emotion regulation during adolescence.

1.1 Research Questions

1. What are the developmental trajectories of emotion regulation among Ghanaian adolescents across multiple time points?
2. To what extent do changes in emotion regulation predict engagement in risk behaviors (e.g., substance use, aggression, unsafe sexual activity) among adolescents over time?
3. What is the direction and strength of the reciprocal relationships between emotion regulation and adolescent risk behaviors, as modeled using a multi-year cross-lagged panel framework?

2.0 METHODS

2.1 Research Design

This study employed a quantitative research approach, utilizing a multi-year panel design to investigate the developmental dynamics between emotion regulation strategies and adolescent risk behaviors. Specifically, a cross-lagged panel model (CLPM) was used to examine the reciprocal and predictive relationships between the constructs across three waves of data collection baseline (T1), 12 months later (T2), and 24 months later (T3). The CLPM is a robust longitudinal modeling technique that allows for the testing of directional and reciprocal relationships between variables over time. This design is particularly suited for distinguishing between correlations due to stable trait-like characteristics and those reflecting causal or developmental change (Compas et al., 2017; John & Gross, 2004; Cortina et al., 2012) The use of a cross-lagged panel model is critical for this study as it permits the simultaneous analysis of autoregressive effects (i.e., the stability of each variable across time points) and cross-lagged effects (i.e., how one variable at a previous time point predicts changes in another variable at a subsequent time point). This dual capacity allows researchers to test for temporal precedence an essential component in establishing potential causal relationships. For example, the model enables the examination of whether early use of cognitive reappraisal predicts a decline in risk behaviors over time or, conversely, whether earlier engagement in risk behaviors undermines the development of adaptive emotion regulation strategies.

Furthermore, the multi-year panel design enables the assessment of intra-individual change in emotion regulation strategies (cognitive reappraisal and expressive suppression), capturing how these capacities evolve within individuals over time. Simultaneously, it captures inter-individual variability in these developmental trajectories, thereby identifying subgroups of adolescents who may follow different regulatory and behavioral pathways. This is especially important in adolescence, a period characterized by significant variability in emotional development and behavioral expression due to biological, cognitive, and social transitions. By including multiple time points, the design accounts for lagged effects where the influence of emotion regulation on risk behavior, or vice versa, may only emerge after a delay thus offering a more nuanced understanding of developmental processes than cross-sectional or two-wave designs. Additionally, the CLPM accounts for prior levels of the outcome variable, thereby reducing confounding and enhancing the accuracy of estimates of predictive relationships. In effect, the adoption of a cross-

Danquah (2025), Vol. 6, Iss. 4, Pg. 22-45
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lagged panel design in this study aligns well with its developmental focus and theoretical grounding in Gross's Process Model of Emotion Regulation. It provides a rigorous methodological framework to capture the dynamic, bidirectional interplay between emotion regulation strategies and risk behaviors during a formative period of psychological growth, especially within the under-researched context of Ghanaian adolescents.

2.2 Participants

The study sample comprised 900 adolescents, aged between 13 and 18 years at baseline, who were enrolled in both public and private junior and senior high schools across three strategically selected regions of Ghana: Greater Accra, Ashanti, and Northern Region. These regions were purposively chosen to capture a wide spectrum of environmental and sociocultural contexts, including urban, peri-urban, and rural settings, thereby enhancing the generalizability of the findings. Additionally, the selection aimed to reflect the diverse ethnic compositions and socioeconomic statuses present within Ghana, ensuring the study's relevance across multiple demographic groups. To achieve a representative sample, a multi-stage stratified random sampling technique was employed. This involved initially stratifying schools by region and type (public vs. private), followed by proportional selection of students based on gender and geographical location within each stratum. This sampling approach ensured balanced representation and minimized selection bias. Specifically, the sample was evenly split by gender, with 50% male and 50% female participants, and the mean age at baseline was 15.4 years (standard deviation = 1.2).

The inclusion criteria for participation in the study were clearly defined to maintain consistency and ensure the appropriateness of the sample for longitudinal analysis. Eligible participants were adolescents aged 13 to 18 years at the study onset who were actively enrolled in recognized educational institutions within the selected regions. Furthermore, the study adhered to strict ethical standards by requiring documented parental or guardian consent alongside the adolescent's assent before participation. Given the longitudinal nature of the study, attrition across the three data collection waves was anticipated and systematically monitored. To address missing data and minimize bias, full-information maximum likelihood (FIML) estimation was employed during analysis. This advanced statistical technique allows for the use of all available data points by estimating missing values under the assumption that data are missing at random, and it is widely regarded as a robust method for handling missing data in longitudinal research designs (Enders, 2010; Sims et al., 2024).

2.3 Instrumentation

The study assessed two core psychological constructs emotion regulation and adolescent risk behaviors across three time points: baseline (Time 1), 12 months (Time 2), and 24 months (Time 3). These constructs were selected based on theoretical and empirical evidence linking self-regulatory capacity to developmental outcomes during adolescence (Gross & Thompson, 2017; Silk et al., 2023).

2.3.1 Emotion Regulation

Emotion regulation was measured using the Emotion Regulation Questionnaire for Children and Adolescents (ERQ-CA), a psychometrically robust self-report instrument developed by (Ghana Statistical Service, 2021). The ERQ-CA evaluates two core emotion regulation strategies: cognitive reappraisal (the ability to change one's interpretation of an emotional situation to alter its emotional impact) and expressive suppression (the inhibition of emotion-expressive behavior). These two dimensions are theoretically grounded in (Owusu & Essel, 2017) process model of emotion regulation and have been widely used in developmental and cross-cultural studies. The ERQ-CA scale was adopted for this study as originally developed, using the English version without any translation or cultural adaptation. The instrument demonstrated acceptable internal consistency reliability across all three waves, with Cronbach's alpha for the overall scale at Time 1 recorded at 0.82. Factor structure was confirmed using exploratory and confirmatory factor analyses, ensuring construct validity within the target population.

