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A review of the literature on childhood executive functions in Zambia

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Abstract

Executive functions development has received a considerable amount of attention in the literature and is known to predict a range of social, cognitive and emotional outcomes in both children and adults; however, little is known about factors that contribute to its development in the Zambian context due to the fragmented literature available in Zambia. A literature review was conducted using five electronic databases (University of Zambia Institutional repository, Google scholar, PubMed, BioMed Central and EBSCO Host) to identify factors that affected executive functions in preschool and primary school children in Zambia. This review established that early childhood education, socio-economic status, physical health, and culture as factors that fall under three categories namely research, environmental and biological affect the development of executive functions among children in Zambia. This review suggests that teachers, caregivers and early childhood stakeholders in Zambia need to pay attention to both environmental and biological factors when designing executive function interventions for preschool children. A focus on improving early childhood education, nutrition, access to good quality health care, intensifying appropriate cognitive stimulating parenting and teaching practices that boost EF in public preschool and primary schools is required

Keywords: Executive function, Zambian children, function development, physical stature, Socio-economic status Culture

Introduction

Early childhood research in the last three decades has focused on activities and skills that prepare young children for school (Dockett and Perry 2007; Margetts 2007), though most of these studies have targeted children in Western countries. Not much is known about the factors that impact executive functions (EF) of children in low- and middle-income countries (Willoughby, Piper, Kwayumba & McCune, 2019).

Executive functions, described as key higher-order mental processes, are important for cognitive development, literacy acquisition and school readiness (Subbotsky, 2016). Zambia has made strides towards the attainment of one of the components of the UN sustainable development goals, #4, which is aimed at achieving equal access to early child development, care and pre-primary school (Wulff, 2017). Some of Zambia's success stories include research efforts targeting early childhood education (Hsiao et al, 2017; McCoy et al., 2017; Zuilkowski, Fink, Moucheraud & Matafwali, 2012), the establishment of a directorate for early childhood education in the Ministry of General Education, employment of early childhood education teachers (MOGE, 2019), integration of early childhood centres in existing public primary schools (Policy Monitoring and Research Centre, 2017) and the increased enrolment of grade one learners, especially in rural areas (MOGE, 2019). Despite all these efforts, there are limited or no efforts to identify factors that influence the development of executive functions in preschool children, making it difficult to develop specific executive function interventions

Childhood executive functioning has long been popular in the literature Goldman-Rakic (1987) investigated how object permanence is related to the development of the prefrontal cortex, a specific area of the brain responsible for executive functions sub components such as working memory, inhibitory control and cognitive flexibility (Li, Subrahmanyam, Bai, Xie, & Liu, 2018; Goldman-Rakic,1987). Diamond (1991) confirmed the development of inhibitory control and working memory in infants. While the concept of executive functioning (EF) has dominated the literature, a consensus on its definition has remined difficult to achieve given the complexity of these cognitive processes (Mulder et al.,2009).

What is clear from most of the EF definitions is that these processes are not a single skill, but a set of skills that are both environmentally and biologically determined (Zelazo & Muller, 2002). It has also been observed to undergo age-related decline in older adults (Diamond, 2013; Mayr, Spieler, & Kliegl, 2001; McDowd & Shaw, 2000). EF are described as a family of cognitive skills that are responsible for intentional coordination of goal-directed thought and action that tap on functional attention, inhibition, planning (Miyake & Friedman, 2012), shifting and working memory (Zelazo, Craik, & Booth, 2004; Gray-Burrows et al., 2019). Executive functions skills help in coordination and goal-directed behaviour (Parong, 2019; Zillmer et al., 2008). Given this sophistication, executive functions demand a comprehensive assessment process that is valid and reliable if firm conclusions are to be made about its nature. Unfortunately, the recent developments in early childhood education reforms in Zambia correspond only minimally to efforts in the promotion of executive functions among

preschool children in Zambia (Dickinson, & Morse, 2019; Fuster, 2013; Yang, Chen, Wang, & Zhu, 2017; Zillmer, Spiers, & Culbertson, 2008).M most of the executive functions studies in Zambia are limited to investigating only the cognitive components of executive functions even when the consensus among researchers is that executive functions involves emotional and social behavioural processes (Zillmer, Spiers, & Culbertson, 2008).

