Self-Regulation in Low- and Middle-Income Countries: Challenges and Future Directions

Divna Haslam[1] · Anilena Mejia[2] · Dana Thomson[3] · Theresa Betancourt[3]

Abstract

Self-regulation is developed early in life through family and parenting interactions. There has been considerable debate on how to best conceptualize and enhance self-regulation. Many consider self-regulation as the socio-emotional competencies required for healthy and productive living, including the flexibility to regulate emotions, control anger, maintain calm under pressure, and respond adaptively to a variety of situations. Its enhancement is the focus of many child and family interventions. An important limitation of the self-regulation field is that most empirical and conceptual research comes from high-income countries (HICs). Less is known about the manifestation, measurement and role of self-regulation in many collectivistic, rural, or less-developed contexts such as low- and middle-income countries (LMICs). This position paper aims to present an initial review of the existing literature on self-regulation in LMICs, with a focus on parenting, and to describe challenges in terms of measurement and implementation of self-regulation components into existing interventions for parents, children and adolescents in these settings. We conclude by establishing steps or recommendations for conducting basic research to understand how self-regulation expresses itself in vulnerable and low-resource settings and for incorporating components of self-regulation into services in LMICs.

Self-regulation is an essential capacity for healthy development and functioning. Although conceptualized and measured in different ways, it encompasses the ability to plan, direct, and modulate one's own behavior, and to have appropriate coping skills and maintain positive social interactions taking into account other people's feelings and needs (Eisenberg et al. 2010; Lengua et al. 2008; Rothbart 2007; Schunk and Zimmerman 1997). Different concepts can be encompassed under the umbrella of self-regulation, some of which have a more behavioral definition (also known as "hot" traits) and some which have a more cognitive definition (also known as "cold" traits). Some of these concepts are emotion regulation (Cole et al. 2004), reflective functioning (Strack and Deutsch 2004), ego resiliency (Block and Block 2014), self-control (Hagger et al. 2010), effortful control (Eisenberg et al. 2004), grit (Duckworth and Gross 2014), executive function (Zelazo and Müller 2007), and mentalization (Fonagy et al. 2011). Regardless of its specific definition, the essential finding of 25 years of research is that self-regulation is associated with physical, mental, social and emotional health, increased academic performance, and better life outcomes (Blair 2003; Buckner et al. 2009; Gardner et al. 2008; McClelland et al. 2014; Moffitt et al. 2011; Ponitz et al. 2009; Sasser et al. 2015; von Suchodoletz et al. 2013).

The capacity to self-regulate develops during early childhood, and parents play an important role in this process both in terms of their own abilities and in helping their children acquire these important skills. Parents with the capacity to self-regulate may be better able to achieve parenting goals, respond calmly when children misbehave, and problem solve parenting challenges. As such parent-training programs should focus on enhancing parental self-regulation as well

✉ Divna Haslam
d.haslam@uq.edu.au

[1] Parenting & Family Support Centre, The University of Queensland, Brisbane, Australia

[2] The University of Manchester, Manchester, UK

[3] Boston College School of Social Work, Chestnut Hill, MA, USA

as using strategies that enhance childrern's self-regulatory capacity. Parents also play a significant role in providing children with the opportunity to develop self-regulation themselves. There is a vast body of research exploring the role of parents on the development of self-regulatory skills in children (Bernier et al. 2010; Dennis 2006; Karreman et al. 2006; Keller et al. 2004) and on the role of self-regulatory skills throughout the life course of an individual (Raffaelli et al. 2005; Simonds et al. 2007). There are numerous approaches to developing self-regulation in children. For example, Pandey et al. (2018) identified 5 categories of self-regulation interventions in their recent meta-analysis: (1) curriculum based, (2) mindfulness and yoga based, (3) family based, (4) social and personal based, and (5) exercised based. A full review of these is beyond the scope of this paper and may be addressed elsewhere in this special issue. We therefore limit our focus to parenting and family interventions.

Many parenting interventions are based on self-regulatory theory (e.g., Triple P Positive Parenting Program Sanders et al. 2014). However, little research has been conducted examining self-regulation as an outcome variable in parenting interventions. In fact, Pandey et al. (2018) only identified nine trials that used parenting training to make changes in children's self-regulation, which suggests more research on the specific ways in which parents can build their children's self-regulation capacities—and particularly in a way that can be replicated in interventions—is needed. Within the parenting domain, the principles of self-regulation have potential application at a range of levels including directly with children (e.g., as they develop emotional regulation and other skills), with parents (e.g., in developing problem solving abilities, identifying personal goals), with professionals delivering services (e.g., the ability to reflect and improve on skills), and even at a country level (e.g., governments and health service providers using self-determination to identify country specific needs and adapting existing programs).

In order to reduce duplication with other papers in this special edition, we also limit our focus to research conducted in low resources settings. In doing so we are faced with a difficult issue in defining low resource contexts as different researchers use different terms, all of which have unique explanatory uses. These include regional divides (i.e., the north–south divide or using the term "Western" to indicate high-income countries), cultural differences (i.e., collectivist versus individualistic), urban–rural divides, income divides (such as the World Bank high-, middle-, low-income categories) and finally setting-based classifications systems (i.e., formal or informal accommodations). We acknowledge these terms are not interchangeable and can indicate substantive differences even within a single country (e.g., different access to services in rural and urban areas in a middle-income country). However, for the sake of clarity we

use the term low- and middle-income countries (LMICs) to encompass all these areas for the purposes of this paper. We use these terms even if the research being cited used different terms. This is not without disadvantage, and we acknowledge some nuances may be lost. However, we argue that LMICs are qualitatively different from high-income countries (HIC) even when there is variation within and between these settings and the use of the World Bank classifications can aid in understanding for the non-specialist reader.

