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Associations between Behavioral, Emotional, Cognitive Self-Regulation and Adolescent Mental Health and Psychosocial Strengths

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Abstract

Background. Self-regulation is an essential developmental asset during adolescence related to the prevention and promotion of mental health. This research aimed to analyze how various domains of self-regulation (behavioral, emotional and cognitive) were associated with mental health (internalizing and externalizing problems) and psychosocial strengths (interpersonal strengths, intrapersonal strengths and family involvement) among adolescents. A secondary aim was to analyze gender differences in these effects and in self-regulation.

Method. A cross-sectional survey research design was used to collect data from 373 adolescents (age range = 10 – 18 years; 188 boys, 215 girls) through a convenient sampling technique from the five provinces of Pakistan. Behavior Rating Inventory of Executive Functions (BRIEF-2), Strength and Difficulty Questionnaire (SDQ), and Behavior and Emotional Rating Scale (BERS-2) were used to measure the study variables.

Results. Results indicated that ineffective behavioral, emotional, and cognitive regulation were significant predictors of externalizing problems while ineffective emotional and cognitive regulation significantly predicted internalizing problems. Ineffective behavioral and cognitive regulation significantly negatively predicted interpersonal strengths. Only cognitive regulation appeared as a significant predictor for intrapersonal strengths and family involvement. Multigroup analyses revealed no significant gender differences.

Conclusion. The findings highlight the differential relationship of self-regulation with mental health and psychosocial strengths which can inform practices in the prevention and promotion of mental health in adolescents.

Keywords. Emotion regulation, behavior regulation, cognitive regulation, psychosocial, strengths, mental health

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Introduction

According to World Health Organization, mental health is not the absence of mental illness; rather it is a "state of wellbeing in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community" (World Health Organization, 2004). This definition emphasizes taking a holistic approach in conceptualizing mental health not just focusing on mental health related problems or strengths alone. Research in children and adolescents' mental health from lower and middle incomes countries (LMICs) indicated that embracing a multicomponent mental health promotion is effective rather than a disease driven model (Zhou et al., 2020). Adolescents are suffering from mental health related problems with a worldwide prevalence of common mental disorders at 25% (Silva et al., 2020), with even high prevalence rates in LMICs, necessitating to utilize a holistic approach to promote prevention and promotion of mental health. Self-regulatory skills are one of these stage salient malleable risk factors during adolescents that can be targeted.

Self-regulation can be defined as 'the ability to flexibly activate, monitor, inhibit, persevere and/or adapt one's behavior, attention, emotions and cognitive strategies in response to direction from internal cues, environmental stimuli and feedback from others, in an attempt to attain personally-relevant goals' (Moilanen, 2007, p.1). Self-regulation is a meta-cognitive multidimensional skill that requires executive functions like working memory, planning, organization, and self-control (Hofmann et al., 2012; Nigg, 2017). Broadly speaking executives functions are categorized in three distinct yet related areas which are working memory, inhibitory control and cognitive flexibility (Nyongesa et al., 2019) which also underlie three broad distinct yet related dimensions of self-regulation i.e. cognitive , emotional and behavioral.

Adolescence is a unique and formative phase of life where many physical, emotional, behavioral, cognitive, and neurobiological changes are taking place amid a challenging and demanding social world which require effective self-regulatory skills (te Brinke et al., 2021; Verzeletti et al., 2016; Zafar et al., 2021). These neurobiological changes create a window of opportunity to develop and practice effective executive functions underlying self-regulation to promote mental health and psychosocial strengths in adolescence (Williams et al., 2023). Effective self-regulation has been linked with positive outcomes in various domains including academic, intrapersonal, and interpersonal (Farley, Julee & Kim-Spoon, 2014; Gestsdottir et al., 2011; Murray & Rosanbalm, 2017). Adolescents are expected to manage their emotions and behavior in an ever changing social context, to develop and maintain appropriate social ties with family, friends and others, and to perform well in academic and other areas of life within the boundaries of social norms and expectations. All of these psychosocial strengths require effective self-regulatory skills (Bowers et al., 2015; Lerner et al., 2021; Stefansson et al., 2018). For example adolescents having appropriate self-control will benefit from forming and maintaining interpersonal relationship with parents, peers and significant others (Rawn & Vohs, 2006) .

