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More than poverty: Pathways from economic inequality to reduced developmental potential

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Abstract

Studies from both high and low-middle income (LAMI) countries have documented how being reared in poverty is linked to compromised child development. Links between poverty and development are mediated by the timing and extent of exposure to both risk factors nested under poverty and to protective influences which can attenuate the impact of risk. While children from high-, middle-, and low-income countries are exposed to similar types of developmental risks, children from low- and middle-income countries are exposed to a greater number, more varied and more intense risks. Given these contextual differences, cumulative risk models may provide a better fit than mediated models for understanding the nature of pathways linking economic insufficiency and developmental inequality in low- and middle-income countries, and for designing interventions to promote development of children from these countries. New evidence from a large scale UNICEF data set illustrates the application of a cumulative risk/protective perspective in low- and middle-income countries.

Keywords

cumulative risk, low-income countries, mediators, MICS-4, poverty, protective/promotive influences

Based on gross national income (GNI-US $$ per year), the World Bank categorizes countries as low (GNI < US$1045), middle (US$1045 < GNI > US$12,746) or high income (GNI > US$12,746). With poverty defined as a daily income of $1.25 or less per day, nearly 15% of the world's population lives in poverty, but the frequency of those living in poverty varies tremendously, ranging from 46.8% of the population in Sub-Saharan Africa to 0.5% in Europe (figures taken from the World Bank website: http://data.worldbank.org/news/2015-country-classifications). However, interpreting such inter-country differences can be problematical when there is high variability in intra-country income or when countries grouped in different GNI categories are similar on dimensions such as levels of health or social protection services (Knerr, Gardner, & Cluver, 2013).

In spite of these ambiguities consistent evidence from both high (Chen, Hetzner, & Brooks-Gunn, 2010; Evans, 2004; Luby et al., 2013;Vernon-Feagans, Cox, and the FLP Investigatory Team, 2013) and low-middle income countries (LAMI; Boyle et al., 2006; Engle & Black, 2008; Grantham-McGregor et al., 2007; Patel, 2009) documents that children growing up in poverty conditions are more likely to show compromised outcomes in the areas of cognitive–academic competence, social–emotional development, neural functioning and health. Such evidence has driven intervention efforts to increase both national income (e.g., government social safety net programs: Patel, 2009) and family income (e.g., cash supplements to families; Lomeli, 2008).

However, not all children being reared in poverty show compromised development; nor does poverty equally impact on all children or families (Huston & Bentley, 2010; Wachs, 2015; Werner & Smith, 1982). Individual variation in the consequences of poverty may partially reflect differences in the definition (Dercon, 2012), duration, timing or depth of poverty (Huston & Bentley, 2010; Yeung, Linver, & Brooks-Gunn, 2002). For example, poverty can be defined as a function of absolute income (daily income < US$1.25), relative income (family income relative to median national income) or temporally (persistent versus intermittent; Chen et al., 2010). While definitional differences are one explanation for individual variation evidence from both high (Chen et al., 2010; Duncan, 2012; Masten et al., 2014; Yeung et al., 2002) and low-middle income countries (Dercon, 2012; Engle, 2010; Engle & Black, 2008; Patel, 2009) also shows systematic variability in the consequences of poverty as a function of specific child, caregiver, family, and community characteristics. These findings indicate that the impact of poverty on development is not a main effect but rather probabilistic in nature (Engle & Black, 2008; Wachs, 2015).

For developmental scientists, *bio-ecological theory* (Bronfenbrenner & Morris, 2006) offers a means for understanding the probabilistic nature of the links between poverty and children's development. Within a bio-ecological framework, it is not poverty per se that directly drives development, but rather specific proximal psychosocial, biological, and individual characteristics which are nested under the demographic label of poverty. Developmental variability in response to poverty is a function of (a) the number, timing, and intensity of encountered risks that inhibit development; (b) the degree of exposure to promotive influences, which can facilitate development, or protective influences which can buffer

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competencies against risks (although theoretically different we will refer to protective/promotive influences as a general category in this article); (c) the overall context within which risk and protective/promotive influences occur (Engle & Black, 2008; Evans, 2004; Huston & Bentley, 2010; Wachs, 2015).

Similarly, when considering the impact of poverty on children, economists emphasize the availability of family (or societal) resources and opportunities, the decision strategies used by individuals or families to allocate available resources and individual characteristics like age or gender that influence allocation, selection, and impact of resources (Behrman & Urzua, 2013; Duncan, 2012; Mendoza, 2009). Resource availability and allocation impacts on individual exposure to risk or protective/promotive influences. For example, economic interventions such as earned income tax credit programs have been shown to reduce the incidence of developmental risks such as low birth weight or maternal stress (Gassman-Pines & Hill, 2013).