Self-regulation is a particularly important concept to consider in low- and middle-income countries (LMICs) given the vulnerable contexts in which children and families in these countries live. LMICs are characterized by poverty, low-quality education, inequality, poor access to basic services, home over-crowding, war, conflict and natural disasters. Consequently, children in LMICs are at greater risk of emotional, behavioral and physical difficulties (Grantham-McGregor et al. 2007; Patel and Kleinman 2003; Walker et al. 2007). Thus, the development of adequate self-regulatory skills in these contexts may be a potential pathway for positive social development, healthy functioning and community involvement later in life. In low-income settings in the USA, for example, self-regulation has been found to moderate the associations between poverty-associated stressors and poor outcomes (Blair 2010; Buckner et al. 2009; Evans and English 2002; Evans and Kim 2013). That is, children with better self-regulatory skills are more resilient to high-risk situations and have increased likelihood of better outcomes (Blair 2010; Blair and Raver 2012). In LMICs, self-regulation could similarly be a mechanism to reduce high rates of violence, crime, drug use and the humanitarian conflicts that maintain cycles of poverty and inequality. A recent Global Mental Health Movement has called for more research and implementation of evidence-based mental health interventions in LMICs in order to improve quality of life of its inhabitants and socioeconomic development in these countries (Collins et al. 2011; Patel et al. 2007). Self-regulation-focused interventions need to be considered under this umbrella.

Unfortunately, most research on self-regulation has been conducted in high-income countries (HICs). There is a significant amount of research on self-regulation with low income and ethnically diverse samples in HICs (Buckner et al. 2009; Crossley and Buckner 2012; Garner and Spears 2001; Hong 2012; Raikes et al. 2007; Raver 2012; Zalot et al. 2007). These families may be similar to families living in LMICs when viewed as a microsystem. For example, parents in HICs and LMICs are both likely to want the best for their children and experience parenting-related challenges in terms of getting children to behave in particular ways. This may explain why Gardner et al. (2016), in their meta-analysis of parenting programs across countries, found programs transported well (or better) to LMICs in terms

of effect size when delivered as a part of clinical trials. However, the differences between HIC and LMICs in the macro-system (i.e., educational, health and social services) and the levels of poverty in which vulnerable children in HICs live are not comparable. We argue more research is needed directly in LMICs to take into account the key contextual factors of LMICs. In general, LMICs have far fewer health and clinical support services, higher financial and food insecurity, higher levels of government corruption and high levels of poverty, which means families do not always have access to such basic amenities as clean water, access to health care and education. LMICs also often vary from HICs as a function of culture. Culture is an important factor to take into account. It may be that self-regulation manifests differently in LMICs. LMICs are often countries with a different culture to HICs. Most LMICs are characterized by a collectivist culture with fewer boundaries within the family and between community members and where there is less focus on teaching children independence (Greenfield and Cocking 2014; Triandis 2001). Later in the paper, we will discuss the concept of "collective regulation" as a potential new definition for LMICs.

In light of the amount of research in HICs that supports the importance of self-regulation for healthy child development, and given the potential of this construct to improve the lives of children in LMICs and to promote social development in these countries, the aim of the present paper is to briefly review the literature on self-regulation in LMICs and to establish challenges and future directions in the field. Specifically, we will explore challenges with the concept of self-regulation in terms of (1) definition, (2) measurement and (3) implementation of interventions in LMICs. We will conclude by providing a set of steps or guidelines for implementing self-regulation-focused interventions in LMICs or for adding self-regulatory elements to existing psychosocial interventions implemented in these settings.

What Do We Know About Self-Regulation in LMICs?

In order to state challenges and future directions, it is key to firstly establish the state of the field in LMICs. This review is not intended to be systematic, but rather an initial, rapid and pragmatic search of the existing literature on self-regulation in LMICs (Featherstone et al. 2015; Harnan et al. 2015; Tricco et al. 2017). We acknowledge that our search terms are restrictive. For example, we decided to focus on "self-regulation" and "emotion regulation", and left out of our search other common terms such as "executive functioning", "self-control", "reflexivity", "impulsivity" or "mentalization." Importantly, we only searched a limited number of databases mainly publishing research in English

and Spanish. However, one key finding of our search is that we were unable to find an existing systematic review of self-regulation in LMICs. Thus, this rapid, pragmatic and initial search allowed us to make an important first statement: our main recommendation is investing in conducting a systematic review of studies exploring manifestation and outcomes associated with self-regulation (and its associated concepts) in low- and middle-income countries, as well as interventions addressing self-regulation, including regional databases in languages other than English.

