DLL **Evidence Review**

Authors Bet Caeyers Charlotte Ringdal

Volume 01

Issue 01

May 2024

Impacts of parenting programs in low- and middle-income countries: Nutrition, violence against children, and mental health





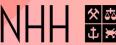




Table of content

bstract		3
ain poi	nts	3
Back	kground and objectives	4
Meth	hodology	5
Liter	ature review	5
3.1	Nutritional outcomes	5
3.2	Violence against children	7
3.3	Mental health of children and their caregivers	9
Disc	ussion	12
Reco	ommendations	13
References		
	ain poi Bac Meti Liter 3.1 3.2 3.3 Disc Rec	Methodology Literature review 3.1 Nutritional outcomes 3.2 Violence against children 3.3 Mental health of children and their caregivers Discussion Recommendations

Abstract

This evidence review explores the impacts of parenting programs in low- and middle-income countries (LMICs) on child nutrition, violence against children, and caregiver and child mental health. The review synthesizes findings from systematic reviews together with the most recent research in the area. Effective parenting interventions can significantly enhance nutritional outcomes, reduce instances of violence against children, and improve the mental health of children and in some instances their caregivers. The review highlights important components of parenting programs to affect each of the three outcome areas. The review also discusses gaps in current research and provides recommendations for future interventions

Main points

- Parenting programs can improve child nutrition by integrating educational interventions on feeding practices with supplementary nutrition and WASH initiatives.
- Parenting programs can reduce violence against children especially when including positive parenting skills and non-violent discipline strategies.
- Programs focusing on psychoeducation and behavioral strategies can improve the mental health of both children and their caregivers, relying on communitybased, non-specialist delivery.
- There is a lack of evidence of the effect of parenting programs on intimate partner violence (IPV), violence against adolescents, sexual abuse, and maternal depression.

1 Background and objectives

In low- and middle-income countries (LMICs), over 250 million children are at risk of not reaching their full developmental potential, largely due to insufficient nutrition and early stimulation (Black et al., 2017). Effective parenting interventions have been shown to significantly benefit children's physical health, cognitive abilities, and socioemotional growth. Furthermore, such interventions contribute to enhanced educational achievements, higher earnings, and improved life outcomes in the long term (Black et al., 2017; Engle et al., 2011; Gertler et al., 2014). This evidence review examines the relationship between parenting programs and three outcomes: Child nutrition, violence against children (VAC), and the mental health of children and their caregivers.

Child nutrition. Globally, malnutrition remains a pressing issue, with nearly 150 million children under five affected by stunting, wasting, and obesity (WHO, 2024). Nearly half of all deaths among this age group are associated with undernutrition, predominantly occurring in LMICs. The consequences of malnutrition are profound, affecting individuals, families, and societies both immediately and over the long term. Essential nutrition actions during the first 1000 days of life – that is, the period from conception until age 2 – are crucial for preventing undernutrition's adverse effects (WHO, 2024). As primary caregivers – in particular, during the early child development period – parents play a pivotal role in determining children's diet and nutritional intake. Parenting programs have been frequently used to enhance caregivers' knowledge, attitudes, and practices around the provision of adequate nutrition and safe water and sanitation environments.

Violence against children. Over a billion children worldwide, aged between 2 and 18 years, are affected by violence, with it being more prevalent in LMICs (Hillis et al., 2016; Stoltenborgh et al., 2015). Violence against children refers to any form of physical, sexual, or emotional harm inflicted upon individuals under the age of 18, whether perpetrated by adults or peers. It encompasses various acts such as physical abuse, sexual exploitation, neglect, and psychological maltreatment (United Nations, 2006). This definition excludes practices like female genital mutilation (FGM) and child marriage, which are distinct issues but are often associated with broader discussions of violence against children. This review focuses on violence against children within their homes, that is usually perpetrated by their parents. Additionally, while this review primarily focuses on violence against children, intimate partner violence (IPV), recognized as a form of child maltreatment due to its impact on children witnessing or experiencing it, is considered relevant and included in the review. This violence does not only cause immediate harm; it also leads to long-term wellbeing issues such as mental health struggles, physical impairments, disabilities, and even death (Hughes et al., 2017; Mehta et al., 2023, O'Sullivan et al., 2018). Furthermore, it places a significant economic and societal burden on communities (Fang et al., 2015). One of the key strategies to combat this issue is through parenting programs. These programs, which encompass activities and services designed to enhance parenting knowledge, skills, and competencies, have been recognized as a crucial tool in preventing and reducing violence against children (World Health Organization, 2016; UNICEF, 2020).

Child mental health. Mental health issues are a primary cause of decreased productivity among young people worldwide (Mokdad et al. 2016). Nearly half of the global population under 24 years, predominantly residing in LMICs, are at a heightened risk of mental illness due to factors like poverty, violence, and inadequate healthcare services (Kieling et al. 2011). Most mental disorders begin in childhood or adolescence and can have lifelong negative impacts. The family environment, particularly a

positive caregiver-child relationship, plays a crucial role in a child's mental health and development (Biglan et al. 2012). As such, psychosocial parenting programs may positively impact children's mental health. Protective factors include parent mental health, family cohesion, and parent-child attachment, while risk factors encompass caregiver mental health issues and violent family environments (Patel et al. 2008; White et al. 2015; Parsons et al. 2012; Repetti et al. 2002).

Caregiver mental health. Addressing the mental health of mothers and caregivers is vital for several reasons. Firstly, caregiver mental health directly influences their ability to provide responsive, nurturing care, which is essential for healthy child development. Mental health issues in caregivers can lead to decreased emotional availability, impaired parenting practices, and an increased risk of adverse child outcomes. Additionally, mental health challenges among caregivers can affect the overall emotional climate of the household, further impacting children's emotional and psychological well-being. Thus, interventions aimed at improving caregiver mental health not only benefit the caregivers themselves but also create a more supportive and healthier environment for children's growth and development. By integrating caregiver mental health components into parenting programs, we can enhance the efficacy of these interventions, promoting better outcomes for both children and their families.

2 Methodology

This evidence review process was initiated with a foundation of previously known papers that set the preliminary context for our topics of interest. To expand upon this base and ensure a thorough exploration of the subjects, we conducted a targeted search on the 3ie Evidence Portal, a reputable repository for systematic reviews and evaluations related to international development interventions. Our search criteria were focused on systematic reviews within our areas of interest – i.e. child nutrition, violence against children, child mental health and caregiver mental health – aiming to capture a broad spectrum of evidence-based findings and insights.