Regardless of whether poverty is viewed through a bioecological or an economic lens it is essential to specify poverty-linked biological, psychosocial, and individual factors that act to compromise or promote development and the pathways through which identified factors lead to compromised or optimal functioning. Such information is a necessary precursor for developing effective interventions to promote the development of children reared in poverty. However, the bulk of developmental science research on poverty-development links has been carried out in high-income Western countries (Bornstein et al., 2012; Chen et al., 2010) whereas the great majority of children growing up in poverty live in low- and middle-income non-Western countries (Engle, 2010; Grantham-McGregor et al., 2007). The gap between knowledge base (high-income countries) and need (low- and middle-income countries) is problematical, given that the nature of associations or pathways between poverty, risk protective/promotive factors, and child outcomes can vary across countries (Boyle et al., 2006; Ungar et al., 2007; Wachs, 2015; see also Lopez Boo, 2016; Santibanez & Fagioli, 2016) or between regions within a country (Woldehanna, 2016).

To address this informational gap, we first review findings on the nature of identified risk and protective/promotive factors found in both high- and low-middle income countries. Because our focus is on potentially remediable risks, we will not consider currently non-remediable risk factors such as genetics or climate change. This information is then applied to the question of which current conceptual models linking poverty and risk-protective/promotive factors are most applicable to understanding the nature of developmental inequalities in low- and middle-income countries.

Table 1. Poverty-linked developmental risk factors found in both high and low-middle income countries.

Risk dimension	High-income countries	Low- and middle-income countries
Nutritional risks (e.g., diets low in trace minerals or vitamins).	Darmon & Drewnowski (2008), Hubbs-Tait, Kennedy, Droke, Belanger, & Parker (2007)	Engle (2010), Walker et al. (2011)
Exposure to environmental toxins (e.g., heavy metals or industrial and agricultural chemicals.)	Evans (2004)	Ferguson, Cassells, MacAllister, & Evans (2013)
Biomedical risks (e.g., reduced access to pre and post-natal health care; exposure to infectious diseases or parasitic infection)	Guo & Harris (2000), Karp (2010)	Peters et al. (2008), Walker et al. (2011)
Psychosocial risks (e.g., lower early cognitive stimulation or home learning resources; parental use of harsh physical punishment	Chen, Hetzner, & Brooks-Gunn (2010), Huston & Bentley (2010), Vernon-Feagans, Cox, and the FLP Investigatory team (2013)	Bradley & Putnick (2012), Richter & Dawes (2008), Wachs & Rahman (2013), Walker et al. (2011)
Mental health risks (e.g., maternal depression)	Beeber, Perreira & Schwartz (2008), Chen et al. (2010)	Wachs, Black, & Engle (2009)
Educational risks (e.g., poorly equipped or maintained schools)	Evans (2004), Huston & Bentley (2010)	Ferguson et al. (2013)
Physical-ecological risks (e.g., living in noisy, crowded, or unsafe homes; living in neighborhoods that are disorganized, violent, crowded and low in basic services, resources or opportunities)	Evans (2004), Leventhal, Dupere, & Shuey (2015), Masten et al. (2014)	Bradley & Putnick (2012), Ferguson et al. (2013), Sheuya (2008)
Societal risks (e.g., prejudice or stigmatization as a function of gender, ethnicity, social class, refugee status or disability)	Marks, Ejesi, McCullough, & Coll (2015)	Cueto, Guerrero, Leon, Seguin, & Munoz (2012), Mann (2012)

Comparing risk and protective/promotive factors in both high- and low-middle income countries

Risk factors

Potentially remediable poverty-linked developmental risk factors found in both high and low-middle income countries are shown in Table 1. In interpreting Table 1, it is essential to recognize that in both high- (Beeber, Perreira, & Schwartz, 2008; Masten et al., 2014; Vernon-Feagans et al., 2013) and low-middle income countries (Engle, 2010; Wachs & Rahman, 2013) risk factors *co-vary*, such that at risk children and their families are likely to simultaneously encounter multiple risks. For example, in low- and middle-income countries, children living in refugee camps are at greater risk for infectious diseases (Hershey et al., 2011) and maternal depression co-varies with compromised child nutrition and quality of parenting (Wachs & Rahman, 2013).