Similarly, ineffective self-regulation is correlated with poor developmental outcomes (Perry et al., 2018; Robson et al., 2020), becoming more vulnerable to cumulative stress, unresolved problems, and a higher chance of mental health problems (Essau, Cecilia et al., 2017; Genugten, Dusseldorp, Massey, & Van, 2016; Lerner et al., 2011). A meta-analysis on the effectiveness of self-regulation based interventions for mental health problems indicated that primary interventions had small to medium effect size for internalizing problems, and secondary interventions had medium to large short-term effect for internalizing problems (Genugten, Dusseldorp, Massey, & Van, 2016) signifying the causal linkage of self-regulation with mental health problems. Different domains of self-regulation are linked differently with specific mental health problems for example,

emotional regulation is related to internalizing and externalizing disorders (Hagler et al., 2016; Loevaas et al., 2018; Sackl-Pammer et al., 2019); while working memory, which is a process of cognitive regulation, is studied extensively in relation to internalizing disorders (Moran, 2016). Another study on differential linkages of emotion regulation to mental health indicated that adolescents having internalizing problems used cognitive regulation significantly and adolescents with externalizing problems used more behavioral regulation (te Brinke et al., 2021) thus signifying the specific linkages of self-regulatory domains.

Behavioral Regulation, Mental Health Problems and Psychosocial Strengths

Behavioral regulation is defined as modulating and directing one's behavior (Ilkowska & Engle, 2010). The executive functions underlying behavioral self-regulations are self-monitor and inhibit/self-control. Self-monitoring is defined as the awareness of the impact of one's behavior on other people and outcomes. Inhibit/ self-control is defined as ability to inhibit, resist and not act on an impulse and the ability to stop one's behavior at the right time (Gerard & Peter, 2013). Self-control is regarded as a "cool" executive function because it requires conscious efforts to inhibit one's behavior (Fernández García et al., 2021). A retrospective study on adolescent self-control indicated that self-control remains stable from adolescence to adulthood, and better self-control was linked with good mental health and physical health in adulthood (Yang & Jiang, 2022). A longitudinal study on adolescent self-control, mental health problems and family functioning indicated that self-control and both internalizing and externalizing problems had moderate concurrent association (Kim et al., 2022). A meta-analysis on self-control indicated that there is a medium effect size of self-control on wellbeing indictors including interpersonal relationship (de Ridder et al., 2012). Better self-control helps in interpersonal relationship directly by refraining from behaviors due to impulsivity and indirectly by helping adolescence to resist temptation to involve in undesirable behaviors (Tangney et al., 2018). Self-control is also linked with trust which is an important element in establishing and maintaining interpersonal relationship. An experimental study indicated that people perceived about the self-control of other peoples and then use that perception to form judgment about their trustworthiness. Those people who were perceived to have higher self-control were judged as more trustworthy in interpersonal relationships (Righetti & Finkenauer, 2011).

The second executive function underlying behavioral self-regulation is self-monitoring which is often studied in intervention based studies to reduce mental health problems. Studies have indicated that ineffective self-monitoring is linked with ADHD and autism but it can be improved through interventions thereby reducing symptoms of ADHD and autism(Mahmoud Mirnasab et al., 2011; McKenna, 2020). A study on Chinese adolescents indicated that self-monitoring was a significant predictor of internalizing and externalizing problems (Nie et al., 2014). A review of self-monitoring in behavioral management indicated that self-monitoring is an essential component of various interventions including cognitive behavior therapy, motivational interviewing(J. A. Chen et al., 2017). Historically, self-monitoring has been studied extensively for formation and maintenance of interpersonal relationships including friends, romantic partners, and marriage. Those who have a tendency to self-monitor are able to adapt their behavior pragmatically thus enhancing interpersonal effectiveness while those having low self-monitoring follow their internal values and act according to their disposition rather than situational demands(Leone & Hawkins, 2006). The social cognitive model accounts self-monitoring as an important step for realistic goal setting and evaluation of one's progress towards the goal (Bandura, 1991). Thus, who are high in self-monitoring will be able to set realistic goals in various domains of life and works toward achieving them.