Additionally, recognizing the importance of the most recent research to capture evolving insights and emerging evidence, we extended our search on the 3ie Evidence Portal to include independent studies published from 2020 to 2024. We also searched the Web of Science for studies published after 2020. This allowed us to incorporate the latest data and analyses on the effectiveness of parenting interventions targeting our key themes. Through this multi-faceted search strategy, we aimed to construct a comprehensive overview of current knowledge and identify gaps where future research could contribute to our understanding of effective parenting interventions in LMICs.

3 Literature review

3.1 Nutritional outcomes

The relationship between parenting programs and nutritional outcomes in LMICs is multi-faceted, with several systematic reviews shedding light on various intervention strategies and their impacts. Prasetyo et al. (2023) delve into the effect of nutritional education provided to mothers, analyzing 15 studies, primarily from Indonesia—a reflection of the country's concerted efforts to combat stunting. Nutritional education is typically delivered by community health workers or nutritionists either in group-settings or during home

visits. For the youngest children, the focus is often on educating mothers on the benefits of exclusive breastfeeding and how to introduce complementary foods safely and effectively thereafter. For older children, nutrition education involves teaching mothers how to identify signs of malnutrition and stunting early and which actions to take. It may also be part of the program to distribute nutritional supplements. This review finds that such educational interventions not only significantly enhance mothers' nutritional knowledge and practices, including the importance of exclusive breastfeeding and recognizing malnutrition signs, but also lead to a reduction in child stunting rates. These outcomes underline the critical role of maternal knowledge in child nutrition, advocating for interactive, participatory educational interventions that foster communal learning and problem-solving.

The distribution of nutritional supplements can play a critical role in child development, as evidenced in a systematic review by Zhang et al. (2021), who found that children receiving oral nutrition supplements significantly increased their energy intake, leading to notable gains in weight and height compared to control groups who received either dietary counseling, a placebo, or maintained their usual diet. Although dietary counseling alone did contribute to growth improvements in some cases, these were substantially smaller than those observed in the nutrition supplement group. The variability in the effectiveness of dietary counseling alone can be attributed to factors such as the intensity of counseling, targeted behavioral changes, caregivers' time constraints, and challenges in achieving dietary diversity. Therefore, Zhang et al. (2021) recommend integrating nutritional supplementation and food fortification with dietary counseling to ensure adequate nutrient density and nutritional adequacy, particularly for promoting catch-up growth in undernourished children. This combined approach is shown to be especially effective in enhancing growth in terms of weight and height over intervention periods of up to 90 days.

Janmohamed et al. (2019) evaluate any type of community health worker (CHW) home visits and mother/peer group interventions – including programs focusing on nutritional education but also other ones such as programs focusing on early learning and responsive caregiving – across 83 studies. Their findings highlight the effectiveness of CHW home visits in increasing early initiation and exclusivity of breastfeeding, while mother or peer group interventions were instrumental in improving children's dietary diversity and meal frequency. This is likely due to participatory cooking demonstrations that often occur during group sessions. Notably, combining home visits and group platforms yielded synergistic effects, particularly in breastfeeding practices and reducing child wasting, suggesting a compounded benefit of multi-platform delivery methods.

Grantham-McGregor et al. (2014) focus on integrated interventions that combine psychosocial parenting components with nutrition and sometimes health-promotion aspects. They report that while nutritional interventions frequently lead to growth improvements and stunting reduction, stimulation activities geared towards early child development consistently show significant cognitive and socio-emotional benefits. The integration of nutrition and stimulation does not dilute the effectiveness of either component, illustrating the feasibility and potential of holistic approaches to child development and nutrition.

Hossain et al. (2016) examine programs specifically aimed at reducing stunting, identifying fourteen programs across nineteen LMICs. Their review underscores that interventions focusing only on nutrition are likely to be insufficient in themselves to reduce stunting. A combination of both nutrition-specific (such as nutrition education, supplements, and growth monitoring) and nutrition-sensitive (such as WASH

programs (water, sanitation, and hygiene) and social safety nets (like cash transfers and food vouchers)) approaches is needed for the best effects.

Relatedly, Gizaw and Worku (2019) assess the impact of WASH interventions (access to clean water, improving sanitation facilities, promoting good hygiene practices) on child nutrition, finding that such interventions significantly enhance growth and reduce stunting. The analysis revealed that the impact of WASH interventions varied by age and the type of interventions (either single or combined). Specifically, WASH interventions had a more significant effect on height-for-age-z scores – a measure of stunting – among children under two years old. Moreover, the review found that combined WASH interventions (involving multiple WASH strategies) were more effective than single interventions, with children receiving combined interventions showing better growth outcomes compared to those who received only one type of intervention. This underscores the importance of clean water, sanitation, and hygiene in child nutrition and health.

Goudet et al. (2019) assess interventions aimed at reducing stunting among children in urban slums in LMICs, finding limited evidence of their effectiveness in these unique settings, despite success in nonslum contexts. The review spans 15 studies, with a majority in Bangladesh, India, and Peru, exploring a range of interventions from micronutrient supplementation to nutrition education. Similarly, Mutisya et al. (2020) focus on urban poor children in sub-Saharan Africa, noting that while interventions generally increase maternal knowledge and nutrition intake, they make only a marginal impact on children's anthropometric status. These findings underscore the complexity of nutritional improvements in slum areas, highlighting that effective strategies must transcend basic education and supplementation to address the multifaceted environmental and social determinants of malnutrition in densely populated, resourcelimited urban settings.

Watson et al. (2023) further expand on the role of behavioral change interventions in sub-Saharan Africa, showing that interventions employing behavior change functions, such as persuasion and incentivization, effectively reduce infant stunting and wasting and improve household dietary intake and maternal psychosocial measures.

Collectively, these reviews underscore the effectiveness of diverse intervention strategies in improving nutritional outcomes, highlighting the need for contextually adapted, multidimensional approaches that leverage community engagement, behavior change techniques, and environmental health measures to address the complex challenge of malnutrition in LMICs.