This paper will provide a brief overview of the importance of executive functions, its development, and the factors that influence executive functions in children. Finally, a critical analysis of the six Zambian studies will be provided. A great deal of prior research (Cardoso, 2017; Gray-Barrows, et al., 2019; Wilmer, et al., 2017; Pereira, 2018; Schmitt, et al., 2019) has investigated different aspects of executive functions including executive functions relations to mobile technology (Wilmer, et al., 2017) and health behaviour (Gray-Barrows, et al., 2019), cerebral palsy (Pereira, 2018), culture (Schmitt, et al., 2019) and socio-economic status (John, Kibbe & Tarullo, 2019). However, limited studies have focused on the Zambian preschool population (McCoy, 2017) and there are also quite a few studies on cost-effective EF interventions. Existing research on executive functions is mainly based on older western populations. The other drawback relates to the cross-sectional nature many executive function studies. Such research designs do not allow for long-term examination of executive functions (Schmitt, et al., 2019).

Promotion of executive functions skills in young children is important in the Zambian context because executive functions predict income and ability to sustain a job. The high graduate unemployability situation in Zambia can easily be addressed by executive function training. Because executive functions contribute to job success, the risk of executive dysfunction negatively affects the household income consequently hindering the family's ability to meet the basic needs of children, resulting in undernutrition which adversely affects physical, socio-emotional and cognitive development of children. These negative outcomes of poverty hinder early school enrolment (McCoy et al, 2017), negatively impacting the child's acquisition of skills that are relevant for their survival and progression in school. If not addressed, the affected children end up performing poorly in school and getting frustrated as a result. This is likely to put children at risk of dropping out of school and engaging in criminal activities, thus creating a burden on the country's rehabilitation, correctional and legal system (Fitzpatrick, 2014).

The following account for the reasons for this review. First, there is a dearth of literature on early childhood executive functions in Zambia which coincides with the Ministry of General

education's recent integration of early childhood education in the public education system (Policy Monitoring and Research Centre, 2017). This review was aimed at uncovering literature that is available on this topic to inform early childhood education practice in the public education sector. Second, the current review is aimed at demonstrating how childhood executive functions research has evolved in Zambia. Third, to alleviate the poor reading levels in Zambia, the Zambian Ministry of General Education introduced the use of Zambian native languages as a medium of instruction to enable these languages to facilitate effective understanding of reading, maths and writing tasks. Because of this, the present review presents evidence that supports the use of executive functions as a platform for the acquisition of reading and maths skills in early childhood. This study is particularly important because it might improve our understanding of some of the underlying mechanisms behind the decreased academic skills often reported in Zambia preschool children (Hsiao, et al., 2017; Van Heerden, et al., 2017). Fourth, this review is required in Zambia to respond to the high number of children with HIV infection (Adams, et al., 2019). What is perhaps distressing are the recent findings that some Zambian children with HIV also have neurocognitive disorders (Buda, et al., 2019; Adams, et al., 2019) which necessitates further investigations on the impact of HIV on executive functions (Li, Subrahmanyam, Bai, Xie & Liu, 2018). Lastly, this review is an attempt to bring together the only large-scale studies conducted in Zambia that provide interventions for effective stimulation of childhood executive functions which has been found to not only bring about academic success but also psychological adjustment across the lifespan (Eslinger, Biddle, & Grattan, 1997). This review also provides an opportunity to improve our understanding of how executive dysfunction can be addressed (Meaney et al., 1991; Bredy, et al., 2003).

If there is one set of skills that needs to be mastered by children, these are executive functions, given their influence on learning, development and future adulthood activities. Executive functions skills do not only help children attain short- and long term academic success (Schmitt, et al., 2019) but they also facilitate pro-social traits that promote healthy behaviour (Gray-Burrows et al., 2019) and good quality of life (Brown & Landgraf, 2010; Davis, Marra, Najafzadeh & Liu-Ambrose, 2010). Many studies have demonstrated a significant association between executive functions and key academic skills such as mathematical and reading ability (Bull & Lee, 2014; Purpura, Schmitt & Ganley, 2017).