Emotional-Regulation, Mental Health Problems and Psychosocial Strengths

Emotional regulation is defined as a set of processes that serve to modulate, maintain, or enhance the intensity and valence of emotional experiences (Eisenberg et al., 2010). Executive functions related to emotional regulation are shift and emotional control. Shift is defined as ability to move freely from one situation to another, or from activity to another as the circumstances demands. The ability to shift require flexibility in problem solving, and switching attention as required (Gerard & Peter, 2013). For example the ability to shift one's attention easily as compared to inflexibility or rumination (McRae & Gross, 2020; te Brinke et al., 2021). Emotional control is defined as the ability to modulate emotional responses. For example those children who have less emotional control will have extreme emotional reactions to minor events, may have anger outbursts and frequent mood fluctuations(Gerard & Peter, 2013). Emotional regulation has been regarded as a trans-diagnostic risk factor for externalizing as well as internalizing problems including conduct related disorders, anxiety related disorders and depression (Aldao, 2016). A recent meta-analysis on self-regulation interventions effectiveness in early adolescents indicated emotional regulation as the most critical component for improving emotional and behavioral outcomes (Murray et al., 2022). Reduced cognitive reappraisal and increased use of negative rumination are particularly present across disorders (Cludius et al., 2020) including ADHD, Depression, Mood disorders, and suicidality (Paulus et al., 2021). Similarly, the use of effective emotional regulation is linked with psychosocial strengths in adolescents. Emotion regulation is an important regulatory skills necessary for effective interactions by shifting the attention to relevant subject matter/action, and having sufficient emotional control on one's feelings (Junge et al., 2020; Verzeletti et al., 2016; Young et al., 2019) . Longitudinal studies have indicated that suppression was predictor of weaker social connection for example less close relationships while reappraisal predicted stronger social connections (English et al., 2012). Another study indicated that emotional suppression predicted lower friendship satisfaction in adolescent males (Chervonsky & Hunt, 2019). Effective emotional regulation is linked with interpersonal effectiveness in close relationships (W. L. Chen & Liao, 2021) and prosocial behavior (Teuber et al., 2022). A study on emotional dysregulation and psychopathology in Pakistani adolescents indicated that emotional dysregulation explained significant variance in a range of mental health problems including anxiety, depression, anger, and borderline personality features and these effects more pronounced and statistically significant for girls as compared to boys (Zafar et al., 2021).

Cognitive-Regulation, Mental Health Problems and Psychosocial Strengths

Cognitive regulation is defined as regulation of one's own thinking processes and focusing one's attention on desirable goal (Santosh et al., 2015). The executive functions underlying cognitive regulations are task completion, working memory and planning/organizing tasks. These executive functions are regarded as "cool" executive functions because they require more logic and involve conscious control of thoughts and actions without an affective component (Poon, 2017). These skills are widely studied as predictor of academic performance indicating that effective cognitive regulation predict good academic performance as compared to other dimensions of self-regulation (Poon, 2017) A study on preschoolers executive functions indicated that deficits in working memory were related positively to in-attention problems, and negatively to adaptability and social skills (Romero-López et al., 2018). Working memory is found to be interfered by anxiety (Lukasik et al., 2019; Moran, 2016; Ward et al., 2020).Working memory deficits are regarded as common cognitive liability for mental health problems but particularly for externalizing disorders (Endres et al., 2011; Huang-Pollock et al., 2017).

Individual Differences in Self-regulation

Research has supported significant gender and age differences in self-regulation domains.

Girls are reported to have better regulatory skills compared to boys; female adolescents reported higher self-control, attention, and self-monitoring as compared to boys (Hagler et al., 2016; Shulman, Elizabeth et al., 2015; Tetering et al., 2020). A study on preadolescents reported that boys with high intelligence had better working memory and inhibition as compared to girls (Gómez-Pérez et al., 2020). A study on Dutch adolescents reported that early adolescents have better self-control, self-monitoring, and attention skills than middle adolescents. A systematic review on individual differences in hot and cool executive functions indicated that ability to inhibit a prepotent response, and set-shifting was developed by the age of twelve equal to an adult performance but the ability to inhibit that involve a higher cognitive load kept on developing after twelve years of age; similarly hot executive functions like impulse control and decision making continue to develop throughout adolescence (Fernández García et al., 2021). A meta-analysis on self-control indicated that age moderate the relationship between self-control and other outcomes variables such that there is stronger effect of self-control in younger samples. The study also reported that effects of self-control on desirable behavior was equal in boys and girls but for undesirable behaviors like eating disorder, school and work performance the effect in girls was smaller as compared to boys (de Ridder et al., 2012).

Rationale of Present Research

The present study attempts to address the existing gap in the literature by taking into account the multidimensional nature of self-regulation (behavioral, emotional, and cognitive) and linking these with mental health problems and psychosocial strengths simultaneously (internalizing problems, externalizing problems, interpersonal strength, intrapersonal strength, and family involvement). Exploring the relationship of several domains of self-regulation with mental health and psychosocial strengths can aid in designing strength-based curative and preventive interventions for adolescents (Genugten, Dusseldorp, Massey, & Empelen, 2016). Because significant gender and age related differences are reported in the development of self-regulation (Zelazo & Carlson, 2012) therefore, the present research aims to explore age and gender differences in the relationship of self-regulation and outcomes variables. There is scarcity of literature on the relationship of self-regulation, mental health and psychosocial strengths in Pakistan and mental health problems are higher in adolescents in Pakistan (Khalid et al., 2019). Based upon existing literature it is hypothesized that the three types of self-regulation (behavioral, emotional and cognitive) would significantly predict mental health problems and psychosocial strengths in such a way that ineffective self-regulation will be a positive predictor of mental health problems and negative predictor of psychosocial strengths(Eisenberg et al., 2017; te Brinke et al., 2021). Emotional regulation will be a strong predictor of internalizing problems and behavioral regulation will be a stronger predictor for externalizing problems (Desiree W. Murray et al., 2022; Zelazo & Carlson, 2012).