3.2 Violence against children

A recent scoping review by Wang and Zhang (2023) provides a comprehensive overview of parenting programs aimed at preventing violence against children in LMICs, with a significant emphasis on interventions conducted in Africa and Asia, particularly in East Africa (Tanzania, Kenya, and South Sudan), South Africa, and Southeast Asia (Thailand, the Philippines, Malaysia, and Indonesia). Most of the interventions targeted younger children (under 10 years old), all of them were group-based and a significant portion of the programs were delivered by trained local community/childcare workers or lay workers. The interventions considered cover positive parenting practices, non-violent discipline strategies, stress or anger management, dealing with conflict and problem solving, the basic needs and the

developmental characteristics of children, potential dangers of violence, and crisis response and economic management.

Wang and Zhang (2023) analyze the results of 31 interventions. While violence against children was the primary outcome in all studies, papers vary in the forms of maltreatment considered and reported on. 24 trials (77.4%) measured general maltreatment (which includes physical, psychological, and sexual abuse, neglect, and any behavior that harms or is likely to harm the child), with 18 (75.0%) showing significant reductions as a result of the parenting programs. All 16 interventions (100%) that assessed physical abuse or corporal punishment reported significant decreases. Among the studies that looked at emotional abuse, 13 out of 14 (92.9%) reported significant improvements. Of the 7 interventions that measured neglect, 4 (57.1%) found significant reductions, illustrating varied effects on this specific outcome. Only one study measured sexual abuse, and it reported no significant effects from the intervention. The review also emphasizes that out of the 21 trials that measure positive parenting strategies, 15 (76.2%) show notable improvements.

Crucial components of these interventions include the promotion of positive parenting and non-violent discipline strategies. Positive parenting practices encompass strategies and approaches that foster a supportive, nurturing, and non-violent environment for children's development. These practices include consistent and compassionate communication, setting clear boundaries and expectations in a respectful manner, engaging in active listening, offering praise and positive reinforcement for good behavior, and using non-punitive discipline techniques. The aim is to promote children's self-esteem, emotional intelligence, and social skills by emphasizing love, support, and guidance rather than punishment. For adolescents (above 10 years old), all implemented programs are based on the Parenting for Lifelong Health (PLH) program, indicating a lack of evidence on the breadth and effectiveness of parenting interventions for this older age group. Further, there is a lack of evidence concerning sexual abuse and child neglect.

The findings from Wang and Zhang (2023) are further enriched by the systematic review and metaanalysis conducted by McCoy et al. (2020), which specifically investigates parenting programs aimed to reduce child maltreatment, harsh or dysfunctional parenting, teach positive child behavior management strategies or improve parent-child relationship either as primary or secondary outcomes in East and Southeast Asia. This analysis scrutinizes the effectiveness of parenting interventions in reducing violence against children, including abusive, harsh, or negative parenting practices. McCoy et al. found that such interventions have a statistically significant, but small effect on reducing abusive parenting behaviors.

In addition to the parenting programs, a 2021 systematic review, Little et al. (2021) shed light on the effects of combining cash transfers with child protection interventions (defined as violence prevention and parenting interventions), a strategy aimed at enhancing child welfare in high-poverty and food-insecure contexts. These combined programs, designed within an early child development framework, predominantly utilized home visits, with some incorporating small-group and village assembly components to strengthen community engagement. While these integrated approaches were effective in reducing violent discipline practices among parents, meta-analysis indicated that Cash + Child Protection programs did not significantly outperform cash transfers alone in diminishing parental violent discipline or in promoting exclusive positive parenting practices. Ismayilova and Karimli (2018) find, however, that when working with ultra-poor families in Burkina Faso, an economic intervention plus family coaching

was more successful in reducing harsh discipline and improving child-parent relationships than only receiving an economic intervention.¹

Violence against children and intimate partner violence (IPV) often occur within the same families, and witnessing IPV is considered child maltreatment. While we have not been able to identify any systematic review that looks at the effect of parenting on IPV (or domestic violence in general) in LMICs, we have identified two recent studies. Cao et al. (2021) do not find an effect of a parenting intervention on IPV in Ghana while Jensen et al. (2021) find that both VAC and IPV decreased after a parenting intervention embedded in a social protection program in Rwanda. The two studied interventions are considerably different. Jensen et al. (2021) use a home-visit program and target the poorest families in Rwanda. The aim of the parenting program was to improve early child development and reduce violence and use psychoeducation and active coaching of caregivers to promote responsive caregiving, nutrition, hygiene, and non-violent interactions among household members. Further, active participation of both female and male caregivers in childcare and household decision-making was encouraged. Cao et al. (2021) investigate the effect of a group-based maternal and mental health intervention and did not specifically target IPV. Thus, the combination of home-visits and a curriculum specifically targeting IPV may explain why Jensen et al. (2021) find an effect while Cao et al. (2021) do not.

The exploration of parenting programs as a strategy to mitigate violence against children and domestic violence in LMICs reveals a promising yet complex landscape. Studies like those by Wang and Zhang (2023) and McCoy et al. (2020) demonstrate the potential of these interventions to significantly reduce various forms of maltreatment through the promotion of positive parenting and nonviolent discipline strategies. Despite the clear benefits, challenges such as the underrepresentation of adolescents as target individuals and curriculum gaps in addressing sexual abuse and intimate partner violence (IPV) highlight areas for future research and program development. The variability in outcomes across different settings and intervention designs calls for a nuanced understanding of how parenting programs can be optimized to foster safer, more nurturing environments for children and families globally.

3.3 Mental health of children and their caregivers

This section examines the role of parenting programs in improving mental health in LMICs, focusing on two key groups: children/youth and mothers. We begin by assessing the impact of these programs on the mental health and behavioral development of children and adolescents. Understanding the effects on young individuals is crucial as early interventions play a significant role in their long-term psychological well-being. Next, we turn our attention to the mental health of mothers, highlighting the importance of maternal well-being for its direct influence on child development, parenting practices, and the overall emotional environment of the family.

¹ The economic intervention included savings group formation and training, livelihood planning training, seed capital grants and biweekly to monthly one-on-one mentoring and coaching.

3.3.1 Maternal mental health

Pedersen et al. (2019) provide a systematic review focusing on the mental health outcomes of parenting programs for children and their caregivers LMICs. Their review spans 36 papers detailing 32 unique trials, with a concentration in Africa (14 out of 32 trials) and within community settings (22 out of 32). The interventions examined fall into two broad categories: those centered on parents and those involving the whole family, covering a spectrum of approaches including psychoeducation, skills training, behavioral strategies, psychosocial support, and trauma-focused cognitive-behavioral therapy. A vast majority (88%) of these studies reported improvements in children and youths' mental health and well-being, alongside enhancements in parenting practices and family dynamics, demonstrating the substantial positive impact of these interventions.