Our initial, rapid and pragmatic search was conducted in 4 databases: (1) Medline EBSCO hosted, (2) Psych-Info, (3) ERIC Education Database, (4) Lilacs and (5) Scielo. The latter two are regional databases from Latin America given that the first author of this paper works in this region and is fluent in Spanish. Our search terms were ["self-regulation" OR "emotion regulation"] AND ["low income"]. A total of 149 titles were retrieved in Medline, 114 in Psych-Info, 1268 in ERIC, 4 in Lilacs and 1 in Scielo. Eleven papers addressing self-regulation in a LMIC as a central concept or an outcome measure were found. One of these papers was from Medline (Baker-Henningham et al. 2016), 2 from Psych-Info (Kliewer et al. 2017; von Suchodoletz et al. 2015), 1 from Lilacs (Arán-Filippetti and Minzi 2011), and 5 from ERIC (Gündüz et al. 2015; Ivrendi 2016; Morelen et al. 2011; Orta et al. 2013; Yagmurlu and Altan 2010). Two papers were known to one of the authors but did not appear in any of our searches (Hong et al. 2009; Sun and Tang 2017). See Table 1 for a summary of papers.
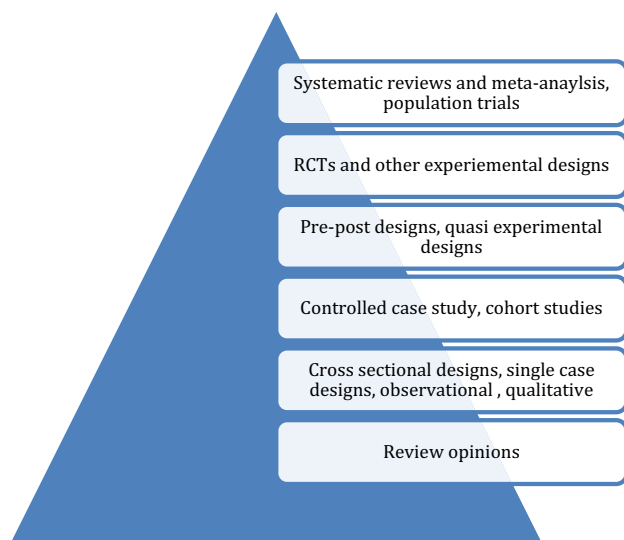
Levels of Evidence

In the next section, we present the results of our pragmatic search. Prior to this, we find it useful to review the issues associated with research in LMICs. Numerous hierarchies or pyramids of evidence exist for different disciplines. As an example, see the Centre for Evidence-Based Medicine hierarchy, which places systematic reviews with homogenous studies at the top and expert opinion at the bottom with small scale RCTs in the middle (http://www.cebm.net). In Fig. 1, we present a more generic conceptualization of evidence strength of well-conducted studies of different designs that includes case studies and cross-sectional designs that are often not included in the medical literature papers on levels of evidence (e.g., Burns et al. 2011).

In HIC, the expectation of evidence is high and numerous well-designed, high-quality studies are published and meet the criteria for strong levels of evidence. This is not the case in LMICs where the challenges associated with conducting research or delivering interventions (e.g., the lack of experienced researchers, low funding, literacy issues) can be prohibitive (Mejia et al. 2017). However, high-quality research

Table 1 Summary of studies found in initial search

Year	Author	Country	Design	Instrument to measure self-regulation	Aspect of self-regulation measured
2015	von Suchodoletz and colleagues	Albania	Cross-sectional	Performance based: Head–Toes–Knees–Shoulder Task (Cameron Ponitz et al. 2009), the Pencil Tapping Task (Blair and Razza 2007) and Watch-and-Wait Task (Neubauer et al. 2012) Teacher reported: Child Behavior Rating Scale (Bronson et al. 1995) Parent reported: Children's Behavior Questionnaire (Putnam and Rothbart 2006) and the Emotion Regulation Checklist (Shields and Cicchetti 1997)	Inhibitory control, self-regulation in academic tasks, effortful control and emotion regulation
2013	Orta and colleagues	Turkey	Cross-sectional	Parent reported: Emotion Regulation Checklist (Shields and Cicchetti 1997) adapted for Turkey	Emotion regulation and dysregulation
2010	Yagmurlu and Altan	Turkey	Cross-sectional	Parent reported: Emotional Regulation Checklist (Shields and Cicchetti 1997) adapted for Turkey Teacher reported: Emotional Regulation Checklist (Shields and Cicchetti 1997) adapted for Turkey	Emotion regulation
2015	Gunduz and colleagues	Turkey	Cross-sectional	Performance based: Peg Tapping Task (Diamond and Taylor 1996) adapted for Turkey Parent reported: Children's Behavior Questionnaire (Rothbart et al. 1994) adapted for Turkey (Batum and Yagmurlu 2007)	Effortful control and executive function
2011	Irvendi	Turkey	Cross-sectional	Performance based: Head–Toes–Knees–Shoulders test (Ponitz et al. 2009) adapted for Turkey (Ivrendi 2011)	Self-regulatory skills
2017	Kliewer and colleagues	South Africa	Cross-sectional	Adolescent reported: Children's Emotion Management Scale (Zeman et al. 2002)	Emotion dysregulation
2016	Baker-Henningham and colleagues	Jamaica	Protocol of a cluster RCT	Performance based: Adaptations of the Day-Night Stroop Test (Gerstadt et al. 1994) and of the Bear/Dragon test (Carlson et al. 2004)	Inhibitory control
2009	Aran-Filippetti and de Minzi	Argentina	Quasi-experimental	Performance based: MFF-20 (Cairns and Cammock 1978)	Reflexivity and impulsivity
2009	Hong and colleagues	China	Cross-sectional	Self-reported by 7th and 11th graders using an instrument by O'Neil et al. (1992)	Meta-cognitive strategies
2017	Sun and Tang	China	Cross-sectional	Performance based: Tapping task (Diamond and Taylor 1996)	Self-regulation
2011	Morelen and colleagues	Ghana and Kenya	Cross-sectional	Self-reported: Children's Anger and Sadness Management Scales (Zeman et al. 2001)	Effortful control of anger and sadness