Executive functions (EF) skills are essential for not only academic achievement but also across the lifespan (Blair & Razza, 2007; Diamond, 2012; Moffitt et al., 2011). It is

important to note that while many studies have been done for the Western world, few prior systematic literature reviews have been conducted in Zambia. Cardoso and colleagues (2016) systematically examined 19 studies that evaluated the effectiveness of executive functions interventions among typical preschool and primary school children and reported that, while the transfer of intervention gains remain inconclusive, most of the executive functions interventions used computerized school curriculum approaches and only targeted working memory relative to other executive functions components. An apparent limitation of the review by Cardoso and colleagues, for our purpose, is their exclusive focus on the western world. Another western-based review conducted on 45 studies was by Wilmer and Colleagues (2017) which found that the impact of mobile technology habits on executive functions, demonstrated that mobile technology use has adverse effects on attention, memory and delayed gratification. Another literature review aimed at investigating assessment measures of executive functions in children with cerebral palsy by Pereira and others (2018) found that, despite the diverse number of instruments available on the market to assess executive functions among children, a non-verbal assessment standardized tool, D-KEFS was commonly used by the majority of EF studies. Gray-Burrows et al. (2019) in another detailed systematic review on the relationship between executive function and healthy behaviour concluded that there is a small but significant relationship between EF and health-promoting behaviour. This one also is based on studies conducted in the western context.

What is currently known from the literature is that while executive functions is influenced both by environmental and biological factors, the role of environmental factors has dominated the literature (Huber, Yeates, Meyer, Fleckhammer, & Kaufman, 2018; Mayer, Parong, & Bainbridge, 2019; Parong, Mayer, Fiorella, MacNamara, Homer, & Plass, 2017). For instance, a study of 216 preschool children from the United States of American and China aged approximately 4 years old found that concerning general EF, Chinese children outperformed their US counterparts during the preschool period. However, there were no socioeconomic status or cross-cultural differences in the observed groups (Schmitt, Korucu, Purpura, Whiteman, Zhang, & Yang, 2019). On the biological bases of executive functions, Li, Subrahmanyam, Bai, Xie, & Liu (2018) argued that the use of modern neuroimaging technology (functional near-infrared spectroscopy), in the study of how executive functions are influenced by physical development should be prioritized because EF is influenced by brain development (Cuevas et al., 2012; Kochanska, Coy, & Murray, 2001; Loeher & Roebers, 2013). The above studies are limited to western & non-African samples, making it difficult to

generalize their findings to the Zambian setting. The current study reviewed the literature on the relationship between executive functions and physical posture.

Study Objectives

The overall goal of this review is to examine factors that influence executive functions in young children in Zambia. Given the few executive functions studies in Zambia, the current review is important to identify the gaps that exist in prior research in this field. This review addressed three objectives. First, it examines factors that influence the development of executive functions in Zambian preschool children. Second, it critically examines the methods used in these studies. Finally, it assesses the theoretical framework utilized in the studies that were reviewed.

Methods

This section examines the characteristics of the methods used in the studies selected for this review and describes the eligibility criteria and search strategies that were employed to obtain the relevant literature will be provided. The eligibility criteria will be explained. The following PRISMA guidelines (Moher, Liberati, Tetzlaff & Altman, 2009) were used to search and select studies for inclusion in this review. All studies were categorized in terms of whether they adopted an experimental, descriptive, or mixed methods research design. The number of research participants and instruments used for data collection were also examined.

Eligibility criteria

Only studies that were published between July 2001 to September 2019 on Zambian preschool and primary school children aged between 5 and 11 years, both male and female participants were selected for inclusion in this review. Only publications that were available in English qualified for inclusion in this review.Five electronic databases including the University of Zambia Institutional repository, Google scholar, PubMed, BioMed Central and EBSCO Host were searched for publications between the period from 2001 to 2019.