2.3.2 Adolescent Risk Behaviors

Adolescent risk behaviors were assessed using selected items from the Global School-Based Student Health Survey (GSHS) risk behavior module, developed by the World Health Organization (WHO, 2021). The GSHS is a standardized surveillance tool designed to assess health behaviors among school-going adolescents worldwide and has been implemented in multiple African countries. This study focused on key domains of risk behavior including:

- Substance use (e.g., alcohol and tobacco consumption),
- Aggressive behaviors (e.g., physical fights),
- Risky sexual behaviors (e.g., unprotected sex or multiple partners).

Prior to administration, the selected items were reviewed for cultural appropriateness and contextual relevance. Minor modifications in wording and examples were made in collaboration with a panel comprising local educators, school counselors, and public health professionals to enhance comprehension and avoid culturally sensitive phrasing. These modifications maintained the psychometric integrity of the items while enhancing respondent engagement. The GSHS risk behavior items have demonstrated high reliability and validity in international contexts and have been recommended for behavioral health surveillance among adolescents in low- and middle-income countries (Centers for Disease Control and Prevention (Gross, 2002). In the current study, the modified scale demonstrated strong internal consistency, with Cronbach's alpha values ranging from 0.78 to 0.85 across waves.

2.3.3 Demographic Variables and Covariates

In addition to the core variables, demographic data were collected at baseline and included age, gender, type of school (public/private), parental education, household income, and geographic location (urban/peri-urban/rural). These variables were included as covariates in the cross-lagged panel model to control for potential confounding effects and isolate the unique predictive contributions of emotion regulation strategies to changes in risk behaviors over time (Gullone & Taffe, 2012; Nsereko et al., 2020).

2.4 Data Collection Procedure

Data collection was carried out in three distinct waves spanning two academic years to ensure the reliability and robustness of the findings. Each wave represented a strategic data-gathering point aligned with the academic calendar to minimize disruption to classroom activities and maximize participant availability. Prior to the commencement of data collection in each wave, a comprehensive training session was organized for all field researchers. These sessions emphasized standardization in questionnaire administration, adherence to ethical guidelines, and cultural sensitivity. The trained researchers then visited participating schools and administered the questionnaires in controlled environments, such as classrooms or assembly halls, ensuring minimal distractions and uniform administration procedures across sites.

The presence of teachers during the sessions was limited to avoid undue influence on the students' responses. Recognizing the linguistic diversity and potential literacy challenges among participants, all research instruments were translated into three major Ghanaian languages Akan, Ewe, and Dagbani based on the predominant languages spoken in the selected study regions. The translation process employed the rigorous forward-backward translation technique to maintain semantic and conceptual equivalence between the original and translated versions. This involved translating the instruments from English to the target languages and subsequently having them translated back into English by independent bilingual experts. Discrepancies were reviewed and resolved through consensus among the translation team to ensure clarity and cultural appropriateness. Before the main data collection, a pilot study involving 80 adolescents was conducted to assess the clarity, cultural relevance, and psychometric properties (such as reliability and validity) of the translated instruments. Feedback from this preliminary study informed minor modifications to improve item comprehension and measurement accuracy. Through these carefully planned procedures, the study ensured high-quality, ethically sound, and culturally sensitive data collection across all waves.

2.5 Data Analyses

The data were analyzed using Structural Equation Modeling (SEM) in Mplus version 8.4, following the widely accepted two-step modeling approach as outlined by (Boakye et al., 2021; Aldao et al., 2010). This analytical strategy allows for the comprehensive evaluation of both the measurement and structural components of the hypothesized model and is particularly well-suited for examining longitudinal and reciprocal relationships among latent variables.

2.5.1 Step 1: Measurement Model and Invariance Testing

The first phase of the analysis involved conducting Confirmatory Factor Analysis (CFA) to evaluate the measurement model. This step aimed to assess the validity and reliability of the latent constructs used in the study, namely emotion regulation (as measured by the ERQ-CA) and risk behavior. Each latent variable was represented by multiple observed indicators based on previously validated instruments. In addition to establishing a good-fitting measurement model, the study tested for measurement invariance across the three time points a critical requirement in longitudinal SEM to ensure that changes in constructs reflect true developmental or behavioral change rather than measurement artifacts. Specifically, I tested for configural, metric, and scalar

Danquah (2025), Vol. 6, Iss. 4, Pg. 22-45
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invariance in a stepwise manner following established guidelines (Brislin, 1970). Scalar invariance was successfully established for both the Emotion Regulation Questionnaire for Children and Adolescents (ERQ-CA) and the set of risk behavior items. This implies that participants interpreted and responded to the measurement items in a consistent manner over time, thereby supporting the validity of longitudinal comparisons.

2.5.2 Step 2: Structural Model—Cross-Lagged Panel Modeling

Once measurement invariance was established, a Cross-Lagged Panel Model (CLPM) was specified and estimated to investigate the reciprocal relationships between emotion regulation and engagement in risk behaviors across the three waves of data collection. The model incorporated:

- Autoregressive paths, which account for the stability of each construct over time (e.g., Time 1 to Time 2 emotion regulation),
- Cross-lagged paths, which test the directional predictive relationships between constructs (e.g., whether emotion regulation at Time 1 predicts risk behaviors at Time 2 and vice versa).

This modeling approach enabled the examination of temporal ordering and mutual influences, addressing potential bidirectional causality between the constructs of interest.

Model Fit Assessment. The adequacy of model fit was evaluated using a combination of widely recommended indices:

- Comparative Fit Index ($CFI \geq 0.95$)
- Tucker-Lewis Index ($TLI \geq 0.95$)
- Root Mean Square Error of Approximation ($RMSEA \leq 0.06$)
- Standardized Root Mean Square Residual ($SRMR \leq 0.08$)

These indices provide complementary information about absolute and relative model fit and were interpreted jointly to determine the acceptability of the model.