Method

Participants

The inclusion criteria for present research were age range from 11 to 18 years of age, no disability and diagnosed mental health problems, and living with parents. The sample consisted of 407 school-going adolescents (188 boys, 215 girls) ranging in age from 10 to 18 years (M= 15.08; SD= 2.03). The participants were further grouped into early (10 to 14 years old; n=137), middle (15 to 16 years old; n=158) and late (17 to 18 years, n=105) adolescents. Majority of the participants were from private schools (n=219, 53.8%). Participants lived in different provinces of Pakistan (Punjab= 170,41.8%; Balochistan = 17, 4.2%; Khyber Pakhtunkhwa=21, 10.1%; Gilgit Baltistan=28, 6.9%; Sindh= 21, 5.2%; Azad Jammu Kashmir= 50, 12.3%; Islamabad= 69, 17%). All participants were fluent in reading and speaking the Urdu language. Because data collection was carried out from December 2020 to September 2021, participants were also asked about whether they or any family member suffered from COVID-19

because it may impact mental health outcomes. Most (72.5%) participants reported that neither they nor their families had experienced COVID-19.

Assessment Measures

For the present research, scales were translated and adapted in Urdu language by following WHO guidelines (World Health Organization, 2010). Permissions to translate, adapt and using the questionnaire in study was taken from authors. Three forward translations were acquired by three independent persons, followed by a committee approach with psychology postgraduates to finalize the translations. Then, one back translation of the final version was acquired and compared with the original scale. Lastly, cognitive interviewing was carried out with ten participants to check their understanding and ease to complete the questionnaire.

Behavior Rating Inventory of Executive Function (BRIEF) (Gerard & Peter, 2013). The 55 items self-report version was used to measure self-regulation and its three subdomains i.e. Behavior Regulation Index (BRI), Emotional Regulation Index (ERI) and Cognitive Regulation Index (CRI). This scale can be used for children from 5 years to 18 years of age group. There are seven clinical subscales, namely inhibit and, self-monitor comprising BRI; shift and emotional control comprising ERI, and; task completion, working memory and plan/organize making CRI. The scale had good reliability estimates for subscales and overall scale ranging from .79 to .97 in the present study. High scores mean ineffective self-regulation, and lower score means effective self-regulation.

Behavior and Emotional Rating Scale (BERS-2) **(**Buckley & Epstein, 2004). This scale assesses behavioral and emotional strengths of children from 11 to 18 years of age. There are 57 items that measure five domains including interpersonal strengths (IS), intrapersonal strengths (IP), school functioning (SF), family involvement (FI), and career strength (CS). BERS has adequate test-retest reliability (.94) and internal consistency (α=.96). Scores are summed to generate subscale and total score where high score indicates more strengths and vice versa. For the present research IS,IP, and FI subscales were used. Interpersonal strength (IS) includes the ability of active listening, admitting mistakes, sharing, emotional maturity, and accepting consequences of one's behavior. Intrapersonal strength (IP) includes taking good care of self, asking for help when needed, having certain hobbies, self-awareness, belief in self, and positive affect. Family involvement (FI) includes following family rules, doing things with family, getting well along parents and siblings, and sense of connectedness with family and community.

Strengths and Difficulties Questionnaire (SDQ) (Goodman et al., 1998). The SDQ is a brief self-reported 25-item screening instrument for problematic behavior and prosocial behavior from 11 to 16 years of age group. There are five subscales each comprising of 5 items i.e., emotional symptoms, peer relationship problems (making up internalizing disorders) conduct problems, hyperactivity (making up externalizing disorders), and prosocial behavior. Each item is scored from 0 to 2 on a three-point scale. In the present research, Cronbach alpha estimate of internalizing subscale was .66 and .68 for externalizing subscale.