An important aspect of these programs is their reliance on non-specialists for delivery in 65% of cases, including lay health workers and facilitators, as opposed to the 19% and 16% where mental health specialists and trained para specialists were engaged, respectively. This approach underscores a pragmatic strategy to overcome the scarcity of mental health professionals in LMICs. However, the methodologies and quality of these studies vary, with approximately half employing randomized controlled trials (RCTs) or cluster RCTs and the others utilizing less rigorous designs. Pedersen et al. raised concerns about study quality, with only half of the studies being rated as "Good" and issues such as small sample sizes and inadequate reporting on sample size power, suggesting a risk of bias.

Despite these methodological concerns, the outcomes for child and youth mental health were largely positive, with strategies like caregiver psychoeducation (that is, educating caregivers about mental health issue, their causes, and how they can be managed or treated, particularly focusing on the developmental aspects of children) and the development of coping skills (that is, equipping caregivers with practical skills to help both themselves and their children manage stress, regulate emptions and cope with challenges) emerging as the most effective. Additional techniques, such as assigning between-session homework and enhancing treatment accessibility, also contributed to the success of these interventions, highlighting the multifaceted approach needed to address mental health in this demographic.

Complementing this, Burkey et al. (2018) conducted a systematic review of interventions targeting disruptive behavior problems in children, a concern closely linked with mental health. Among the 28 interventions identified, a subset focused on behavioral parenting interventions (including psychosocial stimulation (structured play sessions), positive parenting, and parenting strategies) demonstrated efficacy, with a meta-analysis of eight parent-focused programs showing a significant reduction in disruptive behaviors. This further corroborates the value of targeted behavioral parenting programs in mitigating behavioral and mental health issues among children and adolescents in LMIC settings.

3.3.2 Maternal mental health

Maternal depression effectively responds to cognitive behavior therapy, interpersonal therapy, and pharmacological treatments when delivered by specialists, such as those trained in psychology, psychiatry, or clinical social work (Patel et al., 2016). Yet, in LMICs, most individuals with depression face significant barriers in accessing mental health services (Chisholm et al., 2016). This challenge is exacerbated by a scarcity of specialists, highlighting the necessity for interventions deliverable by non-specialists like trained community health workers (CHWs), traditional community midwives (TCMs), or primary care

workers. Despite the effectiveness of pharmacotherapy in symptom reduction, its access and availability remain poor in LMICs (Patel et al., 2018).

Systematic reviews indicate that non-specialist, psychosocial treatments have a moderate impact on mental and neurological disorders, although they predominantly focus on general adult mental health rather than targeting pregnant and postpartum mothers specifically (Singla et al., 2017; Barbui et al., 2020). A 2013 review of non-specialist depression interventions for mothers during the perinatal period found moderate reductions in maternal depression and minor improvements in child health and mother–child interactions (Rahman et al., 2013).

Parenting programs focusing on the first two years of life often aim to educate caregivers about the importance of caregiver-child interactions and coach them in responsive stimulation practices. These interventions can potentially indirectly improve maternal depressive symptoms through the social support provided by the facilitators or group members, enhancing the mother-child interaction which, in turn, may improve caregiver mood, decrease perceived stress, and increase self-esteem (Aboud and Yousafzai, 2015). A recent systematic review and meta-analysis examining the effects of psychosocial stimulation interventions on maternal outcomes in LMICs found mixed effects on maternal depression, with some interventions demonstrating significant reductions in depressive symptoms (Jeong et al., 2018). Success in reducing maternal depressive symptoms was attributed to explicit mental health content or the combination of social support and efforts to build parenting self-esteem (Singla et al., 2015; Baker-Henningham et al., 2005).

Recent systematic reviews and studies have delved deeper into the specifics of how various parenting programs impact maternal mental health. Notably, Jervis et al. (2023) conducted a focused review on the Reach Up Parenting program, a singular initiative with roots in a program first implemented in Jamaica in the 1970s-1980s. The Reach Up program aims to build parenting skills to foster child development, with the review uncovering no effects on maternal depressive symptoms. This suggests that while the program holds promise for child development, enhancing its impact on maternal depression may require the incorporation of additional, targeted content addressing this specific objective.

Parallel to this, Pedersen et al. (2018) offered a broader perspective through their systematic review of parenting programs discussed above, which found that approximately 42% of the studies reporting on caregivers' mental health observed positive effects. This variance in outcomes underscores the complexity of addressing maternal mental health within the context of parenting programs and highlights the necessity for tailored approaches that directly address the multifaceted needs of mothers.

The Integrated Mothers and Babies Course (iMBC) exemplifies a targeted effort to blend maternal mental health support with early childhood development principles. Implemented in Ghana (Baumgartner et al., 2021) and Kenya (Kim et al., 2021), the iMBC program seeks to address postpartum depression through an evidence-based curriculum integrated with ECD content. In Ghana, the study compared the outcomes between groups receiving the iMBC and ECD curriculum against those receiving only the ECD curriculum. Both groups exhibited reductions in depressive symptoms from pregnancy to post-birth, but the lack of a significant difference between the intervention arms suggests the need for a deeper analysis to untangle the effects of ECD curriculum components on maternal depression. The application of the iMBC program in Kenya offered further insights. Kim et al. (2021) explored the program's impact across

different demographic subsets of the population. While the overall effect on maternal depression was not significant, a more nuanced analysis revealed that the intervention was particularly beneficial for women with lower education levels, those with more children, and those without recent experiences of intimate partner violence.

Studies exploring the impact of parenting programs without a direct mental health focus report varied outcomes on maternal mental health. For instance, interventions targeting nutrition and parenting practices, such as a home visiting program in India's urban slums (Andrew et al., 2020) and a group-based intervention in Uganda (Atukunda et al., 2019), have demonstrated improvements in maternal depressive symptoms. Similarly, parenting programs in Iran (Bemanalizadeh et al., 2022) and South Africa (Cluver et al., 2017) also reported reductions in maternal depression and anxiety. Conversely, research conducted by Jeong et al. (2023) in Tanzania evaluating an intervention that included stress management, couples' communication, decision-making, and conflict resolution found no significant effect on depressive symptoms. Additionally, Sargsyan et al. (2023) reported no significant impacts on depressive symptoms in a humanitarian setting in Rwanda. These mixed results underscore the critical role of context and the specific design of the program in determining the effectiveness of parenting interventions on mental health outcomes.