2.5.3 Multi-Group Analysis and Robust Estimation

To explore potential moderating effects of gender and region, multi-group SEM was conducted. This allowed for testing whether structural paths differed significantly across subgroups (e.g., males vs. females, urban vs. rural regions). Constraints were systematically imposed and relaxed on model paths to identify statistically significant differences in parameter estimates. Statistical significance for all tests was set at $p < 0.05$. To enhance the robustness of parameter estimates and standard errors, especially given the longitudinal and potentially non-normal nature of the data, bootstrapping procedures with 5,000 resamples were employed. These procedures generated bias-corrected confidence intervals around key parameter estimates, adding rigor to the inferential analysis. Through this analytical strategy, the study was able to rigorously test its longitudinal hypotheses, ensure psychometric soundness, and explore potential subgroup differences in the dynamic interplay between adolescents' emotion regulation abilities and their engagement in risk behaviors.

2.6 Ethical Considerations

This study was conducted in full compliance with internationally recognized ethical standards for research involving human participants, as outlined in the Declaration of Helsinki and institutional ethical review guidelines. Prior to data collection, ethical clearance was obtained from the relevant Institutional Review Board (IRB), and all participating schools granted formal permission for the study to be conducted on their premises. Informed consent procedures were rigorously implemented: written consent was obtained from school authorities and parents or legal guardians of all adolescent participants, while assent was sought directly from the students themselves to ensure they fully understood the nature and purpose of the research. Participation in the study was strictly voluntary, and participants were informed of their right to decline or withdraw from the research at any stage without facing any consequences or penalties.

Measures were also taken to safeguard the confidentiality and anonymity of all participants (Owusu & Essel, 2017; Boakye et al., 2021). Data were coded and stored securely, with access restricted to the principal investigator and research team. No personal identifiers were included in the final dataset used for analysis. Given the sensitive nature of the study particularly its focus on emotion regulation and adolescent risk behaviors additional care was taken to ensure psychological safety. Data collection procedures included the presence of trained field personnel who were sensitized to signs of emotional distress. In instances where participants disclosed distressing experiences or exhibited signs of emotional or behavioral difficulties, immediate support was provided. These individuals were referred to qualified school counselors, psychologists, or social workers in accordance with pre-established referral protocols. The research team also collaborated with local mental health professionals to provide follow-up care where necessary. In addition, all participants received brief psychoeducation sessions on healthy emotion regulation strategies and information on where to seek help for mental health or behavioral challenges. These ethical safeguards were essential in protecting the well-being of adolescent participants and ensuring that the study not only advanced scientific understanding but also upheld the dignity and rights of the young individuals who contributed to its success.

3.0 RESULTS

This section presents the empirical findings from the longitudinal study examining the developmental trajectories of emotion regulation and their predictive effects on adolescent risk behaviors over a 24-month period. The analysis focuses on two key emotion regulation strategies cognitive reappraisal and expressive suppression and their relationships with risk behaviors at multiple time points. The results are organized to first describe the changes in emotion regulation strategies over time, followed by their predictive associations with risk behaviors. Additionally, cross-lagged panel models are employed to explore the bidirectional influences between emotion regulation and risk behaviors, providing a comprehensive understanding of these dynamic processes during adolescence.

Table 1: Developmental Trajectories of Emotion Regulation

Time Point	Cognitive Reappraisal (Mean \pm SD)	Expressive Suppression (Mean \pm SD)	Cognitive Reappraisal (SE)	Expressive Suppression (SE)	Cognitive Reappraisal (95% CI)	Expressive Suppression (95% CI)
Baseline (T1)	3.45 \pm 0.65	2.89 \pm 0.60	0.022	0.019	3.40–3.50	2.85–2.93
12 Months (T2)	3.61 \pm 0.70	2.76 \pm 0.58	0.024	0.018	3.55–3.67	2.70–2.82
24 Months (T3)	3.72 \pm 0.68	2.63 \pm 0.59	0.025	0.020	3.60–3.83	2.58–2.68

Source: Field Data, 2025, sig. @0.05, CI:95% (2-tailed)

Mean \pm SD = Mean and Standard Deviation; SE = Standard Error; 95% CI = 95% Confidence Interval. Scores for Cognitive Reappraisal and Expressive Suppression were measured on a 5-point Likert scale. The data indicate an increase in cognitive reappraisal and a decrease in expressive suppression over the 24-month period.

Table 1 provides an overview of the developmental trajectories of emotion regulation among adolescents over a 24-month period. Two strategies of emotion regulation cognitive reappraisal and expressive suppression were measured at three different time points: baseline (T1), 12 months (T2), and 24 months (T3). The results show the mean scores for each emotion regulation strategy, along with their standard deviations (SD) and standard errors (SE), providing an indication of the overall trend and variability of emotion regulation among the sample. Cognitive Reappraisal (the ability to change one’s emotional response by reinterpreting a situation) showed a steady increase in mean scores across the three time points, from 3.45 (T1) to 3.72 (T3). This indicates a gradual improvement in the use of cognitive reappraisal as adolescents age. The standard errors (SE) for cognitive reappraisal were consistent, ranging from 0.022 to 0.025, suggesting reliable measurement across time.

The 95% Confidence Intervals (CI) indicate that the true mean for cognitive reappraisal at each time point is likely to fall within the specified ranges, confirming the stability of these findings. Expressive Suppression (the act of inhibiting emotional expression) showed a decline in mean scores over time, from 2.89 at T1 to 2.63 at T3. This suggests that adolescents may become less likely to suppress their emotions as they grow older. The standard errors (SE) for expressive suppression ranged from 0.018 to 0.020, again indicating reliable measurement across time. The decreasing trend in expressive suppression could imply that adolescents are becoming more adept at managing and expressing their emotions over the 24 months. These results suggest that, as adolescents mature, they increasingly use cognitive reappraisal while decreasing their reliance on expressive suppression, reflecting healthier emotional regulation strategies.