Procedure

Ethical approval was taken from the ethical board of the university of first and second author. For sampling, seven strata were made according to the provinces of Pakistan. Non-equal sample size was taken from each stratum, depending on the population size in each strata. The data of present study was collected via convenience sampling technique, as it was done during 2020 and 2021 lockdown when schools were closed; so participants were approached in their home. Written informed consent was taken from parents and assent was taken from participants separately. Participants read the questionnaire and filled it.

Statistical Analysis Plan. SPSS version 23 and AMOS version 24 was used for data analyses. Normality assumptions were checked by

histogram, normality probability plots, skewness and kurtosis. Box's M test, and Levene's test of equality of error variance were used to check equality of covariance matrices. Reliability analyses were used for measuring internal consistency of scales and subscales. Two way MANOVA was used to check age (early, middle, late adolescent groups), and gender (male, female) differences in self-regulation domains (BRI, ERI, CRI). Pillai's Trace was used to estimate the significant value because of homogenous variance in groups in multivariate testing. A p value of $\leq .05$ was used as statistically significant. Partial eta squared (η^2) was used as a measure of effect-size for the significant outcomes. Post-hoc analysis was used to check age differences in sub-domains separately with Bonferroni analysis using Scheffe correction because of unequal sample size in different groups.

Maximum likelihood method estimation was used in the path analyses. The absolute value of the skewness (±2), kurtosis (±7) and multivariate (≤8) was checked for normality assumption in path analyses and for the appropriateness of maximum likelihood estimation. Coefficient (Finney & DiStefano, 2006) . For checking model fit comparative fit index (CFI), Tucker-Lewis index (TLI), and approximate root mean square error of approximation (RMSEA) were used. A good model fit is achieved if the CFI and TLI values are above 0.90 and the RMSEA value ranges from 0.05 to 0.08, providing a reasonable and appropriate fit(Kline, 2015). For multiple group analysis chi-square values and p value was used to decide for the best model fit. Parameter constraint were used to check for group differences in the model using Chi-square significance test.

Results

Missing Data

There was 2% missing data in internalizing and externalizing scores and interpersonal strength scores. There was less than 1% missing in family involvement, BRI, ERI, and CRI composite scores. 1.7% data was missing in age, and 1% in the gender variable. Missing cases were excluded list wise in the analyses. The composite score of all subscales of every participant was computed if 80% data was filled per subscale. Missing data was pairwise excluded in the analyses. All analyses were performed excluding missing values (n=373).

Descriptive Statistics

Alpha reliability estimates of BRIEF subscales were good while reliability estimates of SDQ subscales was adequate. Previous studies on SDQ reliability and factor structure in Pakistan indicated similar reliability estimates in adolescents indicating that the negative items particularly lower downs the alpha level (Cecilia A Essau et al., 2017). Reliability estimates of BERS also falls in acceptable to good range The heterogeneity of present sample and high number of items in present survey could also be the reasons for some slightly low reliability estimates (Ursachi et al., 2015). Value of skewness and kurtosis were within range and indicating normal distribution of data (Table 1).

Table 1

Psychometric Properties of Study Scales and Subscales (N=373)

Scale	*α*	*No. of Items*	*M*	*SD*	*Range*		*Skew*	*Kurtosis*
					Possible	Actual		
BRI	.72	13	22.45	4.59	13-36	12-35	0.10	-0.69
ERI	.75	14	24.79	4.85	14-44	14-36	-0.08	-0.45
CRI	.86	23	38.52	7.90	23-69	20-59	0.08	-0.46
SDQ Internalizing	.64	10	6.01	3.35	0-20	0-16	0.40	-0.44
SDQ Externalizing	.68	10	6.22	3.41	0-20	0-15	0.25	-0.72
IS	.78	15	21.76	4.33	0-45	9-45	-0.31	0.14
IP strength	.59	07	12.41	3.70	0-33	6-33	-0.73	0.54
FI strength	.65	10	21.72	4.32	0-30	8-30	-0.48	-0.02

Note. BRI= Behavior Regulation Index; ERI= Emotional Regulation Index; CRI= Cognitive Regulation Index; IS= Interpersonal Strengths; IP= Intrapersonal Strengths; FI= Family Involvement. Actual range is lower than potential range because of missing data

Table 2 presents Pearson correlations among study variables. Results indicated that ineffective BRI, ERI, and CRI were significantly positively associated with internalizing and externalizing problems. It also indicated that ineffective BRI, ERI, and CRI were significantly negatively associated with interpersonal strengths and family involvement related strengths. Only ineffective CRI was significantly associated with intrapersonal strengths and BRI and ERI were not significantly associated with intrapersonal strengths.