While similar risk factors are found in both high-, middle- and lower-income countries evidence summarized in Table 2 illustrates that certain risks are primarily found in low- and middle-income countries. Table 3 identifies those risk factors which occur across all countries but are more common or more intense in low- and

Table 2. Potentially remediable poverty driven risk factors linked to compromised children's development that are unique to low and middle income countries.

Risk category (found in both high and low-middle income countries)	Specific risks found almost exclusively in low and middle income countries
Environmental toxins	Exposure to polychlorinated Biphenyls (Ferguson, Cassells, MacAllister, & Evans, 2013)
Biomedical risks	Cholera (Ali et al., 2012)
Exposure to violence	Living in civil war zone (Werner, 2012); Direct exposure to societal armed conflict (e.g., child soldiers; Chrisman & Dougherty, 2014)

Table 3. Potentially remediable poverty driven risk factors linked to compromised children's development that have a higher incidence or severity level in low and middle income countries.

Risk category (found in both high and low-middle income countries)	Specific risks found with higher incidence or severity in low- and middle-income countries
Nutritional deficiencies	Severe protein-calorie deficits (e.g., stunting, wasting; Black et al., 2008); Severe trace mineral deficits (e.g., iron deficiency anemia; Thakur, Chandra, Pemde, & Singh, 2014)
Exposure to environmental toxins	Arsenic (Rahaman, Sinha, Pati, & Mukhopadhyay, 2013); Lead (Ferguson, Cassells, MacAllister, & Evans, 2013); Mercury (Lin, Vogt, & Larssen, 2012)
Exposure to poor sanitation or unclean water	Ferguson et al. (2013), Ngure et al. (2014)
Infectious diseases	Severe childhood diarrhea (Walker et al., 2013); Malaria (Cullen & Arguin, 2014)
Inadequate cognitive stimulation	Fewer home learning resources like books or educational toys (Bradley & Putnick, 2012); Reduced access to remedial programs for children with disabilities (Walker et al., 2011)
Inadequate or insufficient parenting	Maternal depression (Wachs, Black, & Engle, 2009); Orphan status as a result of parent HIV/AIDS (Andrews, Skinner, & Zuma, 2006); Institutionalization (Walker et al., 2011)
Exposure to family violence	Parent reliance on harsh physical punishment as a disciplinary tool (Lansford & Deater-Deckard, 2012; Smith & Mosby, 2003); Domestic violence (Garcia-Moreno, Jansen, Ellsberg, Heise, & Watts, 2006)
Inadequate societal resources	Reduced access to health care (Peters et al., 2008); Prevalence of substandard overcrowded housing (Ferguson et al., 2013) or slum neighborhoods (Sheuya, 2008)

middle-income countries. For example, while poor children in both high- and lower-middle income countries are at risk for specific micronutrient deficiencies or for exposure to home or neighborhood violence, poor children in low- and middle-income countries are far more likely to experience chronic and severe protein-calorie malnutrition (Victora et al., 2008; Walker et al., 2011) or to become refugees as a result of widespread societal violence or civil war (Lustig, 2010; Mann, 2012).

Protective/promotive influences

Potentially implementable protective/promotive influences identified in high-income countries include: (a) *parenting and family processes* (e.g., high parental involvement, nurturance/warmth, sensitivity, and cognitive/language/academic stimulation: Masten & Obradovic, 2006; Vernon-Feagans et al., 2013); (b) *contextual characteristics* (e.g., social support networks, availability of quality preschools and schools, neighborhoods high in social norms and social cohesion; Huston & Bentley, 2010; McConnell, Breitkreuz, & Savage, 2010); (c) programmatic *influences* (e.g., intervention programs promoting better child health and nutrition; Engle & Black, 2008; Karp, 2010).

Although far less is known about individual protective/promotive influences in LAMI countries, what is known has been highlighted in a number of reviews (Nores & Barnett, 2010; Wachs & Rahman, 2013; Walker et al., 2011; see also Black et al., 2016; Knauer et al., 2016; Rubio-Codina, Attanasio, & Grantham-McGregor, 2016). Protective/promotive influences identified in these reviews include:

(a) *breast feeding* and *nutritional supplementation* of macronutrients (e.g., protein), or micronutrients (e.g., iron, iodine);
(b) *psychosocial stimulation* involving cognitively stimulating and responsive parenting, increasing preschool attendance and early adoption of institutionalized children;
(c) programs facilitating *maternal child-rearing competence* including interventions to identify and reduce postpartum depression and promote maternal education.