4 Discussion

The exploration of parenting programs in LMICs reveals a complex landscape where interventions aimed at improving nutritional outcomes, reducing violence against children and domestic violence, and enhancing mental health offer significant potential to transform the developmental trajectory of young populations. This discussion synthesizes findings across these critical areas, drawing comparisons and highlighting the interconnectedness of these outcomes.

Nutritional Outcomes: Parenting programs have shown success in improving nutritional outcomes, particularly through educational interventions that enhance maternal knowledge and practices. Reviews by Prasetyo et al. (2023) and Janmohamed et al. (2019) underscore the importance of participatory approaches and community engagement in fostering healthier behaviors and reducing stunting and malnutrition. The emphasis on multi-faceted strategies, including WASH and behavior change interventions, points to the necessity of addressing environmental and behavioral determinants of nutrition simultaneously. However, the challenges encountered in urban slums, as highlighted by Goudet et al. (2019) and Mutisya et al. (2020), remind us of the complexities involved in translating these interventions into real outcomes in all contexts.

Violence Against Children: The impact of parenting programs on reducing violence against children and domestic violence is very promising, with studies demonstrating the effectiveness of such interventions in changing parental behaviors and fostering nonviolent discipline strategies. The review by Wang and Zhang (2023) illustrates the potential of group-based programs delivered by local workers to decrease various forms of maltreatment. However, it is important to note that while evidence on reducing violence against children is promising, the research base specifically addressing the effects of parenting programs on intimate partner violence (IPV) is more limited. This gap highlights a crucial area for future exploration to understand the broader implications of these interventions on family dynamics. Additionally, the limited evidence concerning adolescents and sexual abuse, alongside the nuanced findings on the efficacy of cash

transfer plus child protection programs, suggests that more targeted research is needed to fully understand and maximize the protective effects of these interventions.

Mental Health Outcomes: Parenting programs can also play an important role in improving the mental health of children, adolescents, and their caregivers. The systematic reviews and meta-analyses presented indicate that interventions focusing on psychoeducation, skills training, and behavioral strategies can lead to significant improvements in mental well-being and family dynamics. Particularly noteworthy is the reliance on non-specialists for delivering these interventions, a pragmatic approach in settings where mental health professionals are scarce. However, the varied success of programs in addressing maternal depression and disruptive behavior problems underscores the need for tailored and context-specific strategies that consider the diverse needs of families.

Interconnectedness and Comparative Insights: Across these domains, several themes emerge that emphasize the interconnectedness of nutritional, violence-related, and mental health outcomes. First, the critical role of education and behavior change in driving positive outcomes highlights the power of knowledge and behavioral modification as foundational elements of successful interventions. Second, the importance of context-sensitive approaches is evident across all areas, with interventions needing to be adapted to the unique challenges and resources of different settings, particularly in urban slums and among vulnerable populations. Third, the reliance on community-based delivery and non-specialist facilitators across nutritional and mental health interventions points to a broader shift towards leveraging local capacity and resources to address complex health and developmental issues.

In conclusion, parenting programs in LMICs hold potential to address a wide range of challenges affecting child development and family well-being. The synthesis of findings across nutritional outcomes, violence prevention, and mental health enhancement highlights the multifaceted nature of these interventions and the importance of integrated, contextually adapted strategies. Future research should focus on filling the gaps identified, particularly regarding the needs of adolescents, the nuances of domestic violence interventions, and the long-term sustainability of positive outcomes. By continuing to refine and adapt these programs, there is a significant opportunity to make a lasting impact on the lives of children and families in LMICs.

5 **Recommendations**

Based on this review, we recommend that a parenting intervention should include the following elements to improve nutritional outcomes, reduce violence against children and improve mental health:

1. Incorporate Nutritional Education and Support, and nutrition supplements

- Tailor nutritional education to improve maternal knowledge and practices, emphasizing the importance of exclusive breastfeeding, complementary feeding, and recognizing signs of malnutrition.
- In case of undernutrition, consider the use of oral nutrition supplements.
- Utilize interactive and participatory methods for educational interventions, including group-based sessions led by trained community or childcare workers to foster a supportive learning environment. Include cooking demonstrations in these group-based sessions can be useful.

• Integrate WASH interventions as part of the nutritional component to address environmental determinants of child health.

2. Implement Strategies to Reduce Violence Against Children and Domestic Violence

- Promote positive parenting and non-violent discipline strategies through group-based programs and activities that encourage reflection, discussion, and learning among caregivers.
- Address the needs of adolescents by expanding program content to include age-appropriate interventions that consider the unique challenges faced by this group.
- Explore integrated approaches that combine cash transfers with child protection interventions to enhance child welfare, particularly in contexts of high poverty and food insecurity.

3. Enhance Mental Health Through Psychoeducation and Support

- Focus on psychoeducation and skills training for parents and caregivers to improve mental health outcomes for children and adolescents, using methods that can be delivered by non-specialists to increase accessibility.
- Adding group-based parenting sessions so that caregivers can build a network and get more support.
- Support maternal mental health by including targeted interventions within parenting programs that address common mental health conditions, utilizing cognitive-behavioral strategies and social support mechanisms.