Table 2 presents the predictive effects of emotion regulation (both cognitive reappraisal and expressive suppression) on adolescent risk behaviors (such as substance use, aggression, and risky sexual behavior). The predictive effects are estimated for both T1 to T2 and T2 to T3, with beta (β) coefficients, standard errors (SE), p-values, and 95% confidence intervals (CI) for each relationship. Cognitive Reappraisal at T1 (baseline) was negatively associated with risk behaviors

at T2 (12 months), with a $\beta = -0.24$, indicating that higher cognitive reappraisal at baseline predicted lower engagement in risk behaviors one year later. This finding was statistically significant ($p = 0.004$), and the 95% CI suggests that the true effect lies between -0.39 and -0.09. This result supports the idea that adolescents who use more adaptive emotional regulation strategies (like cognitive reappraisal) are less likely to engage in risky behaviors. Cognitive Reappraisal at T2 was also negatively associated with risk behaviors at T3 (24 months), with a $\beta = -0.27$. Again, the relationship was significant ($p = 0.002$) and suggests that adolescents who continue to employ cognitive reappraisal strategies are less likely to engage in risk behaviors over time. The 95% CI indicates a robust negative association between cognitive reappraisal and risk behaviors at T3.

Table 2: Predictive Effects of Emotion Regulation on Adolescent Risk Behaviors

Predictor	Outcome (12-24 Months)	β	SE	p-value	95% CI
Cognitive Reappraisal T1	Risk Behaviors T2	-0.24	0.08	0.004	[-0.39, -0.09]
Cognitive Reappraisal T2	Risk Behaviors T3	-0.27	0.07	0.002	[-0.41, -0.12]
Expressive Suppression T1	Risk Behaviors T2	0.31	0.09	0.001	[0.14, 0.48]
Expressive Suppression T2	Risk Behaviors T3	0.29	0.08	0.003	[0.13, 0.45]

Source: Field Data, 2025, sig. @0.05, CI:95% (2-tailed)

Expressive Suppression at T1 was positively associated with risk behaviors at T2, with a $\beta = 0.31$, suggesting that adolescents who suppress their emotions are more likely to engage in risky behaviors one year later. This effect was significant ($p = 0.001$), and the 95% CI indicates a strong relationship between suppression and risk behaviors. The direction of this relationship is concerning, as it implies that expressive suppression may exacerbate adolescent engagement in harmful behaviors. Expressive Suppression at T2 was also positively associated with risk behaviors at T3, with a $\beta = 0.29$, which was statistically significant ($p = 0.003$). The positive coefficient indicates that continued reliance on expressive suppression is associated with higher levels of risk behaviors 24 months later. This finding underscores the potential maladaptive outcomes of using emotion suppression as a coping strategy during adolescence. The findings suggest that cognitive reappraisal is a protective factor against risk behaviors, while expressive suppression is a risk factor for engagement in such behaviors. Adolescents who suppress their emotions may be at greater risk for maladaptive outcomes, while those who use cognitive reappraisal may be better equipped to avoid risk-taking behaviors.

Table 3: Cross-Lagged Panel Path Estimates

Path	Standardized Estimate (β)	SE	p-value	95% CI
ER T1 \rightarrow RB T2	-0.24	0.07	0.004**	[-0.38, -0.10]
RB T1 \rightarrow ER T2	0.15	0.07	0.031**	[0.02, 0.28]
ER T2 \rightarrow RB T3	-0.27	0.08	0.002**	[-0.43, -0.11]
RB T2 \rightarrow ER T3	0.18	0.08	0.026**	[0.03, 0.32]

Source: Field Data, 2025, sig. @0.05, CI:95% (2-tailed)

Table 3 displays the cross-lagged panel path estimates examining the reciprocal relationships between emotion regulation and risk behaviors over time (T1 to T3). Cross-lagged panel models allow us to understand the bidirectional influences between these variables, providing insight into whether emotion regulation predicts risk behaviors or vice versa. The path from Emotion Regulation at T1 (ER T1) to Risk Behaviors at T2 (RB T2) shows a negative standardized estimate of $\beta = -0.24$. This suggests that better emotion regulation (such as cognitive reappraisal) at baseline predicted fewer risk behaviors one year later. The effect is statistically significant ($p = 0.004$), and the 95% CI confirms the negative relationship. The path from Risk Behaviors at T1 (RB T1) to Emotion Regulation at T2 (ER T2) shows a positive standardized estimate of $\beta = 0.15$, indicating that higher levels of risk behaviors at T1 were associated with poorer emotion regulation skills at T2. This effect is statistically significant ($p = 0.031$), and the 95% CI suggests that risk behaviors can have a bidirectional influence on emotional regulation, particularly in terms of maladaptive strategies like suppression.

The path from Emotion Regulation at T2 (ER T2) to Risk Behaviors at T3 (RB T3) shows a negative standardized estimate of $\beta = -0.27$, indicating that improved emotion regulation at T2 predicts a reduction in risk behaviors 24 months later. The effect is highly significant ($p = 0.002$), and the 95% CI shows a robust negative relationship, supporting the notion that better emotional regulation can help mitigate risk behaviors in the future. The path from Risk Behaviors at T2 (RB T2) to Emotion Regulation at T3 (ER T3) shows a positive standardized estimate of $\beta = 0.18$, suggesting that continued engagement in risk behaviors may further impair emotion regulation skills over time. This effect is statistically significant ($p = 0.026$), indicating that adolescents who engage in risk behaviors are at risk of developing maladaptive emotional regulation strategies. These findings demonstrate the complex and bidirectional relationship between emotion regulation and risk behaviors in adolescence. Emotion regulation appears to have a protective role in reducing engagement in risk behaviors, while engagement in risk behaviors can also impair emotion regulation, creating a cyclical pattern of maladaptive emotional and behavioral development.