As with risk factors, protective/promotive influences also have been shown to co-vary in both high- (Burchinal, Roberts, Hooper, & Zeisel, 2000) and lower-middle income countries (Wachs & Rahman, 2013). For example, in lower- and middle-income countries, higher maternal education co-varies with more cognitively stimulating home environments, better child nutrition, and greater maternal receptivity to intervention programs (Walker et al., 2011). Evidence also indicates that there may be a *reduced availability* of protective/promotive factors in lower- and middle-income countries, including: (a) *lower access to health care* (Peters et al., 2008; WHO Department of Reproductive Health and Research, 2008); (b) fewer child and maternal mental health services (Saxena, Thornicroft, Knapp, & Whiteford, 2007); (c) fewer learning resources in the home (Bradley & Putnick, 2012); (d) lower quality preschool and school education programs (Engle, Rao & Petrovic, 2013) (see also articles by Santibanez & Fagioli, 2016; Woldehanna, 2016).

Further, even when available, the impact of protective/promotive factors in low- and middle-income countries may be attenuated by existing contextual conditions (Wachs & Rahman, 2013). For example, the benefits of increasing educational opportunities in multi-lingual low- or middle-income countries may be severely attenuated when schools primarily use regional or indigenous language as the medium of instruction (Cueto, Guerrero, Leon, Seguin, & Munoz, 2012) or restrict the teaching of non-native languages linked to upward mobility to an elite subsample of children (Tayyaba, 2014).

Summary: Risk and protective/promotive influences in high-, middle- and low-income countries

While there is overlap in the types of developmental risk and protective/promotive factors encountered by poor children from high- and low-middle income countries, children from both low- and middle-income countries are encountering a greater number, more varied and more intense poverty-driven developmental risks than do children from high-income countries. Quantitative differences in level of exposure to developmental risks may be particularly important, given evidence from wealthy countries that high-risk exposure may compromise the beneficial impact associated with protective/promotive influences (Sameroff & Rosenblum, 2006). For example, maternal depression has been shown to reduce the efficacy of parent-based intervention programs (Beeber et al., 2008) and high levels of exposure to lead can overwhelm the impact of normally protective dietary influences (Schell et al., 2004). Limited evidence from low- and middle-income countries also indicates an attenuation of protective/promotive parental influences when risk factors such as maternal depression are present (Baydar et al., 2014). Potential attenuation of protective/promotive influences in low- and middle-income countries due to greater exposure to covarying risks may be particularly detrimental, given that children in these countries already have fewer encounters with protective/promotive factors. Differential exposure to level and type of risk and protective/promotive influences in high-, middle- and low-income countries may also mean differences in underlying pathways through which poverty driven risks translate into developmental inequalities in these countries.

Models of pathways from poverty to developmental inequality in high- and low-middle-income countries

Mediated models

A commonly used model in high-income countries is based on delineating specific factors that *mediate* the impact of poverty upon development. One well-documented mediated pathway involves *poverty-increasing family stress* (Duncan, Magnuson & Votruba-Drzal, 2015). Increased family stress compromises the quality of the child's rearing environment, as manifest in less sensitive responsive parenting, more spousal conflict and increased parental mental health problems (Conger & Donnellan, 2007; Martin et al., 2010). A complementary mediated model involves *poverty-driven reductions in the parent's ability to invest time and resources in ways that promote development*, such as enhancing children's access to books and educational activities, or parental involvement in their child's school activities (Chen et al., 2010; Duncan et al., 2015; Martin et al., 2010). Although mediated models used in high-income countries often focus on single mediators, examples of concurrently operating multiple mediators also have been reported (Luby et al., 2013).

The applicability of mediated models to understanding links between poverty and developmental inequality is well documented in high-income countries. At present, only a few studies have investigated such mediated linkages in low- and middle-income countries (McCoy, Simmons, Zuilkowski, & Fink, 2015; Robila & Krishnakumar, 2005; see also articles by Knauer et al., 2016; Lopez Boo, 2016; Rubio-Codina et al., 2016; Santibanez & Fagioli, 2016; Woldehanna, 2016).

Cumulative risk models

Mediator models focus on the causal impact of specific risk factors. In a cumulative risk model, it is the *combined impact of exposure to a variety of multiple risk factors* rather than any specific risk that drives linkages between risk and development (Sameroff, Bartko, Baldwin, Baldwin, & Seifer, 1998). Although most research validating the cumulative risk approach comes from high-income countries (e.g., Huston & Bentley, 2010; Sameroff, Gutman, & Peck, 2003; Whipple, Evans, Barry, & Maxwell, 2010), a few studies carried out in low- and middle-income countries also have shown a greater adverse developmental impact when children are exposed to multiple risks, compared to exposure to a single risk (Cluver & Orkin, 2009; Neuner, Schauer, Catani, Ruf, & Elbert, 2006; Suliman et al., 2009).