References

- Aboud F.E & Yousafzai A.K. (2015) Global health and development in early childhood. Annual Review of Psychology, 66:433-457. https://doi.org/10.1146/annurev-psych-010814-015128
- Andrew A., Attanasio, A., Augsburg, B., Day, M., Grantham-McGregor, S., Meghir, C., Mehrin, C., Pahwa, S., & Rubio-Codina, M. (2020). Effects of a scalable home-visiting intervention on child development in slums of urban India: evidence from a randomised controlled trial. Journal of Child Psychology and Psychiatry, 61(6): 644-652. https://doi.org/10.1111/jcpp.13171
- Atukunda P., Muhoozi, G. K. M., Westerberg, A. C., & Iversen, P. O. (2019) Nutrition, hygiene and stimulation education for impoverished mothers in rural Uganda: effect on maternal depression symptoms and their associations to child development outcomes. Nutrients, 11(7):1561. https://doi.org/10.3390/nu11071561
- Baker-Henningham H., Powell, C., Walker, S., & Grantham-McGregor, S. (2005). The effect of early stimulation on maternal depression: a cluster randomised controlled trial. Archives of Disease in Childhood, 90(12):1230-1234. https://doi.org/10.1136/adc.2005.073015
- Barbui C., Purgato, M., Abdulmalik, J., Acarturk, C., Eaton, J., Gastaldon, C., Gureje, O., Hanlon, C., Jordans, M., Lund, C., Nosè, M., Ostuzzi, G., Papola, D., Tedeschi, F., Tol, W., Turrini, G., Patel, V., & Thornicroft, G. (2020). Efficacy of psychosocial interventions for mental health outcomes in low-income and middle-income countries: an umbrella review. Lancet Psychiatry 7(2):162-172. https://doi.org/10.1016/S2215-0366(19)30511-5
- Bemanalizadeh, M. Badihian, N., Khoshhali, M., Badihian, S., Hosseini, N., Purpirali, M., Abadian, M., Yaghini, O., Daniali, S. S., & Kelishadi, R. (2022) Effect of parenting intervention through "Care for Child Development Guideline" on early child development and behaviors: a randomized controlled trial. BMC Pediatrics, 22:690. https://doi.org/10.1186/s12887-022-03752-x
- Biglan A., Flay B. R., Embry D. D., Sandler I. N. (2012). The critical role of nurturing environments for promoting human well-being. American Psychologist, 67(4):257-71. https://doi.org/10.1037/a0026796
- Burkey, M. D., Hosein, M., Morton, I., Purgato, M., Adi, A., Kurzrok, M., Kohrt, B. A., & Tol, W. A. (2018) Psychosocial interventions for disruptive behaviour problems in children in low- and middle-income countries: A systematic review and meta-analysis. Journal of Child Psychology and Psychiatry, 59(9): 982-993. https://doi.org/10.1111/jcpp.12894
- Cao, J., Gallis, J.A., Ali, M., Lillie, M., Abubakr-Bibilazu, S., Adam, H. McEwan, E. Awoonor-Williams, J. K., Hembling, J., & Baumgartner, J. N. (2021). The impact of a maternal mental health intervention on intimate partner violence in Northern Ghana and the mediating roles of social support and couple communication: secondary analysis of a cluster randomized trial. BMC Public Health, 21:2010, https://doi.org/10.1186/s12889-021-12121-9
- Chisholm D., Sweeny, K., Sheehan, P., Rasmussen, B., Smit, F., & Cuijpers, P. (2016). Scaling-up treatment of depression and anxiety: a global return on investment analysis. Lancet Psychiatry, 3(5):415-424. https://doi.org/10.1016/S2215-0366(16)30024-4
- Cluver, L. D., Menick, F., Steinert, J. I., Shenderovich, Y., Doubt, J., Romero, R. H., Lombard, C. J., Redfern, A., Ward, C. L., Tsoanyane, S. Nzima, D., Sibanda, N., Wittesaele, C., Stone, S. D., Boyes, M. E., Catanho, R., Lachman, J. M. Salah, N. Nocuza, M., & Gardner, F. (2017) Parenting for Lifelong Health: a pragmatic cluster randomized controlled trial of a non-commercialised parenting programme for adolescents and their families in South Africa. BMJ Global Health, 3:e000539. Https://doi.org/10.1136/bmjgh-2017-000539
- Cluver, L., Shenderovich, Y., Meinck, F., Berezin, M. N., Doubt, J., Ward, C.I., Parra-Cardona, J., Lombard, C., Lachman, J. M. M. Wittesaele, C., Wessels, I. Gardner, F. Steinert, J. I. (2020) Parenting, mental health and economic pathways to prevention of violence against children in

South Africa. Social Science & Medicine, 262: 112194. https://doi.org/10.1016/j.socscimed.2020.113194

- Fang, X., Fry, D. A., Ji, K., Finkelhor, D., Chen, J., Lannen, P., & Dunne, M. P. (2015). The burden of child maltreatment in China: A systematic review. Bulletin of the World Health Organization, 93(3), 176–185. https://doi.org/10.2471/blt.14.140970
- Gisaw, Z. & Worku, A. (2019). Effects of single and combined water, sanitation and hygiene (WASH) interventions on nutritional status of children: a systematic review and meta-analysis. Italian Journal of Pediatrics, 45:77. https://doi.org/10.1186/s13052-019-0666-2
- Goudet, S. M., Bogin, B. A., Madise, N. J, & Griffiths, P. L. (2019). Nutritional interventions for preventing stunting in children (birth to 59 months) living in urban slums in low- and middleincome countries (LMIC). Cochrane Database of Systematic Revies, 6. https://doi.org/10.1002/14651858.CD011695.pub2
- Grantham-McGregor, S. M., Fernald, L. C. H., Kagawa, R. M. C., & Walker, S. (2014). Effects of integrated child development and nutrition interventions on child development and nutritional status. Annals of the New York Academy of Science, 11-23. https://doi.org/10.1111/nyas.12284
- Hamadani J. D., Mehrin, S. F., Tofail, F., Hasan, M. I., Huda, S. N., Baker-Henningham, H., Ridout, D, & Grantham-McGregor, S. (2019). Integrating an early childhood development programme into Bangladeshi primary health-care services: an open-label, cluster-randomised controlled trial. Lancet Global Health, 7(3):E366-E375. https://doi.org/10.1016/S2214-109X(18)30535-7
- Hillis, S., Mercy, J., Amobi, A., & Kress, H. (2016). Global prevalence of past-year violence against children: A systematic review and minimum estimates. Pediatrics, 137(3), e20154079. https://doi.org/10.1542/peds.2015-4079
- Hossain, M., Choudhury, N., Abdullah, K. A. B., Mondal, P., Jackson, A. A., Walson, J., & Ahmed, T. (2017). Archives of Disease in Childhood, 102:903 909. https://doi.org/10.1136/archdischild-2016-311050
- Hughes, K., Bellis, M. A., Hardcastle, K. A., Sethi, D., Butchart, A., Mikton, C., Jones, L., & Dunne, M. P. (2017). The effect of multiple adverse childhood experiences on health: A systematic review and meta-analysis. Lancet Public Health, 2(8), e356–e366. https://doi.org/10.1016/s24682667(17)30118-4
- Husain, N., Kiran, T., Fatima, B., Chaudry, I. B., Husain, M., Shah, S., Bassett, P., Cohen, N., Jafri, F., Naeem, S. Zadeh, Z., Roberts, C., Rahman, A., Naeem, F., Husain, M. I., & Chaudry, N. (2021) An integrated parenting intervention for maternal depression and child development in a low-resource setting: cluster randomized controlled trial. Depression and Anxiety, 38: 925-939. https://doi.org/10.1002/da.23169
- Ismayilova, L. & Karimli, L. (2018). Hars parenting and violence against children: A trial with ultrapoor families in Francophone West Africa. Journal of Clinical Child & Adolescent Psychology, https://doi.org/10.1080/15374416.2018.1485103
- Janmohamed, A., Sohani, N., Lassi, Z. S., & Bhutta, Z. A. (2020). The effects of community home visit and peer group nutrition intervention delivery platforms on nutrition outcomes in Low- and Middle-Income Countries: A systematic review and meta-analysis. Nutrients, 12:440. https://doi.org/10.3390/nu12020440
- Jeong, J., Ahun, M. N., Gunaratna, N. S., Ambikapathi, R., Mapendi, F., Galvin, L., Kieffer, M. P, Mwanyika-Sando, M., Mosha, D., O'Malley, S. F., Verissimo, C. K., PrayGod, G., & Yousafzai, A. K. (2023). Effects of engaging fathers and bundling parenting and nutrition interventions on early child development and maternal and paternal parenting in Mara, Tanzania: a factorial cluster-randomized controlled trial. The Journal of Child Psychology and Psychiatry. https://doi.org/10.1111/jcpp.13897