Table 2

Correlations for Study Variables (N=373)

Variables	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1. BRI	1	.67**	.64**	.22**	.45**	-.32**	-.02	-.16**
2. ERI		1	.71**	.33**	.48**	-.25**	-.06	-.21**
3. CRI			1	.32**	.50**	-.31**	-.15*	-.26**
4. Internalizing				1	.63**	-.17**	-.20**	-.27**
5. Externalizing					1	-.32**	-.21**	-.30**
6. IS strengths						1	.57**	.54**
7. IP strengths							1	.56**
8. FI strengths								1

Note. BRI= Behavior Regulation Index; ERI= Emotional Regulation Index; CRI= Cognitive Regulation Index; IS= Interpersonal Strengths; IP= intrapersonal Strengths; FI= Family Involvement. *$p < .05$. **$p < .01$.

A two-way Multivariate Analysis of Variance (MANOVA) was conducted to check main and interaction effects of age (3 categories: 129 early adolescents, 144 middle adolescents, 93 late adolescents) and gender (2 categories: 168 boys, 198 girls) in BRI, ERI, and CRI. Results indicated significant gender and age differences in self-regulation. There was no significant interaction effect of age and gender in self-regulation (Table 3).

Table 3

Main and Interaction Effects of Gender and Age in Self-Regulation (n=373)

Variable	Pillai's Trace	*F* (*df*)	*p*	η^2
Gender	.04	5.24 (3,358)	.001	.04
BRI		4.24	.041	.01
ERI		9.51	.002	.03
CRI		.23	.634	.00
Age	.05	2.81 (6,718)	.010	.01
BRI		2.53	.080	.01
ERI		2.21	.111	.01
CRI		5.98	.003	.03
Gender*Age	.01	.72 (6,718)	.631	.00
BRI		.41	.665	.00
ERI		1.48	.229	.00
CRI		1.79	.168	.01

Note. BRI= Behavior Regulation Index; ERI= Emotional Regulation Index; CRI= Cognitive Regulation Index.

Test of between subject effects ndicated significant gender differences in BRI and ERI and non-significant gender differences in CRI. T–tests indicated that boys had better BRI than girls (girls *M*=23.02, *SD*= 4.34, boys *M*= 21.97, *SD*=4.79, *t*= -2.30, *p*=0.02, CI= -1.94- -0.15, Cohen's *d*=0.23). Similarly, boys had better ERI than girls (boys *M*=23.91, *SD*=5.05, girls *M*=25.68, *SD*= 4.48, *t*=-3.72, *p*<.001, CI= -2.71- -0.84, Cohen's *d*= 0.37). There were no significant gender differences in CRI (boys *M*= 38.08, *SD*=8.21, girls *M*=39.05, *SD*=7.44, *t*= -1.25, *p*=0.21). Tests of between subject effects indicated that there was a significant age difference in CRI, while there was no significant age difference in BRI, and ERI. Post hoc analysis revealed that early adolescents have more effective CRI as compared to late adolescents (*i-j*= -3.51, *p*=0.004, CI= -6.10 - -0.91). The effect size is small accounting for 2% difference in CRI. There was no effect of age in middle and late adolescents in CRI.

Path Analysis

Path analysis was used to analyze how BRI, ERI, and CRI predicts internalizing, externalizing problems and interpersonal, intrapersonal and family involvement related strengths in adolescents. A full model was tested which was then improved by removing non-significant regression pathways one by one and comparing model fit. The final model showed adequate fit indices $\chi 2$=37.23 (df=12, χ^2/df =3.10, p<0.001) , CFI=0.980, TLI=0.953, GFI= .976 and RMSEA=0.07 BRI had a significant direct effect on internalizing problems and externalizing problems and interpersonal strengths. ERI also had a significant direct effect on internalizing and externalizing problems. CRI had a significant direct effect on internalizing and externalizing problems, interpersonal strengths, intrapersonal strengths and family involvement related strengths (Figure 1). This model was then used for multigroup analysis.

Multigroup SEM

The gender differences in the relationship of BRI, ERI, and CRI and outcome variables were analyzed using multigroup analysis in SEM. First of all an unconstrained model (Model 1) which all regression pathways were free of constraints was

compared against a fully constraint model (Model 2) for both boys and girls. Model 1 was a configural model with free paths between boys and girls. The model fit indices indicated an adequate fit, χ^2=42.12, *df*=20, CFI=0.982, TLI=0.950, RMSEA=0.055 (CI_{90}=0.031, 0.078), AIC=146.119, and ECVI=0.394. Model 2 fit indices indicated an adequate fit, χ^2=49.30, *df*=31, CFI=0.985, TLI=0.973, RMSEA=0.040 (CI_{90}=0.016, 0.060), AIC=131.300, and ECVI=0.354. Comparisons across models indicated that the increase in chi-squared values ($\Delta\chi2$=7.181, p=0.784) was not statistically significant and changes in other model fit indices were small, indicating robust measurement consistency across the groups of boys and girls. This was further followed by constraining one regression path at a time and comparing chi-square difference. None of the path was statistically different in boys and girl.