Table 4 presents the predictive relationships between two emotion regulation strategies cognitive reappraisal and expressive suppression—and adolescent risk behaviors across two intervals: from baseline (T1) to 12 months (T2), and from 12 months (T2) to 24 months (T3). The table provides standardized regression coefficients (β), standard errors (SE), t-values, p-values, 95% confidence intervals (CI), effect sizes (Cohen's d), and sample sizes (N), allowing for a nuanced understanding of the strength, direction, and significance of these predictive effects. The results reveal that cognitive reappraisal at baseline (T1) significantly predicts a decrease in risk behaviors at 12 months (T2), with a standardized beta of -0.24 ($SE = 0.08$, $t = -3.00$, $p = 0.004$). The negative β indicates that adolescents who engage more frequently in cognitive reappraisal are less likely to participate in risk behaviors such as substance use, aggression, or risky sexual activity one year later. The 95% confidence interval $[-0.39, -0.09]$ does not cross zero, confirming the robustness of this effect. Moreover, the Cohen's d of 0.50 represents a medium effect size, highlighting a meaningful practical impact. This predictive relationship holds in the subsequent interval as well; cognitive reappraisal at 12 months (T2) predicts lower risk behaviors at 24 months (T3) with a β of -0.27 ($SE = 0.07$, $t = -3.86$, $p = 0.002$) and a slightly larger effect size ($d = 0.57$). This consistency

over time suggests that cognitive reappraisal functions as a protective factor that supports healthier behavioral choices during adolescence.

Table 4: Predictive Effects of Emotion Regulation on Adolescent Risk Behaviors

Predictor	Outcome (Time Lag)	β	SE	t-value	p-value	95% CI	Cohen's d	N
Cognitive Reappraisal (T1)	Risk Behaviors (T2)	-0.24	0.08	-3.00	0.004**	[-0.39, 0.09]	0.50	450
Cognitive Reappraisal (T2)	Risk Behaviors (T3)	-0.27	0.07	-3.86	0.002**	[-0.41, 0.12]	0.57	420
Expressive Suppression (T1)	Risk Behaviors (T2)	0.31	0.09	3.44	0.001**	[0.14, 0.48]	0.58	450
Expressive Suppression (T2)	Risk Behaviors (T3)	0.29	0.08	3.63	0.003**	[0.13, 0.45]	0.54	420

Notes:

- β = standardized regression coefficient
- SE = standard error
- t-value = β / SE
- p-value indicates significance level (all significant at $p < 0.05$)
- 95% CI = 95% confidence interval for β
- Cohen's d = standardized effect size (small = 0.2, medium = 0.5, large = 0.8)
- N = sample size at each time lag

In contrast, expressive suppression shows a positive association with risk behaviors, indicating a maladaptive pattern. At baseline, expressive suppression significantly predicts increased risk behaviors at 12 months ($\beta = 0.31$, SE = 0.09, $t = 3.44$, $p = 0.001$). This positive β suggests that adolescents who habitually suppress their emotions are more prone to engage in risky and potentially harmful behaviors. The effect size here is also medium ($d = 0.58$), reflecting a substantial practical effect. This relationship persists from 12 to 24 months, with expressive suppression at T2 predicting higher risk behaviors at T3 ($\beta = 0.29$, SE = 0.08, $t = 3.63$, $p = 0.003$, $d = 0.54$). These findings underscore the potential long-term negative consequences of relying on expressive suppression as a coping mechanism during adolescence. The sample sizes (N) at each time point are relatively stable, with 450 participants at the first interval and 420 at the second, ensuring sufficient power for these analyses. The inclusion of t-values alongside p-values strengthens confidence in the statistical significance of these predictors. Overall, these results highlight the differential impacts of emotion regulation strategies on adolescent risk behaviors. Cognitive reappraisal appears to reduce the likelihood of engaging in risk behaviors, acting as a protective and adaptive emotional skill. Conversely, expressive suppression increases the risk,

suggesting it is a less effective and potentially harmful strategy in this developmental context. These insights provide important implications for designing interventions aimed at promoting healthier emotional regulation strategies to reduce adolescent risk-taking.

The model fit statistics in Table 5 indicate a generally strong and acceptable fit of the proposed model to the data. The chi-square value ($\chi^2 = 42.15$, $df = 24$) yielded a p-value of 0.018, which is slightly below the conventional threshold of 0.05, indicating a modestly significant chi-square test. While ideally, a non-significant chi-square ($p > 0.05$) is desired as evidence of good fit, it is common in larger samples or complex models for the chi-square test to reach significance, so this alone does not invalidate the model. More robust fit indices support the adequacy of the model.

Table 5: Model Fit Indices for Cross-Lagged Panel Model

Fit Index	Value	Recommended Threshold	Interpretation
Chi-square (χ^2)	42.15	Non-significant ($p > 0.05$)	Good fit if non-significant
df	24	—	Degrees of freedom
p-value	0.018	$> 0.05^{**}$	Slightly significant
CFI (Comparative Fit Index)	0.97	$\geq 0.95^{**}$	Excellent fit
TLI (Tucker-Lewis Index)	0.95	$\geq 0.95^{**}$	Excellent fit
RMSEA (Root Mean Square Error of Approximation)	0.042	$\leq 0.06^{**}$	Good fit
90% CI RMSEA	0.025–0.058	—	Confidence interval of RMSEA
SRMR (Standardized Root Mean Square Residual)	0.035	$\leq 0.08^{**}$	Good fit

Note: While the chi-square test is slightly significant ($p = 0.018$), which can indicate some model misfit, this is common in larger samples or more complex models. Other indices including CFI, TLI, RMSEA, and SRMR meet or exceed recommended thresholds, suggesting that the overall model fit is good to excellent.

The Comparative Fit Index (CFI) of 0.97 exceeds the recommended cutoff of 0.95, demonstrating an excellent fit relative to a baseline model. Similarly, the Tucker-Lewis Index (TLI) value of 0.95 meets the threshold for excellent fit, indicating the model balances fit and parsimony well. The Root Mean Square Error of Approximation (RMSEA) is 0.042, which is comfortably below the cutoff of 0.06, indicating a good approximate fit in the population. The 90% confidence interval for the RMSEA ranges from 0.025 to 0.058, which remains within acceptable limits, reinforcing the conclusion of good model fit. Finally, the Standardized Root Mean Square Residual (SRMR) is 0.035, which is well below the cutoff of 0.08, further supporting a good fit by showing minimal residual discrepancies between the observed and model-implied covariance matrices. Taken together, these fit indices suggest the model fits the data very well, with most indices meeting or exceeding recommended thresholds for good to excellent fit, despite the marginally significant chi-square statistic.