Search strategy

The computerized Boolean logic was used to search the relevant articles in each database. The search was confined to studies that focused on different factors that influence executive functions in Zambian preschool and primary children. The following key terms were used to search for the relevant articles: (“biological factors” OR “environmental factors” OR “psychosocial factors” OR “ executive function predictors”) AND (“executive functions” OR

"executive functions" OR "working memory" OR "cognitive flexibility" OR "inhibitory control" OR "self-regulation" OR " behavioral regulation" OR "effortful control" OR "update" OR "planning" OR "shifting" OR "attention" OR " processing speed" OR "frontal lobe functions" OR " preschool executive functions" OR " childhood executive functions") AND ("children" OR "child" OR "childhood" OR "preschool" OR "elementary" OR "primary"). The NOT option was used as an exclusive operation to search for Zambian publications only. Thus the search string read "Executive Functions AND Preschool AND Primary School AND Zambia NOT foreign countries (United States of America, United Kingdom, Canada, Russia, China, Japan, and India).

Results

Six studies (N = 6) were included in this review. Age, gender, and educational level were analysed as follows. The participant's age ranged between 2 months and 17 years and included both males and females with not less than 5 years of education. Sample sizes ranged from 45 to 2,711 participants. As shown in table 1, the six studies (N=6) that met the inclusion criteria generally investigated childhood executive functions in preschool and primary school-aged children living in Zambia.

Specifically, the studies under review were aimed at identifying factors that affect executive functions in pre and primary school children, in terms of the nature of executive functions tests used, most of them were standardized (N =4). Inhibitory control was the most widely assessed component of executive functions (N =4). Most of the studies (N =5) utilized cross-sectional research designs, while one used a longitudinal design and another one employed a cross-cultural design. All the studies utilized different statistical analyses which include T-test, MANOVA, bivariate analysis, regression, and structural equation modelling and mixed model multi-level analysis. All these statistical tests were in line with the research questions that were addressed in the specific studies.

In terms of the factors that influence executive functions in pre and primary school children in Zambia, the studies that were reviewed identified the following seven factors: physical stature (Mc Coy, et al., 2015), HIV status (Mwanza-Kabaghe, et al., (in press), cognitive stimulation (McCoy, Zuilkowski & Fink, 2015), participation in early childhood education programmes (Mc Coy, Zuilkowski, Yoshikawa & Fink, 2017), age (Van Heerden, Hsiao, Matafwali, Louw & Richter, 2017), gender (Chalwe, 2015) and culture (Mulenga, Ahonen & Aro, 2001).

The current review critically analyzed six studies according to their objectives and outcomes as follows: Study #7 (Mwanza-Kabaghe et al., in press) examined the effect of HIV infection on executive functions and found that executive functions was adversely affected by HIV infection. Study #6 (Mulenga, Ahonen and Aro, 2001) investigated the influence of education, culture and language on neuropsychological test performance and found that all the neuropsychological tests were neither sensitive to the participants' culture, education level nor the participant's spoken language. Study #5 (Kabaghe-Mwanza, 2015) examined whether executive functions predicted literacy and numeracy skills and the study found that literacy and numeracy were associated with better working memory and inhibitory control. Study #4 (Mc Coy et al., 2015) explored the effect of physical posture on executive functions skills and school enrolment and found that physical posture predicts not only executive functions but also early or on-time school enrolment. Study #3 (Van Heerden, Hsiao, Matafwali, Louw, & Richter, 2017) assessed problem solving and fine motor skills of 5-year-old children and found that children from South Africa outperformed their Zambian peers on the cognitive tasks that were assessed. Study #2 (Chalwe, 2017) investigated the relationship between teacher-reported executive functions and children's numeracy, gender, and age. This study established that whereas numeracy was not related to executive functions, age and gender showed small positive associations. Finally, Study #1 (McCoy et al., 2017) explored the effect of early childhood education (ECE) programmes on executive functions. This study found that these programmes significantly improved executive functions skills among preschool-aged learners.

The assessment tools used in the reviewed studies utilized neuropsychological tests for the assessment of executive functions. There was a limited range of tools used. For instance, for the measurement of attention and executive functions, the following eight tests drawn from the developmental neuropsychological assessment battery (Korkman, Kirk, & Kemp, 1998) were administered: the tower, auditory attention, auditory response set, visual attention and design fluency tests (Study #6), locally adapted pencil tapping test (originally peg tapping test) (Study #1,4 and 5), the behaviour rating inventory of executive function (BRIEF) preschool version (study 2 and 5), Stroop-like task (study 5) and the ages and stages questionnaire version 3 (Study #3). Study #7 also used the Flanker test to assess executive functions.