Fig. 1 Levels of evidence

conducted in HIC does not always translate to LMICs where the context and people can be very different. Therefore, studies with a traditionally low level of evidence can contribute to our understanding. Cross-sectional studies, for example, can provide baseline data; they can help test hypotheses about relationships and establish correlational patterns of variables all of which can be used to build theory and inform future studies. Similarly, quasi-experimental studies might be a suitable test for the transportability of importing a program from a HIC and a stepping stone to a full-scale RCT. In the next section, we present the results of our search grouped by evidence level (low vs. high).

Low-Level Studies

The first paper describes a study conducted with 150 Albanian children aged 4–5 years old (von Suchodoletz et al. 2015). The aim was to establish the relationship of self-regulation and educational outcomes such as emergent vocabulary and math skills. Interestingly, the authors measured self-regulatory skills of children across different contexts based on the assumption that the family and the classroom place different expectations and demands on children and provide different levels of support. Self-regulation was measured using performance-based instruments consisting of four tasks that children completed individually in a standardized laboratory-like setting. These were the Head–Toes–Knees–Shoulder Task (Ponitz et al. 2009) and the Pencil Tapping Task (Blair and Razza 2007) to measure inhibitory control, and the Watch-and-Wait Task (Neubauer et al. 2012) to measure self-regulation. Although two of the three tasks showed good internal consistency in this Albanian sample (Head–Toes–Knees–Shoulder Task

had $\alpha = 0.85$; Pencil Tapping Task had $\alpha = 0.91$; no internal consistency reported for the Watch-and-Wait Task), they were originally created in HICs and no process of cultural adaptation/cultural fit took place. Teachers completed the Child Behavior Rating Scale (Bronson et al. 1995) to measure self-regulation in academic tasks. Parents completed the Children's Behavior Questionnaire (Putnam and Rothbart 2006) to measure effortful control and the Emotion Regulation Checklist (Shields and Cicchetti 1997) to measure emotion regulation. Again, cultural fit of these measures developed in HICs was not explored in this Albanian sample. Parents reported self-regulation of their children at home, while teachers reported self-regulation of their children in the classroom. Thus, authors collected measures of self-regulation in three different contexts: laboratory, the classroom and the home. Moderate relations among self-regulatory processes across different contexts and raters indicate self-regulation may generalize across settings. Emergent vocabulary and math skills were also measured. Results suggest that measures of self-regulation were related to emergent vocabulary and math skills. (Math and performance-based self-regulation was $R = .66**$; vocabulary and assessor-rated self-regulation was $R = 0.22**$), with the exception of parent-reported self-regulation at home. Study limitations must be noted. This paper gives rise to two important questions. First of all, the sample was of high-income children in Albania recruited from early education centers. In addition, the authors stated that most low-income children in Albania do not have access to such early education programs. Thus, although this study was conducted in a LMIC, the findings cannot be extended to Albanian children from urban informal settlements and rural less developed communities. Much more research with typical at-risk populations in LMICs contexts is needed particularly in countries where there are high levels of income disparity. Secondly, all instruments for measuring self-regulation were developed in HICs and no validation for an Albanian context was mentioned in the paper. Whether or not self-regulation expresses and manifests itself similarly in diverse cultures remains unanswered. It is key to explore this question and ensure that the validity and reliability of instruments are examined as they are extended across new settings and cultures. Mixed methods research may be useful to ensure that relevant local processes, and relationships are not overlooked (Betancourt et al. 2011).

A second set of studies was conducted in Turkey. We will describe these four studies, all found in the ERIC database. The first one was a cross-sectional study with $n = 1118$ preschoolers to examine whether emotion regulation/dysregulation-mediated associations between maternal responsiveness and child's effortful control and (a) child's social competency and (b) child's externalizing symptoms (Orta et al. 2013). In sum, maternal responsiveness did predict