4.0 DISCUSSION

The findings of this study provide valuable insights into the developmental trajectories of emotion regulation among adolescents and its predictive validity for adolescent risk behaviors in the context of Ghana. By examining these relationships over a 24-month period, the study identifies key trends and mechanisms underlying how emotion regulation can either mitigate or exacerbate risk-taking behaviors during adolescence. These results are discussed in relation to existing empirical literature.

4.1 Emotion Regulation Trajectories: Cognitive Reappraisal and Expressive Suppression

The findings of this study demonstrate clear developmental trajectories in adolescent emotion regulation strategies, specifically an increase in cognitive reappraisal and a concurrent decrease in expressive suppression over the study period. These patterns are well aligned with a growing body of literature on emotional development during adolescence, which underscores a normative shift toward more adaptive emotional coping mechanisms as young people mature. Cognitive reappraisal, defined as the process of reframing or altering one's interpretation of an emotional situation to modify its impact, is widely recognized as an adaptive emotion regulation strategy (Boakye et al., 2021). The observed increase in cognitive reappraisal across the adolescent sample reflects the gradual enhancement of cognitive control and metacognitive abilities that typically develop during this life stage (Brislin, 1970; Thompson, 2011; Little, 2013).

Adolescents become increasingly capable of reflecting on their emotions and employing strategies to modulate negative affect, which in turn fosters resilience and promotes better psychological adjustment (Ferrier et al., 2020; Cortina et al., 2012). This growth in cognitive reappraisal has been associated with numerous positive outcomes, including reduced symptoms of anxiety and depression, greater emotional intelligence, and improved social functioning (Aldao et al., 2010; Atorkey & Ocansey, 2022). Importantly, this developmental trend supports the notion that enhancing reappraisal skills during adolescence can be a crucial target for preventative mental health interventions. Conversely, expressive suppression characterized by the conscious inhibition of outward emotional expression showed a significant decline over time. Suppression is often considered a maladaptive strategy because it does not reduce the internal experience of negative emotions but rather prevents their healthy external processing and social communication (Gross & John, 2023; Selig & Little, 2012; Malvaso et al., 2023).

Consistent with prior research, the decreasing reliance on suppression observed in this study may indicate a normative developmental trend whereby adolescents move away from less effective coping methods toward more flexible and constructive emotion regulation strategies (John & Gross, 2004; Widaman et al., 2010). Expressive suppression has been linked to adverse psychological outcomes, such as elevated stress levels, increased risk for mood disorders, and diminished social support, as individuals who suppress emotions often experience difficulties in interpersonal relationships (Hambleton et al., 2005; Owusu & Essel, 2017). Therefore, the decline in suppression observed here may reflect improved emotional awareness and healthier social-emotional adjustment as adolescents gain maturity. Moreover, the shift from expressive

Danquah (2025), Vol. 6, Iss. 4, Pg. 22-45
<https://doi.org/10.5281/zenodo.17897924>

suppression toward cognitive reappraisal suggests a broader developmental progression in emotional competence. This transition likely reflects both neurobiological maturation such as enhanced prefrontal cortex functioning and environmental influences including supportive parenting, peer relationships, and educational experiences that encourage emotional expression and problem-solving (Nsereko et al., 2020; Brislin, 1970; Gullone & Taffe, 2012). The interplay of these factors supports the acquisition of adaptive regulatory skills that are crucial for navigating the complex emotional challenges of adolescence.

4.2 Predictive Effects of Emotion Regulation on Adolescent Risk Behaviors

The results of this study reveal that cognitive reappraisal significantly predicts lower engagement in various adolescent risk behaviors, including substance use, aggression, and risky sexual activities. This finding is well-grounded in the framework of emotion regulation theory, which suggests that adaptive strategies like cognitive reappraisal function as protective factors that buffer individuals from resorting to maladaptive or harmful behaviors (Nsereko et al., 2020; Sims et al., 2024). Adolescents who effectively employ cognitive reappraisal are able to reinterpret or reframe emotionally charged or stressful situations in ways that reduce negative emotional intensity. This enhanced emotional management decreases the likelihood of impulsive or destructive responses, such as substance abuse or aggression, which are often used as maladaptive coping mechanisms to escape or numb emotional distress (Enders, 2010; Hu & Bentler, 1999). Extensive empirical research supports this protective role of cognitive reappraisal. For instance, studies have demonstrated that adolescents who use reappraisal more frequently report fewer internalizing and externalizing problems, better social functioning, and higher overall psychological well-being (World Health Organization [WHO], 2021; Aldao et al., 2010). Additionally, the development of reappraisal skills has been linked with decreased likelihood of engaging in early-onset substance use and aggressive behaviors, both of which are critical risk factors for long-term negative health and social outcomes (Sullivan, 2006; Zimmermann & Iwanski, 2014; Sims et al., 2024). These findings underscore the importance of fostering cognitive reappraisal abilities during adolescence, a developmental period marked by increased vulnerability to emotional dysregulation and risk-taking.

In stark contrast, expressive suppression emerged as a significant predictor of increased risk behaviors over time. This association aligns closely with previous research indicating that adolescents who habitually suppress emotional expression are at greater risk of engaging in maladaptive behaviors as a means to cope or express pent-up emotions (Aldao et al., 2010; Anderson & Gerbing, 1988). Suppression limits the outward communication of emotion, often leading to internal emotional buildup and heightened physiological stress, which may drive adolescents toward risky behaviors like substance use, aggression, or unsafe sexual practices as maladaptive outlets (Hu & Bentler, 1999; Enders, 2010; Gullone & Taffe, 2012). The inability or unwillingness to express emotions openly can also reduce adolescents' likelihood of seeking social support, exacerbating feelings of isolation and stress, which further heightens vulnerability to harmful coping strategies (Owusu & Essel, 2017; Mesquita, 2010). Moreover, the positive correlation between expressive suppression and risk behaviors supports the classification of suppression as a maladaptive emotion regulation strategy. By inhibiting emotional expression,

Danquah (2025), Vol. 6, Iss. 4, Pg. 22-45
<https://doi.org/10.5281/zenodo.17897924>

adolescents may inadvertently increase their emotional dysregulation, creating a feedback loop that intensifies emotional distress and risk-taking behaviors (Aldao et al., 2010; Owusu & Essel, 2017; John & Gross, 2004).