Discussion

The present review is one of the first attempts to bring together studies on executive functions in early childhood years in Zambia aimed at gaining a better understanding of how to improve key cognitive functions. The six studies that were examined in this review demonstrate the

following factors that influence executive functions in childhood: early childhood education, socio-economic status, physical stature , and culture. Although the reviewed studies inform us of the activities that stimulate executive functions during childhood in a low resource setting, some limitations have been noted in the theoretical framework, study design, assessment tools and study setting. The following section first discusses the methodological limitations that haunt the reviewed studies and then each of the factors that influences executive functioning.

Methodological Limitations

Theories

While study #2 and #5 have utilized Baddeley's working memory model (Baddeley & Hitch 1994), they have not adequately tested cognitive flexibility, an important subcomponent of executive functions. In study #5, the researcher admits leaving out cognitive flexibility " in the current study, no hands-on cognitive flexibility tasks were used" (Mwanza-Kabaghe, 2015:73). The failure to include other key components of executive functions raises questions on whether executive functions were adequately assessed. Inclusion of cognitive flexibility in the latest version of Baddeley's model is a clear indication that cognitive flexibility is a critical component of executive functions (Garon et al., 2008) relative to inhibitory control and working memory (Diamond, 2013). The exclusion of cognitive flexibility from executive functions is a departure from the supported view of executive functions as a multidimensional concept that includes all the three cognitive skills: inhibitory control, working memory and cognitive flexibility (Miyake & Friedman, 2012)

Apart from this failure to include cognitive flexibility, the other studies (study 1,3,4 and 6) in the current review have not provided information on the theoretical perspectives used, rendering the studies theoretically weak because peer-reviewed studies need to provide information about the theoretical contribution of the research undertaking. The provision of information on the theoretical framework in a study also helps to show the theoretical contribution of the study and the parameters of their applicability to other contexts.

EF Assessment tools

Regarding the executive functions (EF) assessment instruments used in the reviewed studies, most of the studies [which?????] mostly used standardised EF assessment tools. For instance, the pencil tapping test, NEPSY attention and executive function subtest, Stroop test and the Behavior Rating Inventory of Executive Function (Preschool Version). The exclusive use of standardised tools for measuring EF ignores the complexity of EF (Mulder, Pitchford, Hagger

& Marlow, 2009; Klenberg, 2015). Future studies need to address the highlighted shortcomings so that EF measures used are as diverse as possible to respond to the multidimensional nature of EF (Klenberg, 2015). Future studies need to utilize reliable and valid EF measures that not only examine EF in typical but also atypical children (Pereira et al., 2018). Other recommended widely used EF measure for children that could be considered includes the Dimensional Change Card sort task which is a widely used measure among preschool children (Doebel & Zelazo, 2015).

Other methodological issues arising from the review include the following. First, most of the studies in the present review used either of performance-based or reported measures but none used both. This approach to EF assessment is unlikely to provide a clear picture of childhood executive functions because what is assessed and missed in a performance-based measure may be captured by a reported measure. Klenberg (2015) recommends that for a full assessment of EF, both performance-based and reported measures should be administered. Future studies need to include both self-report and performance-based measures. Second, the tendency by most western scholars to use Western-developed EF assessments in non-western contexts raises questions on the validity of the test (Matafwali & Serpell, 2014). Astatke and Serpell (2000) recommend for the development and validation of culturally appropriate EF measures. Consideration of culturally appropriate and sensitive assessment tools that address the specific socio-cultural conditions is critical for less-biased evaluation of children's cognitive skills (Serpell & Nsamenang, 2014).

Lastly, the use of a single EF test to measure several EF indices can be challenging given the multidimensional nature of EF (Wieber et al., 2011; Willoughby, Blair, Wirth, & Greenberg, 2012). Thus, future studies need to employ multiple assessment methods that are not only culturally sensitive but also measure all the aspects of executive functions covered in Baddeley's executive functions model including working memory, cognitive flexibility and inhibitory control.