child's effortful control, which in turn predicted emotional dysregulation in the child. Emotion dysregulation predicted high externalizing symptoms and lower social competency, while emotion regulation was only associated with social competency. Emotion regulation was not found as a mediator of maternal responsiveness, child's effortful control and child's externalizing behavior and social competency. Emotion regulation was measured with the Emotion Regulation Checklist (ERC; Shields and Cicchetti 1997). Unlike other studies discussed in this paper, they used a Turkish version of this instrument. This Turkish version had items removed that did not ask the rater to evaluate the appropriateness of the emotional response given contextual demands/expectations. The absence of this scale makes it difficult to compare results with other countries and speaks to a much broader issue related to measurement in LMICs, namely that measures developed in HICs are not always appropriate and alternative well-validated measures for LMIC contexts are lacking. Internal consistency was $\alpha = 0.71$. In a second study, also in Turkey, authors explored the role of maternal socialization and temperament on children's emotion regulation (Yagmurlu and Altan 2010). In this study, $n = 145$ preschoolers, their mothers and teachers were assessed. As with the previous study, participants were from middle- to high-income socioeconomic backgrounds. Mothers and teachers completed the ECR (Shields and Cicchetti 1997) and its Turkish version as in the previous study. The ECR had an adequate internal consistency with $\alpha = 0.75$ for the mother-reported version and $\alpha = 0.84$ for the teacher-reported version. Results suggested that maternal socialization and inhibited temperament were significant predictors of emotion regulation in preschoolers. In a third study, executive function and effortful control were assessed in $n = 217$ Turkish preschoolers (Gündüz et al. 2015). Authors explored if these self-regulatory skills were mediators of parenting practices and children's socio-emotional competence. Again, the sample was of middle to high-income participants from this middle-income country. Findings should be understood in light of this socioeconomic context that is different to that of many studies conducted in rural villages or informal settlements in low-income countries. To measure executive function, authors used the Peg Tapping Task (Diamond and Taylor 1996). Effortful control was measured with the Children's Behavior Questionnaire (Rothbart et al. 1994) that was adapted for Turkish mothers (Batum and Yagmurlu 2007) and had an adequate internal consistency in this sample ($\alpha = 0.79$). Results suggested that effortful control was a moderator of parenting practices and children's socio-emotional competence. Executive function was not found as a significant mediator. The fourth and final study conducted in Turkey explored whether children's engagement in different forms of play were related to their self-regulatory and number skills (Ivrendi 2016). Participants were

$n = 149$ children from low- to middle-income backgrounds. The Head–Toes–Knees–Shoulders test (Ponitz et al. 2009) was used to measure self-regulation. In this study, they used a Turkish adaptation of the measure (Ivrendi 2011). This Turkish adaptation went through test–retest procedures with a reliability of .79. Results from the study suggested that children's engagement in peer play significantly improved their chances of having better self-regulatory skills. In particular, interactive play significantly contributed to children's self-regulation, although child age, family income and social skills were also significant predictors. In sum, this series of Turkish studies suggest that self-regulation is related to positive outcomes in children from this LMIC and is influenced by parenting practices. An interesting aspect of the research conducted in Turkey is that most studies used measures validated for this particular context.

A different cross-sectional study was conducted with South African adolescents (Kliewer et al. 2017). A total of $n = 324$ South African adolescents (mean age = 13 years) were assessed to explore socio-demographic risk and behavioral adjustment and included emotion dysregulation as a potential moderator or mediator of risk-adjustment links. Emotion dysregulation was found as a partial mediator of socio-demographic risk (e.g., low income) and internalizing difficulties, externalizing difficulties and drug use. In other words, socio-demographic risk was associated with impaired emotion dysregulation, which, in turn, was linked to behavioral and emotional difficulties. One of the strengths of this study is it did include a high proportion of low-income adolescents. Approximately 33% of the sample lived with less than $250 per month and the median household income was $350 per month. Psychosocial risk included measures of poor housing quality, size of household, family stress, maternal mental health problems, exposure to community violence and peer victimization. However, similarly to the Albanian study, measures of self-regulation developed in a HIC were used, specifically the Children's Emotion Management Scale by Zeman et al. (CEMS; 2002) to measure anger and sadness coping regulation skills as reported by adolescents. Internal consistency was good for the CEMS ($\alpha = 0.81$) in this study, but no process for cultural adaptation of the measure was described. We are not trying to convey that existing measures developed in HICs are inappropriate. Internal consistency and correlation with expected outcomes can play a role in helping to provide support for a measure in new cultural settings, but qualitative research to investigate the cultural relevance of a measure is also required (Prince 2008). Also, it is key to mention that the instrument used to measure self-regulation in this study was short and easy to implement. This has pros and cons. Brief and simple instruments are particularly appropriate for low-income samples with low-educational levels. However, self-regulation is a concept that should be measured in different contexts and

ideally, using different informants (McClelland and Cameron 2011).

Two studies found were conducted in China. The first one (Hong et al. 2009) examined differences amongst students from different grades, gender and academic achievement levels in terms of homework task value (utility value, intrinsic value), motivational outcome (effort, persistence) and meta-cognitive strategy use (planning, self-checking). The sample was composed of 805 students from 7th and 11th grade. All measures were self-reported by students. The aspect of self-regulation measured was "metacognitive strategies" using a "well-established instrument" developed in the USA (pp. 271) (O'Neil et al. 1992). Internal consistency of sub-scales of the instrument in this sample was moderate. For 7th graders, internal consistency was $\alpha = 0.55–0.81$ and for 11th graders it was $\alpha = 0.57–0.78$. In both grades, the sub-scale of "planning" had Cronbach alpha coefficients of $\alpha = 0.55$ (7th grade) and $\alpha = 0.57$ (11th grade). Although the authors mentioned adaptation of the instrument, it was not adapted for the culture, but rather to fit homework situations (i.e., context). The method for adaptation is not described in the paper. Findings from this study suggest there is no difference in metacognitive strategies used by males and females. However, achievement level was lower in those that reported less metacognitive strategies. This only applied to 7th graders and not to 11th graders. Interestingly, this study measured a different form of self-regulation, metacognitive strategies, and linked it to academic outcomes. However, as with other studies, instruments and its adaptation process were not well described.