- Jeong J., Pitchik H.O., & Yousafzai A.K. (2018). Stimulation interventions and parenting in low- and middle-income countries: a meta-analysis. Pediatrics, 141(4):e20173510. https://doi.org/10.1542/peds.2017-3510
- Jensen, S. K. G., Placencio-Castro, M., Murray, S. M., Brennan, R. T., Coshev, S., Farrar, J., Yousafzai, A., Rawlings, L. B., Wilson, B. Habyarimana, E., Sezibera, V., & Betancourt, T. S. (2021). Effect of a home-visiting parenting program to promote early childhood development and prevent violence: a cluster-randomized trial in Rwanda. BMJ Global Health, 6:e003508. https://doi.org/10.1136/bmjgh-2020-003508
- Jervis, P., Coore-Hall, J., Pitchik, H. O., Arnold, C. D., Grantham-McGregor, S., Rubio-Codina, M., Backer-Henningham, H., Fernald, L. C. H., Hamadani, J., Smith, J. A., Trias, J. & Walker, S. P. (2023) The Reach Up Parenting Program, Child Development, and Maternal Depression: A Metaanalysis. Pediatrics, 151(S2):e2023060221D. https://doi.org/10.1542/peds.2023-060221D
- Kieling C., Baker-Henningham H., Belfer M., Conti G., Ertem I., Omigbodun O., Rohde L. A., Srinath S., Ulkuer N., & Rahman A. (2011). Child and adolescent mental health worldwide: evidence for action. Lancet, 378(9801):1515-25. https://doi.org/10.1016/S0140-6736(11)60827-1
- Little, M. t., Roelen, K., Lange, B. C. L., Steinert, J. I., Yakubovich, A. R., Cluver, L., Humphreys, D. K. (2021). Effectiveness of cash-plus programmes on early childhood outcomes compared to cash transfers alone: A systematic review and meta-analysis in low- and middle-income countries. PLoS Medicin, 18(9): e100369. https://doi.org/10.1371/journal.pmed.1003698
- Mehta, D., Kelly, A. B., Laurens, K. R., Haslam, D., Williams, K. E., Walsh, K., Baker, P. R. A., Carter, H. E., Khawaja, N. G., Zelenko, O., & Mathews, B. (2023). Child maltreatment and longterm physical and mental health outcomes: An exploration of biopsychosocial determinants and implications for prevention. Child Psychiatry and Human Development, 54(2), 421–435. https://doi.org/10.1007/s10578-021-01258-8
- McCoy, A., Melendez-Torres, G.J., & Gardner, F. (2020). Parenting interventions to prevent violence against children in low- and middle-income countries in East and Southeast Asia: A systematic review and multi-level meta-analysis. Child Abuse & Neglect, 103: 10444. https://doi.org/10.1016/j.chiabu.2020.104444
- Mokdad A. H., Forouzanfar M. H., Daoud F., Mokdad A. A., El Bcheraoui C., Moradi-Lakeh M., Kyu H. H., Barber R. M., Wagner J., Cercy K., Kravitz H., Coggeshall M., Chew A., O'Rourke K. F., Steiner C., Tuffaha M., Charara R., Al-Ghamdi E. A., Adi Y., Afifi R. A., Alahmadi H., AlBuhairan F., Allen N., AlMazroa M., Al-Nehmi A. A., AlRayess Z., Arora M., Azzopardi P., Barroso C., Basulaiman M., Bhutta Z. A., Bonell C., Breinbauer C., Degenhardt L., Denno D., Fang J., Fatusi A., Feigl A. B., Kakuma R., Karam N., Kennedy E., Khoja T. A., Maalouf F., Obermeyer C. M., Mattoo A., McGovern T., Memish Z. A., Mensah G. A., Patel V., Petroni S., Reavley N., Zertuche D. R., Saeedi M., Santelli J., Sawyer S. M., Ssewamala F., Taiwo K., Tantawy M., Viner R. M., Waldfogel J., Zuñiga M. P., Naghavi M., Wang H., Vos T., Lopez A. D., Al Rabeeah A. A., Patton G. C., & Murray C. J. (2018). Global burden of diseases, injuries, and risk factors for young people's health during 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet, 387(10036):2383-401. https://doi.org/10.1016/S0140-6736(16)00648-6
- Mutisya, M., Markey, O., Rousham, E. K., Chintsanya, J. M. N., Pradeilles, R., Kimani-Murage, E. W., Madise, N. J., Munthali, A. C., Kalimbira, A., Holdsworth, M. Griffiths, P. L., & Haycraft, E. (2020). Improving nutritional status among urban poor children in sub-Saharan Africa: An evidence-informed Delphi-based consultation. Maternal & Child Nutrition, 17:e13099. https://doi.org/10.1111/mcn.13099
- O'Sullivan, D., Watts, J., & Shenk, C. (2018). Child maltreatment severity, chronic substance abuse, and disability status. Rehabilitation Psychology, 63(2), 313–323. https://doi.org/10.1037/rep0000196