Research Design

Most of the studies reviewed used cross-sectional study designs rather than randomized controlled trials or longitudinal or cross-cultural designs making it difficult to arrive at firm conclusions regarding the developmental changes and socio-cultural factors that improve executive functions in Zambian Children. EF typically follows a developmental trajectory; EF mature with brain development (Gray-Burrows et al., 2019: 256). This means that research

designs that investigate EF should be longitudinal to allow for an in-depth examination of the EF developmental changes that occur during early childhood years, a stage in one's life when EF matures rapidly (Zelazo & Müller, 2010). Cross-cultural designs help to have a better understanding of how socio-cultural mechanisms arising for culture informed child rearing practices affect childhood executive functions (Schmitt et al., 2019). While rigorous research designs are suggested, there is a need for researchers to avoid the temptation of generalizing western-based findings to non-western settings (Westman & Costello, 2011) without paying attention to the local knowledge, attitudes, values and beliefs (Serpell & Nsamenang, 2014).

Study population

The studies selected for this review have limited sample populations that have mostly been drawn from urban areas, constraining our understanding of the linguistic, geographical setting and cultural diversity of the participants being assessed. In line with this limitation, future studies should include socio-culturally diverse participants. This will allow for easy and adequate validation of standardized western-developed assessment tools for use in non-western contexts. Having noted that the study designs used in the reviewed studies were varied, this review suggests that standardization of research designs in EF research in Zambia is needed to obtain comparable results (Kelly, 2014). Serpell and Nsamenang (2014) also emphasize the need to closely pay attention to rural areas due to the variations in child socialization practices compared to urban areas.

Environment-Based Factors

This review was aimed at evaluating executive functions (EF) research in Zambia to better understand factors that influence early childhood executive functions among Zambian children. Early childhood education, socio-economic status, physical stature , HIV status and socio-cultural issues have been identified to influence the development of executive functions in Zambia. The majority of the Zambian studies identified in this review have pointed to the need to target affordable EF interventions knowing very well that Zambia is a low-resource setting. The next section discusses each of the environment-based factors that influences executive functions among children in Zambia: early childhood education, socio-economic status, physical stature, HIV status and socio-cultural factors that include cultural orientation and language.

Early childhood education

As confirmed by previous studies, both study #1 and study #5 consistently found that participation in either a free private or public early childhood care and education programme for 3 to 5 hours daily significantly improved executive functions among other cognitive skills in Zambian preschool children., They show specifically that working memory and inhibitory control predicted better performance on numeracy and literacy tasks in Zambian preschool-aged children. One of the plausible explanations for the beneficial effect of early childhood education is provided by Mckinnon & Blair (2019) who states that early education provides children with foundational skills such as language, reading and maths that familiarize them to preliminary cognitive skills that include counting, letter identification, colour identification, counting, number recognition, recognizing the letters in one's name (Hsiao, et al., 2017). Thus, there is a need to provide equitable access to good public quality early childhood education in Zambia (Zuilkowski, Fink, Moucheraud, & Matafwali, 2012). This would be one way of compensating for the challenges experienced by public preschoolers (Sameroff & Chandler, 1975).

Socio-economic status

Socio-economic factors such as caregiver income and education have been established to have strong relations with children's performance on executive functions (EF) tasks. This means that children who come from a higher socio-economic home background tend to enrol in preschools earlier than their counterparts who come from poor backgrounds. This was revealed by studies #3 and #4 in this review. These studies reports are consistent with other studies (John, Kibbe, & Tarullo, 2019) that show that working memory and inhibitory control are negatively affected by poverty. This relationship is attributed to the following reasons. First, poor children display limited EF skills as they enter school because of the toxic stress associated with poverty (Raver, Blair, Willoughby, & Family Life Project Investigators, 2013). Second, poverty adversely affects optimal brain function such that neural systems that support EF development are disrupted by poverty-related risks including under-nutrition, disease and limited cognitive stimulation (Blair & Raver, 2015). These findings have potential implications for public social policy in Zambia. First, the Zambian government needs to address challenges experienced in the social cash transfer programme and community literacy programmes. The Ministry of Education needs to ensure that all children have access to early childhood education because this provides the foundation for future school success and employment.