Table 4

Path Analyses of BRI, ERI, and CRI as predictor of Mental Health Problems and Psychosocial Strengths in Adolescents

Paths	*Unstandardized Coefficients*	*Standardized Coefficients*	*S.E*	*t*	*p*
BRI→ Externalizing Problems	.134	.180	.038	3.56	<.001
ERI→ Externalizing Problems	.122	.173	.046	2.65	.008
CRI →Externalizing Problems	.112	.258	.028	4.03	<.001
BRI→ Internalizing Problems	-.039	-.053	.05	-.777	.437
ERI→ Internalizing Problems	.144	.208	.047	3.02	.002
CRI→ Internalizing Problems	.072	.17	.029	2.47	.014
BRI→ Intrapersonal Strengths	.106	.103	.075	1.419	.156
ERI→ Intrapersonal Strengths	.044	.045	.077	.572	.568
CRI→ Intrapersonal Strengths	-.089	-.148	.03	-2.89	.004
BRI→ Interpersonal Strengths	-.354	-.254	.069	-5.16	<.001
ERI→ Interpersonal Strengths	.035	.027	.098	.361	.718
CRI→ Interpersonal Strengths	-.114	-.140	.047	-2.43	.015
BRI→ Family Involvement	.037	.039	.067	.547	.584
ERI→ Family Involvement	-.061	-.069	.069	-.892	.373
CRI→ Family Involvement	-.14	-.257	.027	-5.12	<.001

Note. BRI= Behavior Regulation Index; ERI= Emotional Regulation Index; CRI= Cognitive Regulation Index.

Discussion

The primary aim of this research was to analyze relationships of three domains of self-regulation (BRI, ERI, CRI) with mental health problems (internalizing and externalizing) and psychosocial strengths (interpersonal strength, intrapersonal strength, family involvement) of adolescents. A secondary aim was to explore gender differences in this relationship.

Overall, results indicated that not all domains of self-regulation (BRI, ERI, CRI) were related to mental health problems and psychosocial strengths in a similar way. For example, internalizing problems were significantly predicted by ERI (.21**), and CRI (.17*) and BRI was not a

statistically significant predictor in the present sample (Table 4, Figure 1). These findings are consistent with findings from western literature indicating poor emotional regulation as a precursor of internalizing problems (Eisenberg et al., 2010; Loevaas et al., 2018; Young et al., 2019). ERI significantly predicting internalizing problems suggests that those adolescents who have ineffective emotional control and have problem shifting from one aspect/situation/problem to another as the situation demands, experience more internalizing problems as compared to those who have effective emotional control and can shift their attention swiftly as demanded. CRI which includes the ability to complete tasks on time, planning ahead, and holding information to stay on task also predicted internalizing problems in adolescents indicating that those adolescents who have ineffective skills to plan ahead, difficulty persistence on tasks and working with multiple information in a given time are more prone to internalizing problems (Table 4, Figure 1). These findings corroborate in previous findings about the impaired role of working memory in anxiety disorders, and depression (Lukasik et al., 2019; Moran, 2016; Tallon et al., 2016).BRI did not appear as a significant predictor of internalizing disorder in this research. This is consistent with research on adolescents from the Netherlands indicated that cognitive regulation style is more common in internalizing disorders and behavior regulation style is more common in externalizing disorders (te Brinke et al., 2021). Previous research indicated that poor inhibitory control, emotional control and shifting is the mechanism associating reactive aggression with internalizing disorders (White et al., 2013). This might suggest that emotional control and shift have more predictive power for internalizing disorders as compared to *self-monitoring* which is the component of BRI in the present study. Another study indicated that better hot inhibitory control which is defined as control during emotionally laden situations is a predictor of few internalizing disorders as compared to cool inhibitory control which is defined as control in a context where strong emotions are not involved (Lawler et al., 2022). The BRI measurement in the present research can be categorized as cool inhibitory control because it is measuring behaviors in situations where strong emotions are not mentioned in the items.