The applicability of cumulative risk models to low- and middle-income countries

Mediated and cumulative risk models both offer an enhanced understanding of how poverty translates into compromised development, and illustrate the need to avoid models based solely on simple direct poverty-development links. However, a fundamental thesis of this article is that cumulative risk models may be particularly applicable and have greater ecological validity in low- and middle-income countries than specific mediator models. This conclusion is based on evidence cited in this and other reviews (Engle et al., 2013; Wachs & Rahman, 2013) documenting that poor children in low- and middle-income countries are more likely to be exposed to a greater number and variety of risk factors. Greater numbers of poverty-linked risk factors increases the probability that exposure to a given risk also reflects simultaneous exposure to other poverty-related risks (covariance) resulting in greater cumulative risk exposure. By summing across encountered risks, covariance among multiple risks is fundamentally built into cumulative risk models (Wachs, 2015).

However, what must be emphasized is that development is a function of the interplay of risk and protective/promotive factors encountered by the child rather than just the number of risk factors per se (Huston & Bentley, 2010; Sameroff et al., 1998, 2003). As reviewed earlier poor children from low- and middle-income countries are less likely to encounter protective/promotive influences than poor children from high-income countries. This emphasizes the need for an expanded cumulative risk model which takes into account the developmental consequences of differential exposure to cumulative risk and protective/promotive exposures. While some studies done in high-income countries have tested such a model

(Klebanov & Brooks-Gunn, 2006; Sameroff & Rosenblum, 2006), little evidence is currently available from low- and middle-income countries. Findings described below are used to illustrate the applicability of a differential exposure model to low- and middle-income countries.

Consequences of differential exposure to risk and protective/promotive influences in low- and middle-income countries: Illustrative findings

The findings reported here are based on data from round 4 of the UNICEF Multiple Indicator Cluster Survey (MICS-4) carried out between 2009 and 2012. The MICS-4 survey is based on a sample of 99,987 children, aged 3–4 years, living in 52 LAMI countries. Participating families were categorized into wealth quintiles based on the availability of household commodities; and 26,639 children were from the lowest family wealth quintile whereas 14,450 were from families in the highest family wealth quintile. Three MICS-4 item sets based on mother or caretaker's responses were used to assess whether a child was on track for *physical* (the child can *both* pick up a small object with two fingers and is not normally too sick to play: $n = 89{,}822$), *social-emotional* (child gets along with other children; not easily distracted: $n = 89{,}199$) and *learning* competencies (child can follow simple directions and/or can carry out tasks independently: $n = 90{,}692$). MICS-4 details are available on http://mics.unicef.org/tools.

Based on earlier reviews (Ferguson, Cassells, MacAllister, & Evans, 2013; Wachs & Rahman, 2013; Walker et al., 2011), nine items contained in the MICS-4 database were selected to construct a cumulative risk index (CRI). An additional nine items were used to derive a cumulative protective/promotive index (CPI). Both CRI and CPI scores were based on maternal or caretaker responses to specific questions plus direct observation. To compute total CRI and CPI scores, individual CRI and CPI items were scored as 0 (not present) or 1 (present). Scores were then summed yielding a potential 9-point scale for both indexes. CRI items included measures of severe physical punishment, child morbidity, lower physical growth status, and less adequate home sanitation or childcare. CPI items included child participating in an early education program, availability of educational toys and children's books at home, higher maternal education, and child vaccinated or nutritionally supplemented (CRI and CPI items are listed in Supplementary material A1).

Children were classified into 4 groups based on their relative CRI and CPI scores (total CPI-total CRI): *Group 1:* Greater risk exposure (exposure to 2 or more risk factors than to protective/promotive factors; *Group 2:* Similar exposure (difference between risk and protective/promotive factors between +/− 1); *Group 3:* Moderately high protective/promotive exposure (exposure to 2–3 more protective/promotive factors than to risk factors; *Group 4:* Very high protective/promotive exposure (exposure to 4 or more protective/promotive factors than to risk factors). When differential exposure occurs, we would expect development to be compromised in children with greater exposure to risk than to protective/promotive influences, compared to children with greater exposure to protective/promotive influences than to risks.