The second study in China (Sun and Tang 2017) explored maternal scaffolding and the development of self-regulation in preschoolers. A sample of 33 children completed the tapping task (Diamond and Taylor 1996) to measure self-regulation. However, unlike other studies, this task was adapted because previous research by the authors suggested that Chinese children usually perform well in this task and a ceiling effect is easily reached. Thus, in this study, the task was completed in a second occasion with two objects instead of one. Internal consistency of the task was high ($\alpha = 0.94$). Results suggested that maternal cognitive assistance and positive feedback was positively associated with children's self-regulation. This study is a good example of adapting a HIC measure for a LMIC culture. However, most Chinese children in this sample did easily well in this task. There might be several explanations for this. Firstly, it is possible that Chinese children use different self-regulatory strategies (and have different difficulties) than children from HICs. A second possibility is that Chinese children are better at self-regulation (as defined in HIC contexts) and further research needs to explore mechanisms behind enhanced self-regulation in Chinese children. Finally, an alternative possibility is that self-regulation manifests itself differently across cultures. Thus, different measures need to be developed and validated to measure this construct across contexts.

The final study compared children from Ghana, Kenya and the USA (Morelen et al. 2011). A sample of 105 Ghanian children from a rural village, 142 Ghanian children from a middle-class urban context, 106 Kenyan children from an impoverished urban context and 170 American children from lower-middle class urban areas completed the Children's Anger and Sadness Management Scales (Zeman et al. 2002) to assess emotion regulation of anger and sadness. Children were 8–15 years old. In this study, emotion regulation was defined as effortful control over these two emotions. The idea was to compare findings across nations and genders. Unlike other studies, authors re-labeled the scales to reflect neutral descriptors and conducted factor analyses to determine whether the original structure of the instrument was retained with this new sample. Besides checking the factor structure and re-labeling the scales, no further adaptations were made. The original factor structure of the scale did not fit the new sample, and some items were removed resulted in a revised scale structured used with both African and American samples. Results suggest that Ghanian children reported less anger inhibition than Kenyan and American children. American children reported being more constrained over sadness than Kenyan and Ghanian children. Comparing different regional contexts in Ghana, village children reported more anger control than urban children. Across nations, boys reported more control over sadness than girls and less control over anger. The innovative aspect of this study is that it compared children from two LMICs with children from a HIC. In addition, it compared children from urban and rural settings in a LMIC.

Moderate- and High-Level Studies

The first studies discussed were cross-sectional and explored self-regulation as a mechanism linked with academic, behavioral and emotional outcomes in children and adolescents. Next we outline the findings of the two experimental studies found. The first is the protocol of a cluster randomized controlled trial conducted in Jamaica of a classroom intervention implemented to prevent violence (Baker-Henningham et al. 2016). The intervention implemented was the Irie Classroom Toolbox that is based on the Incredible Years Teacher Training Program. This is a socio-emotional learning package implemented by teachers in the classroom. The program includes training for teachers to partner with parents, develop positive relationships with children, use praise and rewards to motivate children, prevent and manage inappropriate behavior and teach social skills, problem solving and anger management in the classroom. The trial involved implementation and evaluation of the intervention in 24 preschools selected randomly from those meeting inclusion

criteria and located in urban areas in Kingston. Interestingly, in this protocol paper they identified children's self-regulation skills as a secondary outcome of interest. They proposed a performance-based instrument for measuring a particular aspect of self-regulation, inhibitory control or the ability to suppress impulsive thoughts and resist distractions. Play tests that include sounds and pictures were supposed to be used. These were adaptations of the Day–Night Stroop Test (Gerstadt et al. 1994) and of the Bear/Dragon Test (Carlson et al. 2004). These measures were developed in HICs, and although authors of this trial mentioned adaptation of the measures, it is not clear who and how they adapted these instruments, and whether the adaptations were made for the Jamaican context or previously for a different context. Results from this trial are published (Baker-Henningham and Walker 2018); however, the effects of the intervention on children's self-regulation (i.e., inhibitory control) are not reported in their findings. It is not clear whether they ultimately assessed self-regulation and if so, whether the intervention had an effect on it. We contacted the author to clarify and were advised they did measure children's inhibitory control and found intervention effects. A publication outlining these results will be forthcoming (Personal Communication, Baker-Henningham, 21st November, 2018). This is promising. However, we await further details in the publication.

The second intervention study was conducted in Argentina. It describes the evaluation of an intervention to increase reflexivity and reduce impulsivity in children 6 years of age (Arán-Filippetti and Minzi 2011). The study is quasi-experimental with measures at baseline and post-intervention. The sample was composed of 110 children from 2 schools in poor urban neighborhoods. They used the Matching Familiar Figures Test 20 (MFF-20; Cairns and Cammock 1978) that is a problem-solving test to specifically measure reflexivity and impulsivity in children. The intervention was developed by the authors and delivered over 35 sessions (3–4 per week) of 30 min each. Facilitators were a psychologist and the classroom teacher. Unfortunately neither the content nor logic model of the intervention was clearly described in the paper. The intervention did include a standardized workbook for children to increase planning and self-instruction and facilitators used modeling and praise in an attempt to increase reflexivity and reduce impulsivity in the classroom. There were significant differences in reflexivity and impulsivity as measured with the MFF-20 in the intervention group before and after the intervention but no differences in the non-randomized comparison control. There were also significant differences between children that received the intervention and those that did not at post-intervention. Although the evaluation of the intervention was not rigorous, given difference in sample sizes between intervention ($N=47$) and control groups ($N=63$) and lack of randomization, this study is novel as it is one of the few that have tested an intervention designed specifically to target self-regulation in children from poor urban neighborhoods in a LMIC. Although promising, the intervention was lengthy (35 sessions) and is therefore unlikely to be fully scalable in low-resource settings where finances are limited (Meija et al. 2017). For comparison, the family checkup program implemented in the USA found improvements in children's self-regulation with an average of 98 min per child (implemented at a school level) (Fosco et al. 2013). Additionally as discussed with reference to other studies in this paper, the instruments used were designed in HIC assuming that self-regulation manifests similarly in LMICs. There is no evidence these instruments are appropriate, reliable and valid for use with children in LMICs.