- Parsons, C. E., Young, K. S., Rochat, T. J., Kringelbach, M. L., & Stein, A. (2012). Postnatal depression and its effects on child development: a review of evidence from low- and middle-income countries, British Medical Bulletin, 101(1): 57–79. https://doi.org/10.1093/bmb/ldr047
- Patel, V., Flisher, A. J., Nikapota, A., & Malhotra, S. (2008). Promoting child and adolescent mental health in low and middle income countries. Journal of Child Psychol and Psychiatry, 49 (3), 313–334. https://doi.org/10.1111/j.1469-7610.2007.01824.x.
- Patel V., Chisholm, D., Parikh, R., Charlson, F. J., Degenhardt, L., Dua, T., Ferrari, A. J., Hyman, S., Laxminarayan, R., Levin, C., Lund, C., Mora, M. E. M., Perersen, I., Scott, J., Shidhaye, R., Vijayakumar, L., Thornicroft, G., & Whiteford, R. (2016) Addressing the burden of mental, neurological, and substance use disorders: key messages from Disease Control Priorities, 3rd edition. Lancet, 387(10028):1672-1685. https://doi.org/10.1016/S0140-6736(15)00390-6
- Patel V., Saxena, S., Lund, C., Thornicroft, G., Baingana, F., Bolton, P., Chisholm, D., Collins, P. Y., Cooper, J. L., Eaton, J., Herrman, H., Herzhallah, M. M., Huang, Y., Jordans, M. J. D., Keinman, A., Medina-Mora, M. E., Morgan, E., Niaz, U., Omigbodun, O., Prince, M., Rahman, A., Araceno, B., Sarkar, B. K., Silva, M. D., Singh, I., Stein, D. J., Sunkel, C., & Unützer, J. (2018) The Lancet Commission on global mental health and sustainable development. Lancet, 392(10157):1553-1598. https://doi.org/10.1016/S0140-6736(18)31612-X
- Pedersen, G. A., Smallegange, E., Coetzee, A., Hartong, K., Turner, J., Jordans, M. J. D., & Brown, F. L. (2019) A systematic review of the evidence for family and parenting interventions in Low- and Middle-Income Countries: Child and Youth Mental Health Outcomes. Journal of Child and Family Studies, 28: 2036-2055. https://doi.org/10.1007/s10826-019-01399-4
- Prasetyo, Y. B., Permatasari, P., & Susanti, H. D. (2023). The effect of mothers' nutritional education and knowledge on children's nutritional status: a systematic review. International Journal of Child Care and Education Policy, 17:11. https://doi.org/10.1186/s40723-023-00114-7
- Rahman A., Fisher, J., Bower, P., Luchters, S., Tran, T., Yasamy, M. T., Saxena, S., & Waheed, W. (2013). Interventions for common perinatal mental disorders in women in low-and middleincome countries: a systematic review and meta-analysis. Bulletin of the World Health Organization, 91(8):593-601I. https://doi.org/10.2471/BLT.12.109819
- Repetti R. L., Taylor S. E., & Seeman T. E. (2002). Risky families: family social environments and the mental and physical health of offspring. Psychological Bulletin, 128(2):330-66.
- Sargsyan, V., Tenorio, A., Uwera, M., Gasirikare, A., Habyarimana, J. A., Salcido, J. S., Felner, C., & Rasheed, M. A. (2023). The benefits of nurturing care interventions on early child development and care: findings from a quasi-experimental study in a humanitarian setting. BMC Pediatrics, 23:419. https://doi.org/10.1186/s12887-023-04239-z
- Singla D.R., Kohrt, B. A., Murray, L. K., Anand, A., Chorpita, B. F., & Patel, V. (2017). Psychological treatments for the world: lessons from low-and middle-income countries. Annual Review of Clinical Psychology, 13:149-181. https://doi.org/10.1146/annurev-clinpsy-032816-045217
- Singla D.R., Kumbakumba E., & Aboud F. E. (2015) Effects of a parenting intervention to address maternal psychological wellbeing and child development and growth in rural Uganda: a community based, cluster-randomised trial. Lancet Global Health 3(8):e458-e469. https://doi.org/10.1016/S2214-109X(15)00099-6
- Stoltenborgh, M., Bakermans-Kranenburg, M. J., Alink, L. R. A., & van Ijzendoorn, M. H. (2015). The prevalence of child maltreatment across the globe: Review of a series of meta-analyses. Child Abuse Review, 24(1), 37–50. https://doi.org/10.1002/car.2353
- UNICEF. (2020). Designing parenting programmes for violence prevention: A guidance note. https://www.unicef.org/documents/designing-parenting-programmes-violence-preventionguidance-note

United Nations. (2006). World Report on Violence Against Children. https://violenceagainstchildren.un.org/sites/violenceagainstchildren.un.org/files/document_file s/world_report_on_violence_against_children.pdf

Watson, D., Mushamiri, P., Beeri, P., Rouamba, T., Jenner, S., Proebstl, S., Kehoe, S. H., Ward, K. A., Barker, M., Lawrence, W., the INPreP Study Group (2023). Behaviour change interventions improve maternal and child nutrition in sub-Saharan Africa: A systematic review. PLOS Glob Public Health 3(3):e0000401. https://doi.org/10.1371/journal.pgph.0000401

Wang, W. & Zhang, H. (2023) A scoping review of parenting programs for preventing violence against children in low- and middle-income countries. Trauma, violence & abuse, https://doi.org/10.1177/1524838023120788

World Health Organization. (2016). INSPIRE: Seven strategies for ending violence against children. https://www.who.int/teams/social-determinants-of-health/violenceprevention/inspiretechnical-package

World Health Organization. (2024) Malnutrition. https://www.who.int/news-room/factsheets/detail/malnutrition

White O. G., Hindley N., Jones D.P. (2015). Risk factors for child maltreatment recurrence: An updated systematic review. Medicine, Science and the Law, 55(4):259-277. https://doi.org/10.1177/0025802414543855

Zhang Z., Li F., Hannon B. A., Hustead D. S., Aw M. M., Liu Z., Chuah K. A., Low Y. L., & Huynh D. T. T. (2021) Effect of Oral Nutritional Supplementation on Growth in Children with Undernutrition: A Systematic Review and Meta-Analysis. Nutrients,13(9):3036. https://doi.org/10.3390/nu13093036