As expected, family poverty levels were positively related to child CRI scores and inversely related to CPI child scores. For example, 43% of children in the bottom wealth quintile had higher exposure to risk than to protective/promotive factors versus only 4% of children from the top family wealth quintile. Conversely, only 14% of children from the bottom wealth quintile had higher exposure to protective/promotive than to risk factors, compared to 25% of children from the top family wealth quintile.

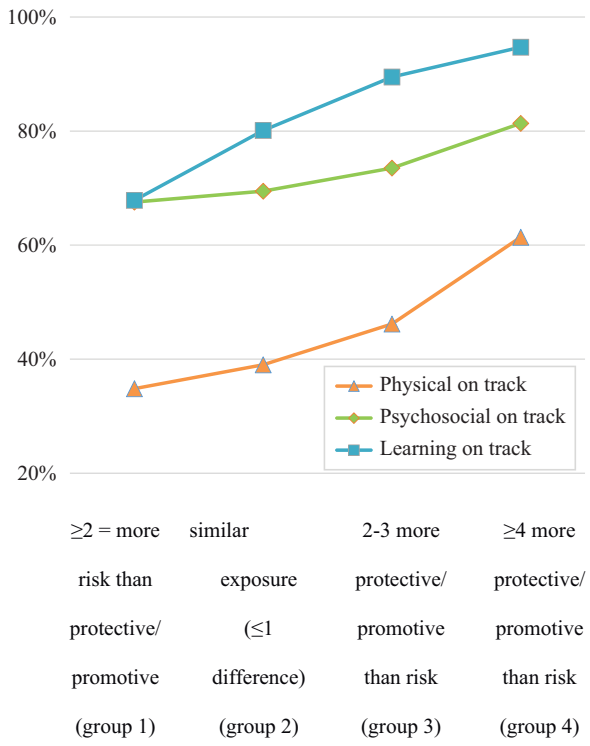

Figure 1. Developmental consequences of the imbalance between risk and protective/promotive influences in low- and middle-income countries.

As shown in Figure 1, children were significantly more likely to be developmentally on track in physical, psychosocial, and learning competence as CPI scores increased and CRI scores decreased (all group differences shown in Figure 1 are significant at $p < .001$:t test range: $t = 3.62$–33.80). For example, the percentage of children whose learning was on track for age was 68% for children in the group characterized by high CRI/low CPI, versus 95% of children in the group characterized by very high CPI/low CRI (results for individual countries are shown in Supplementary Table A2).

Intervention implications

Poor children in low- and middle-income countries are exposed to a greater variety, number and intensity of developmental risks factors, and to fewer protective/promotive influences than are poor children from high-income countries. The developmental consequences of this imbalance between cumulative risk versus cumulative protective/promotive influences are shown in Figure 1. Two implications are derived from this imbalance. *First*, causal paths from poverty to developmental inequality in low- and middle-income countries are more likely to reflect the impact of greater exposure to multiple cumulative risks than of single risk mediators. *Second*, the combination of exposure to multiple covarying risks and the relative paucity of protective/promotive influences in low- and middle-income countries emphasizes the importance of implementing multi-domain intervention strategies for children

living in poverty in these countries where the need for such interventions is greatest.

An increasing realization of the importance of multi-domain intervention strategies is seen across multiple disciplines. Economists working within low- and middle-income countries have emphasized the importance of direct investment in a variety of strategies that promote "human capital" in low-income families such as providing better nutrition, promoting maternal education, and keeping children in school (Alderman & Linnemayr, 2009; Mendoza, 2009). Developmental scientists have emphasized the importance of implementing strategies in low- and middle-income countries to reduce children's exposure to poverty- linked multiple risks and enhance their exposure to protective/promotive influences (Engle & Black, 2008; Wachs & Rahman, 2013; Walker et al., 2011). Policy makers are increasingly recognizing that meeting targeted goals is more likely to occur when multiple complimentary interventions are utilized, particularly when such interventions are synergistic (del Rio & Howlett, 2013).

Real-world progress in implementing such strategies also is seen in the increasing number of promising multi-domain intervention programs in low- and middle-income countries targeted to children and families (Black & Dewey, 2014; Rahman, Patel, Masselko, & Kirkwood, 2008). Such programs have the potential to reduce the imbalance between exposure to cumulative risk and cumulative protective/promotive influences and thus facilitate the development of the over 200 million young children from low- and middle-income countries living in poverty who are at risk for compromised development (Grantham-McGregor et al., 2007).

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