What are the Challenges in the Field of Self-Regulation in LMICs?

Our initial search of the literature on self-regulation in LMICs highlights the paucity of research on the topic. We acknowledge our search was not systematic and did not include regional databases published in other languages beyond English and Spanish. However, it is clear that more research in this area is needed before we can fully understand self-regulation in a LMIC context. Interestingly, there are a growing number of evaluations of parenting and psychosocial programs for children and adolescents in LMICs, especially to prevent violence, child maltreatment, behavioral and emotional difficulties (Kliewer et al. 2017; von Suchodoletz et al. 2015). Unfortunately, many of the programs widely implemented have not included measures of self-regulation in children as a potential mechanism of change or primary outcome of parenting and psychosocial interventions.

Important questions yet to be answered are (1) whether self-regulation manifests itself and can be measured in the same way in LMICs that it is in HICs, (2) whether self-regulation can similarly be linked to positive outcomes in LMICs in the same what that it is in HICs, and (3) how interventions can be designed to improve self-regulation in LMIC contexts.

A body of research suggests that LMICs have a collectivistic culture where decisions are made much more interdependently than in HICs (Brew et al. 2001; Tjosvold et al. 2003). There are differences in historic, linguistics, and cultural backgrounds between LMICs and HICs related to how they value different social behaviors (e.g., Chen and French 2008). For example, collectivist cultures might value a family model that emphasizes psychological interdependence. Children who are modest and obedient, as well as socially attentive to the needs of the family or community as a whole, may receive more positive feedback. In contrast,

more individualistic cultures might value a family model of independence and self-reliant orientation that is characterized by "interpersonal separation" (Kagitcibasi 2005, 2013, 2017).

Although there are many definitions for self-regulation and empirical research from LMICs suggest different aspects of it can be measured (e.g., inhibitory control, reflexivity, emotion regulation, metacognitive strategies), most would argue that self-regulation entails autonomy, self-control and appropriate regulation of one owns emotions. This conceptualization may fit individualistic cultures better and may be more consistent with parenting emphasis common in HICs. It is possible that regulation in LMICs is more collective and less individualistic. Collective efficacy is an important concept that could overlap with self-regulation in LMICs and be more predictive of positive outcomes in these settings. Collective efficacy is a form of "collective regulation" that refers to communities' capacity to control and/or direct the behavior of individuals and groups in order to create safe and orderly environments (Bandura 2000). This concept has mainly been explored in low-income neighborhoods in Chicago (e.g., Morenoff et al. 2001; Sampson et al. 1999). We are not arguing that "collective efficacy" should be a new re-conceptualizing of "self-regulation" for LMICs but rather that researchers need to recognize that there are potentially overlapping aspects of these two concepts (i.e., collective efficacy and self-regulation) as well as their varying roles in different cultures. For example, self-regulation could potentially be more predictive of positive outcomes (and thus having more potential as an intervention target) in individualistic cultures, while collective efficacy may be potentially more predictive of positive outcomes (and thus having more potential as an intervention target) in LMIC contexts. Nevertheless, we want to be careful with our statements. Self-regulation mainly involves autonomy or self, but it also involves attentiveness to others' emotions and differing contexts. There is research that suggests collectivist cultures manifest autonomy and independence too (Raeff 2010; Tamis-LeMonda et al. 2007). Thus, the issue of individualistic versus collectivistic traits is not black and white. What we are arguing in this paper is that most research on self-regulation in LMICs to date has used measures and conceptualizations that come from the HIC. A new direction would be to conduct observational and qualitative research to establish if (1) "collective regulation" manifests itself in LMICs, (2) can be measured quantitatively, (3) is more prevalent than self-regulation, and (4) is better linked to positive outcomes. It would also be important to examine whether collective regulation is present in HIC with collectivist cultures (e.g., Japan). This would assist in disentangling collective regulation related to cultural values from the role of income.