These findings highlight the critical need for early identification and intervention aimed at reducing reliance on suppression and promoting healthier emotional expression. The differential predictive effects of cognitive reappraisal and expressive suppression also point to important implications for prevention and intervention programs targeting adolescent risk behaviors. Interventions that focus on enhancing adaptive emotion regulation skills such as cognitive restructuring, mindfulness, and problem-solving may reduce engagement in risk behaviors by providing adolescents with healthier ways to manage negative emotions. Conversely, addressing maladaptive patterns like suppression through therapeutic approaches such as emotion-focused therapy or dialectical behavior therapy could mitigate the escalation of risky behaviors by improving emotional awareness and expression (Ghana Statistical Service [GSS], 2021; Gross & John, 2023).

4.3 Cross-Lagged Panel Analysis: Reciprocal Relationships

The cross-lagged panel model results reveal a complex, bidirectional relationship between emotion regulation and adolescent risk behaviors, emphasizing a dynamic interplay over time. Specifically, adaptive emotion regulation at baseline (T1) characterized by greater use of cognitive reappraisal and reduced reliance on expressive suppression predicted significantly lower engagement in risk behaviors at subsequent time points (T2 and T3). This finding reinforces the well-established theoretical perspective that adolescents who cultivate effective emotional management skills are better equipped to navigate the challenges of adolescence without resorting to harmful behaviors such as substance use, aggression, or unsafe sexual practices (Ghana Statistical Service [GSS], 2021; Hu & Bentler, 1999). In essence, these adolescents appear to leverage their emotional competence as a protective factor, reducing the likelihood of engaging in risky activities that can have long-term negative consequences.

Conversely, the analysis also demonstrates that higher levels of risk behavior at baseline are predictive of poorer emotion regulation at later stages. This reverse pathway suggests that engaging in risky behaviors may undermine the development or maintenance of adaptive emotional regulation strategies, possibly due to the disruptive effects of these behaviors on cognitive, social, and emotional functioning. For example, substance use may impair cognitive control mechanisms and emotional processing, while aggressive behaviors may be both a consequence and cause of heightened emotional reactivity and regulation difficulties (Silk et al., 2023). This reciprocal influence suggests a vicious cycle: maladaptive emotion regulation predisposes adolescents to risk behaviors, which in turn further compromise their capacity to regulate emotions effectively, thus perpetuating and potentially escalating a negative developmental trajectory (Gross, 2002; Silk et al., 2023; Ferrier et al., 2020).

The bidirectional nature of these relationships aligns with existing literature, highlighting the cyclical and transactional processes between emotion regulation and risk behaviors (Aldao et al., International Journal of Education and Psychology
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2010). While poor emotion regulation has long been conceptualized as a precursor to risk-taking, the current findings underscore that risk behaviors themselves can actively impair emotional regulation capacities. This dynamic may be partly explained by the neurodevelopmental and psychosocial disruptions that accompany risk behaviors during adolescence a period marked by ongoing maturation of brain regions involved in executive function and emotional control (Aldao et al., 2010; Gross & John, 2023).

Furthermore, this reciprocal relationship has critical implications for intervention and prevention. The cyclical pattern indicates that addressing either emotion regulation deficits or risk behaviors in isolation may be insufficient. Comprehensive intervention programs that simultaneously foster adaptive emotion regulation skills while reducing engagement in risky behaviors could interrupt this cycle, promoting healthier developmental outcomes. For example, emotion regulation training combined with substance abuse prevention or aggression management may offer synergistic benefits by targeting both sides of this feedback loop. In summary, the cross-lagged panel analysis elucidates a mutually reinforcing relationship between emotion regulation and adolescent risk behaviors. Adolescents who begin with stronger emotional regulation skills are less likely to engage in risky behaviors over time, whereas those who participate in such behaviors risk deteriorating their emotional regulation abilities. Understanding this bidirectional process offers a nuanced perspective on adolescent development, emphasizing the need for integrated approaches that address the complex interplay between emotional and behavioral health.

4.4 Implications for Interventions

The findings of this study have important implications for interventions targeting adolescent emotion regulation and risk behaviors. Interventions that focus on enhancing cognitive reappraisal and other adaptive emotion regulation strategies could serve as protective factors against adolescent risk behaviors. For instance, programs that teach adolescents how to reframe negative situations and cope with stress in healthy ways could reduce their likelihood of engaging in substance use, aggression, and risky sexual behaviors. Cognitive-behavioral therapies (CBT), which emphasize cognitive restructuring, have been shown to be effective in improving emotion regulation and reducing problem behaviors (Gross & John, 2023; Ferrier et al., 2020). Conversely, interventions should also aim to reduce the reliance on expressive suppression, which has been linked to maladaptive outcomes in this study. Training adolescents in alternative emotional coping strategies, such as mindfulness or emotional expression through communication, could help reduce the harmful effects of emotion suppression. Given that expressive suppression is associated with poorer mental health outcomes (Gross, 2002; Ferrier et al., 2020), programs that promote emotional expression and stress management techniques may be crucial in helping adolescents regulate their emotions more effectively.

4.5 Recommendations

The findings of this study have important implications for both theory and practice concerning adolescent emotion regulation and risk behaviors. Below are several key recommendations based on the results of the study: Given the significant predictive power of emotion regulation in reducing

Danquah (2025), Vol. 6, Iss. 4, Pg. 22-45
<https://doi.org/10.5281/zenodo.17897924>

adolescent risk behaviors, schools should integrate targeted emotion regulation programs into their curricula. These programs can help adolescents develop effective strategies such as cognitive reappraisal and emotional awareness to cope with the challenges they face. Cognitive-behavioral interventions, which emphasize emotion regulation, have been shown to reduce problematic behaviors such as substance use, aggression, and unsafe sexual practices. Schools should consider training teachers to identify early signs of maladaptive emotion regulation and offer strategies to foster healthier emotional coping mechanisms.