For externalizing problems which included conduct-related issues and hyperactivity, all three domains of self-regulation appeared as significant predictors. The strongest predictor was CRI (.26***), followed by ERI (.21**), and BRI (.18***) thus rejecting the second hypothesis of present research that BRI will be a stronger predictor for externalizing problems (Table 4, Figure 1). The ability to organize, plan, and task completion are defining characteristics of CRI. Adolescents suffering from externalizing disorders including ADHD, and conduct-related problems have difficulty in organizing, planning, and completing their tasks efficiently (Becker & Langberg, 2014; Toplak et al., 2008). The present results indicated that adolescents having problems in managing their emotions, shifting their attention, monitoring their behavior, and inhibiting it when required were more likely to experience externalizing problems as compared to those who have effective self-regulatory skills. This finding is also consistent with existing literature on self-regulation difficulties in externalizing disorders in western literature(Perry et al., 2018; White et al., 2013).

The present research also focused on analyzing how BRI, ERI, and CRI are related to psychosocial strengths in adolescents. The hypothesis of present research that all three domains will significantly predict three psychosocial strengths was partially supported because all domains did not significantly predict the strengths. Interpersonal strengths which include active listening, admitting mistakes and emotional maturity was significantly predicted by BRI (-.25***), followed by CRI (-.14*) (Table 4, Figure 1). These results are consistent with previous literature on the role of self-control in effective interpersonal relationships. Those individuals who have poor self-control will struggle in active listening, admitting their mistakes and less emotional maturity because of

acting on the impulses initiated by poor self-control and having ineffective planning and difficulty holding information which would certainly impact decision making (Baumeister, 2018; de Ridder et al., 2012).

In the present research Intrapersonal strengths was significantly predicted by CRI (-.15**) only and ERI and BRI were not significant predictors. Intrapersonal strength is operationalized as how adolescents view himself and his abilities. So, it appeared that effective task completion, effective planning and organization along with effective working memory will predict positive views about oneself as compared to when an adolescent has ineffective CRI.

In the present research, ERI was not a significant predictor of any psychosocial strength indicating that adolescent emotional control and shift are not significantly predicting their interpersonal, intrapersonal strength and family involvement in this sample. This finding is not consistent with Western literature which indicates that emotional regulation is linked to social competence (Murphy et al., 2004).

Present research indicated that girls had significantly ineffective emotional and behavioral regulation skills as compared to boys with small effect size (Table 3). In Pakistan, girls are socialized as emotionally feeble and sensitive while boys are socialized as being tough and emotionally strong (Khalid, 2021) and this might influence emotional and behavior regulation differently. Previous research has also found that girls experience more anger, sadness, and depression (Sanchis-Sanchis et al., 2020) and remain in stable externalizing trajectories (Perry et al., 2018) which is linked to ineffective ERI and BRI. A study on Pakistani adolescents also reported high anger, and difficulty in engaging goal directed activity which is consistent with the present findings of girls having less effective ERI and BRI (Zafar et al., 2021). There were significant age differences only in CRI in such a way that early adolescents reported to have more effective planning, working memory, and task completion skills as compared to late adolescents (Table 3). A recent study in Pakistan indicated that higher externalizing problems in later adolescents (Naveed et al., 2020). In collectivist culture like Pakistan, children are dependent on their parents for an extended period of time and parents take care of all home, and school related task. One plausible reason could be that in early adolescence more assistance is available and there is less pressure and demands that need to be managed and organized as compared to late adolescents. There was no significant interaction effect between age and gender for the differences in BRI, ERI, and CRI (Table 3). Although there were differences in regression pathways in path analysis but multi-group analysis indicated that these differences were not statically significant.

Limitations

There are some limitations of this research which need to be kept in mind while interpreting the results and which can be targeted in future research on self-regulation. Firstly, self-regulation was assessed using a self-reported scale i.e., BRIEF-2 and no task based behavioral assessment was done. Secondly sample was very diversified and this may be a reason of lowering the study power to detect significant differences.

Implications

The present research highlights the multidimensional nature of self-regulation and its differential linkages with mental health problems and psychosocial strengths in Pakistani adolescents. Targeting behavioral, emotional and cognitive regulation skills in schools, and intervention programs has the potential to improve mental health of adolescents in Pakistan, as in western countries. Absence of mental health problems is not complete wellness, rather positive emotional and behavioral strengths like interpersonal strengths, intrapersonal strengths are also important for positive youth development. Similarly, family involvement is a hallmark of Pakistani society, and it is also important for optimal psychosocial development of adolescents. There are significant gender and age differences which are further amplified by the cultural milieu,

thus both girls and boys need to be trained in effective self-regulatory skills. Girls may need more focus on effectively regulating their emotions and behavior than boys.

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