Although we are proposing that self-regulation might manifest differently in LMICs, there is consistent evidence

from HICs that self-regulation is a key mechanism associated with improved mental, physical and cognitive adjustment of children. Thus, another important issue to consider is whether self-regulation is similarly associated with positive outcomes in LMICs, and if so what are the best methodologies for either (1) increasing evaluation and access of self-regulation-focused interventions in these settings or (2) incorporating self-regulation components into existing interventions. The study in Argentina (Arán-Filippetti and Minzi 2011) suggests that self-regulation-focused interventions can be developed from within these countries which has the advantage of being culturally relevant. However, developing, testing and disseminating interventions in each country can be costly. It is also possible to transport existing interventions from HICs, as recent meta-analyses suggest that transported interventions are as effective as those developed from within countries (Leijten et al. 2016). Although this meta-analysis refers to parenting interventions, it suggests the possibility of adding "booster" self-regulation sessions to parenting interventions and school-based socio-emotional learning packages (SEL) already implemented in LMICs. It is key that these processes of refinement of existing interventions are done with rigorous methodologies such as SMART and MOST that would allow to test if adding new components is actually more efficacious than the original intervention (Collins et al. 2007, 2014).

In Fig. 2, we summarize the challenges discussed in this section. As shown, we believe these challenges should be addressed as a series of iterative steps in order to reduce gaps in self-regulation research in LMICs.
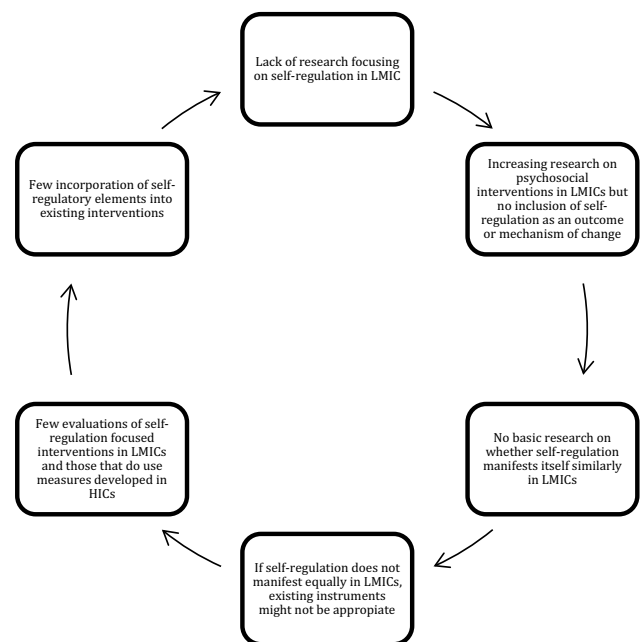

Fig. 2 Challenges in self-regulation research in LMICs

What are the Next Steps in Self-Regulation Research in LMICs?

It is apparent that research on self-regulation in LMICs is scarce and more targeted research is needed. There are several basic questions yet to be answered. Do different aspects of self-regulation manifests equally in LMICs given their collectivist culture? Could other concepts such as collective efficacy be incorporated into the definition of self-regulation? Are instruments from HICs applicable and appropriate to LMICs? When is the best developmental period for implementing these interventions in LMICs? And in what contexts (schools, family or community-based settings) might implementations be most effective? It is also important to develop, evaluate and implement self-regulation-focused interventions in these settings or add "booster" self-regulation sessions to existing psychosocial interventions already being implemented. Self-regulation needs to be measured not only as a mechanism of change but also as a primary outcome. Examining self-regulation as an outcome measure is needed to add to the evidence regarding how to improve self-regulation in cost effective ways. By merely tracking self-regulation without improving it we limit the potential positive impact of high self-regulation. This is particularly important given many parenting interventions based on self-regulation theory have not actually empirically tested if self-regulation improves as a results intervention completion. However, we argue that without answering basic research questions first (i.e., about manifestation, culture, measurement and context), research examining the efficacy of interventions aimed at improving self-regulation in children and adolescents in LMICs could be confounded.

We want to make two final suggestions. Firstly, that the development or adaptation of instruments and interventions appropriate to LMICs need to be made in collaboration with communities using participatory research to ensure consumer and cultural fit. Consumers of interventions (parents, children and adolescents) should be part of the process that determines best formats, length and content of such instruments and intervention packages to be assessed. Combining consumer input with efficacy-focused research is needed. Finally, if self-regulation-focused interventions are implemented in LMICs, it is key to establish local efficacy and/or effectiveness before broader dissemination. LMICs often do things the other way around. Implementation of services tends to precede piloting and testing of interventions. It is important to conduct systematic design of interventions (or adding components to existing ones), piloting and conduction of high-quality randomized controlled trials while also considering potential scalability in low resource settings. If the field is moving toward self-regulation-focused interventions in LMICs, then this process needs to be done in a logical, systematic and scientifically rigorous way.

Conclusion

Research in HIC has established that self-regulation is key for healthy mental and physical adjustment of children, adolescents and families. In this paper, we conducted an initial, pragmatic search of the literature on self-regulation in LMICs showing that there is a paucity of research. As a first recommendation, it is key to conduct systematic reviews that include regional databases in languages other than English and Spanish and use a comprehensive list of terms to encompass different aspects of self-regulation. We also propose that basic research on child development should explore if specific aspects of self-regulation manifests equally in collectivistic LMICs than in HICs and whether the instruments used to measure aspects of this concept are appropriate for disadvantaged and low resource settings in LMICs. Ideally, this basic research needs to be done prior the design, piloting, evaluation and implementation of self-regulation-focused interventions or the incorporation of self-regulatory elements into existing psychosocial interventions in these countries. There is no doubt that the field of self-regulation has potential for protecting children, families and adolescents and for improving socioeconomic development in LMICs. Increasing research on the topic in these settings is a pressing priority.

Compliance with Ethical Standards

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