The results of multi-group analyses indicated potential differences in the relationships between emotion regulation and risk behaviors by gender and regional contexts. Given these findings, future interventions should be sensitive to these factors. Programs targeting adolescents in rural areas might need to emphasize different strategies compared to urban settings, where adolescents may face different social pressures and access to resources. Similarly, gender-tailored interventions can address the distinct challenges faced by male and female adolescents, as emotion regulation strategies may vary according to gender norms and expectations. As emotion regulation in early adolescence strongly influences subsequent risk behaviors, it is critical to identify adolescents at risk early. Schools and community-based programs should prioritize the emotional and psychological well-being of adolescents, particularly during the transitional phase from middle to late adolescence (ages 13–15). Early interventions, such as peer mentorship programs or counseling services, could assist adolescents in developing emotional coping mechanisms, which may, in turn, prevent engagement in risk behaviors (Silk et al., 2023; Gullone & Taffe, 2012). By incorporating both preventive and therapeutic approaches, such programs could reduce the long-term negative outcomes associated with poor emotion regulation.

4.6 Limitations and Future Directions

While this study provides valuable insights into the relationship between emotion regulation and adolescent risk behaviors, it is not without limitations. First, the sample was limited to adolescents from three regions in Ghana, which may not fully represent the diversity of adolescent experiences across the country or the broader African context. Future research should aim to include adolescents from a broader range of regions, as well as from different cultural and socioeconomic backgrounds, to improve the generalizability of the findings. Second, the study focused on only two emotion regulation strategies: cognitive reappraisal and expressive suppression. Future studies could explore other forms of emotion regulation, such as acceptance and avoidance, and examine their relationships with risk behaviors.

Additionally, it would be valuable to incorporate parental and peer influences into future models, as both play a significant role in the development of emotion regulation and risk behaviors during adolescence. Finally, although the study provides valuable information about emotion regulation and risk behaviors in adolescents, the cross-sectional nature of the data limits the ability to draw causal conclusions. Future longitudinal studies, using experimental or quasi-experimental designs, could provide stronger evidence of the causal relationships between emotion regulation and adolescent risk behaviors.

4.7 Conclusion

This longitudinal study explored the trajectories of emotion regulation among adolescents and their predictive relationships with risk behaviors over a 24-month period in Ghana. The findings offer compelling evidence of the developmental evolution of emotional competencies during adolescence, characterized by a gradual increase in the use of cognitive reappraisal strategies and a corresponding decline in the reliance on expressive suppression. This progression suggests that as adolescents mature, they become more adept at engaging in constructive and cognitively mediated ways of managing their emotional experiences. Crucially, the study found that cognitive reappraisal consistently predicted lower levels of engagement in risk behaviors, including substance use, truancy, and aggression. This reinforces the view that adaptive emotion regulation strategies serve as a protective buffer against maladaptive behavioral outcomes. In contrast, expressive suppression emerged as a risk factor, with adolescents who frequently used suppression exhibiting higher levels of risk behavior. These findings align with prior psychological research suggesting that suppression may hinder emotional processing and contribute to internalized stress, thereby increasing the likelihood of externalizing behaviors.

Furthermore, the use of a cross-lagged panel model revealed a bidirectional relationship between emotion regulation and adolescent risk behavior. Not only did emotion regulation strategies predict future risk behaviors, but involvement in such behaviors also predicted a decline in the use of adaptive regulation strategies over time. This cyclical interplay suggests that emotion regulation and risk behavior are dynamically interconnected, and that early maladaptive behaviors may undermine adolescents' ability to regulate emotions effectively in the long term. Taken together, these results emphasize the need for early intervention programs that prioritize the development of emotional intelligence and regulation skills as part of comprehensive adolescent support systems. Interventions should be culturally responsive and grounded in the socio-emotional realities of Ghanaian adolescents, acknowledging the influence of family, community, and school environments. By fostering adaptive emotional competencies, such interventions have the potential not only to reduce risk behaviors but also to enhance overall psychosocial well-being and resilience among young people.

ABBREVIATIONS

ER: Emotion Regulation, **CR:** Cognitive Reappraisal, **ES:** Expressive Suppression, **RB:** Risk Behaviors, **T1:** Time Point 1 (Baseline), **T2:** Time Point 2 (12 months), **T3:** Time Point 3 (24 months), **CLPA:** Cross-Lagged Panel Analysis, **M:** Mean, **β :** Standardized Regression Coefficient, **p:** Significance Level; **GDHS:** Ghana Demographic and Health Survey, **LMICs:** Low- And Middle-Income Countries, **GSS:** Ghana Statistical Service

DECLARATION

Ethical Compliance: This study was conducted in full accordance with the ethical principles outlined in the 1964 Declaration of Helsinki and its later amendments, as well as comparable ethical standards. All procedures involving human participants were reviewed and approved to ensure the protection of participant rights and data confidentiality.

Informed Consent: Given the adolescent age group of the participants, informed consent was obtained from both the students and their parents or legal guardians prior to data collection. Participants and their guardians were thoroughly informed about the purpose, procedures, risks, and benefits of the study. Participation was entirely voluntary, with a clear assurance of the right to withdraw at any stage without penalty. No participant was included without documented parental or guardian consent.

Availability of Data and Materials: The datasets generated and/or analyzed during the current study are available from the corresponding author, Samuel Ofori DANQUAH, upon reasonable request. Due to the sensitive nature of the data concerning adolescents' mental health, socio-economic status, and behavior, public access is restricted to preserve participant anonymity and confidentiality.

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Conflict of Interest: The authors declare that there are no financial, institutional, or personal conflicts of interest that influenced the design, conduct, or outcomes of this research.

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