Physical stature and HIV status

As indicated by study #4 and #7, health wellbeing as indicated by physical stature, good nutrition and access to quality health care are strong predictors of executive functions. This is consistent with other studies (Gray-Burrows, Taylor, O'Connor, Sutherland, Stoet, & Conner, 2019; McCoy, Zuilkowski, & Fink, 2015) because executive functions are enhanced by adequate food, physical fitness and mindfulness (Diamond & Lee, 2011). The relationship between executive functions and physical development confirms the theory that majority of children's developmental domains are interdependent (Grantham-McGregor et al., 2007). This review provides empirical evidence to promote universal health care coverage, child and maternal health programmes in Zambia. HIV infection among children needs to be addressed by the proivision of mother to child prevention programmes and pharmocological interventions.

Culture

Culture, defined as the child's behaviour norms, beliefs, values and practices within its collectivistic community arrangement influences executive functions (Schmitt, et al., 2019). Cross-cultural differences in EF development have been noted between Chinese and American preschool children, with Chinese children performing better than their American counterparts (Schmitt, et al., 2019). Previous studies support the observation of cultural influence on executive function development (Ng et al., 2015). The advantage in executive functions among the Chinese children is attributed to their strength in early maths skills (Huntsinger et al., 1997; Siegler & Mu, 2008; International Association of Evaluation, 2011) and genetic factors (Sabbaghe, et al., 2006). The socialisation experiences of Chinese children also play a huge role in subsequent EF development. For instance, Chinese parents effectively provide early toilet training (as early as 6 months) to their children (Camras et al., 1998; Chen et al., 1998; Chen, et al., 2003; Sabbaghe, et al., 2006). Given effective executive function training that is achieved through socialisation, Chinese???? children tend to demonstrate inhibitory control earlier than other children (Ng, et al., 2015). If collectivistic culture has a positive effect on the development of executive functions, then Zambian children whose culture is largely collectivist should have an advantage in terms of adequate executive functions skills. However, this is not the case as revealed by some studies in this review (Mwanza-Kabaghe, 2015 and Mulenga, Aro & Ahonen, 2001). This could be due the assessment tools used on Zambian children which are not culturally appropriate. The cultural invasion of western values on Zambian society could also explain this discrepancy (Akani, 2012). The need for development of culturally appropriate assessment and intervention strategies is crucial.

One of the suggested measures to address the low EF skills in the Zambian population is to provide awareness to caregivers and teachers on the potentially positive influences of the local collectivist culture on childhood executive functions. Second, caregivers and teachers need to be more sensitive and responsive to the emotional, physical and cognitive needs of children (Zeytinoglu, Calkins, Swingler & Leerkes, 2017; Hamond, Muller, Carpendale, Bibok & Liebermann-Finestone,2012; Hughes & Enson,2009). Third, since Zambia and China share similar collectivist culture, Zambian children need to be trained to exercise self-control in the same manner that Chinese children are trained (Tardif, Wang & Olson, 2009). Lastly, teachers and caregivers need to provide opportunities for cognitive stimulation and??? have interactions with children (Lan et al., 2009; Schmitt et al., 2019). Intensifying better parenting practices and provision of effective teaching and learning resources has the potential to provide a strong foundation for the development of executive functions in preschool and primary children in Zambia.

Conclusion

This literature review study was aimed at identifying methodology, environment and biological-based factors that affect executive functions development among Zambian children. Overall, the results demonstrate that four factors contribute to the development of executive functions. These include early childhood education, socio-economic status, physical stature, and culture. These findings highlight the environmental and biological determinants of cognitive development.

Despite the limited research base on childhood executive functions in Zambia, it is apparent that different factors that contribute to executive functions have been identified. Several implications of these findings discussed focus on improving early childhood education, nutrition, access to good quality health care, intensifying cognitive stimulation; parenting and teaching practices and provision of learning materials that boost EF in public preschool and primary schools. It is important for future research in Zambia to explore the effect of parenting practices and teaching practices on the development of executive functions in private schools as this review exclusively examined public school studies. In addition, potential reasons for the influence of culture on executive functions need to be explored because of the pervasive influence of western cultural values on Zambian society. As one of the first investigations to examine factors that affect the development of executive functions, this review has aimed to inform the design of interventions that support the development of executive functions among preschool and primary school learners in Zambia.

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