

Effectiveness of Parental Nutrition Education to Prevent and Reduce Undernutrition among Children Under Five Aged: Literature Review

Bardiatul Azkia¹, Asih Setiarini²

Nutrition, Faculty of Public Health, Universitas Indonesia, Depok ^{1,2}

E-mail: bardiatulazkia@gmail.com

Received:

Revision:

Published:

Keywords:

undernutrition, children
under five years,
nutritional education.

Abstract: Malnutrition in children is still a public health problem in various countries, especially low- and middle-income countries, especially the problem of undernutrition (wasting, stunting, underweight). Specific nutritional intervention strategies are needed to improve the nutritional status of children under the age of five. This literature review study was conducted to summarize various nutritional education interventions that have been carried out in the last 3 years and their relationship to improving knowledge and nutritional status of children. The literature search was sourced from various electronic databases (ProQuest, Science Direct, and Springer Link). The type of research used in this literature review is experimental research so that the differences in the effects of the nutritional education interventions carried out can be seen. The main results obtained are that nutritional education has an effect on increasing the knowledge of mothers and caregivers of children regarding the necessary nutritional science and also has an effect on the average z-score and even reducing the number case of undernutrition. Providing adequate additional food can strengthen the positive impact on improving the nutritional status of children which runs linearly with the provision of nutritional education. Nutrition education also has an effect on increasing knowledge of the importance of monitoring growth and food diversity at the household level which also has an indirect effect on the nutritional status of children. Nutrition education can be done with several methods and nutritional content according to needs and targets. More nutritional education interventions are needed with appropriate adjustments to methods, needs, and targets as an effort to prevent and reduce undernutrition rates in children.

This is an open access articles under the CC BY License (<https://creativecommons.org/licenses/by/4.0>).



Copyright holders:

Bardiatul Azkia, Asih Setiarini (2025)

INTRODUCTION

Undernutrition affects children's health and growth as well as their cognitive abilities and productivity in adulthood. Hunger and severe undernutrition remain obstacles to sustainable development. This is why ending all forms of hunger and undernutrition has been targeted as one of the Sustainable Development Goals (SDGs). Undernutrition makes children especially more vulnerable to disease and death. Referring to the WHO definition, there are 4

common forms of undernutrition: wasting, stunting, underweight, and vitamin and mineral deficiencies.

In 2022, there were 148.1 million children under the age of 5 or 22.3 percent of children under the age of five who were stunted, 45 million children under the age of 5 or around 6.8 percent who were wasted worldwide. Children with undernutrition are more likely to live in Africa and Asia. The Joint Malnutrition Estimates (JME) released in 2023 showed a lack of progress in achieving the 2025 World Health Assembly (WHA) global nutrition targets and the 2030 Sustainable Development Goal (SDG) 2 targets. More intensive efforts are needed if the world is to achieve the global target of reducing the number of children experiencing all forms of undernutrition.

Previous research has demonstrated the long-term health and economic benefits of improving early childhood nutrition. The effectiveness of interventions to address childhood undernutrition depends on the needs of the community and the context and setting. Children and their families need access to nutritious food, health services, and positive practices to stop undernutrition before it occurs. Lack of progress in reducing undernutrition can be attributed to mothers' underutilization of nutrition. Research suggests this is related to mothers' unbalanced diets, poor child feeding practices, inadequate food intake, inadequate breastfeeding for 6 months, and poor hygiene knowledge and practices.

Nutrition education and counseling is one strategy that has a significant impact on improving children's anthropometric indices. Community-based nutrition education interventions have been effective in improving the nutritional status of children under five years of age in developing countries. However, the cost-effectiveness, time-effectiveness, and other aspects of various strategies need to be measured to determine which future interventions effectively reduce the consequences of undernutrition in children.

METHOD

This literature review writing uses a four-step approach to conduct a narrative review as proposed by Demiris et al. The first step is done by searching online from several databases (ProQuest, Science Direct, and Springer Link) to collect relevant literature. The second step is to use the right keywords during the literature search process in each database. Database searches were carried out using the Boolean operator "AND" from several keywords and the following search terms: "undernutrition," "children under five years," and "nutritional education." The article screening process using these keywords resulted in 21,919 of the total searches of all databases. Then the articles were filtered again by sorting articles published in 2022-2025 so that 3,890 articles were obtained. A total of 360 articles were set aside because they did not contain the full text, leaving 3,530 articles for further content analysis.

Third, from the search, we identified relevant articles related to the topic through eligibility criteria that are useful for writing this literature. The eligibility criteria that need to be met in an article to be reviewed include: 1) participants aged between 0 and 59 months; 2) investigating one or more anthropometric indicators of undernutrition (stunting, wasting, and underweight); 3) using intervention or experimental research methods; (4) written in English only. A total of 3,522 articles were excluded because they were considered not to meet the criteria, leaving 8 articles that could be analyzed. Finally, we synthesized and summarized the findings reported in the identified literature, and this was used to develop the content of this

narrative review.

RESULTS AND DISCUSSION

The results of screening with keywords and several criteria from the ProQuest, Science Direct, and Springer Link databases obtained 8 articles that met the requirements for analysis, which are presented in Table 1 below:

Table 1. Results of Literature Review

No.	Author Name/Year of Research	Journal Name	Research Title	Method	Intervention	Control	Results
1.	Mardani RAD et al., (2024)	Journal of Pediatric Health Care	Effect of a Nutritional Education Program on Children's Undernutrition in Indonesia: A Randomized Controlled Trial(10)	A Randomized Controlled Trial	The intervention group received a 4-week HBM-based nutrition education program covering undernutrition management and complementary feeding practices.	The control group received standard care in the form of routine measurements of height, length, weight, head circumference, activity, and immunization status of the children at a health care center.	Mothers in the intervention group through the HBM-based nutrition education program experienced significant increases in knowledge about undernutrition ($b = 4.77$, $p < .001$), self-efficacy ($b = 32.22$, $p < .001$), knowledge about complementary feeding practices ($b = 2.13$, $p < .001$), and complementary feeding practices ($b = 5.70$, $p < .001$), compared to the control group. In addition, children in the intervention group showed an increase in the average Z-score for stunting, wasting, and underweight after the intervention, compared to the control group.
2.	B, Ansuya et al., (2023)	BMC Public Health	Impact of a home-based nutritional intervention program on nutritional status of preschool children: a cluster randomized controlled trial(11)	A cluster randomized controlled trial	The intervention group received a health education program and demonstration of nutritious food preparation in addition to the routine services provided at the Anganwadi center.	The control group received only standard routine care provided at Anganwadi centers.	Significant increase in mean kilogram weight was noted in the intervention group (11.9 ± 0.98 to 13.78 ± 0.89) compared to the control group (11.8 ± 1.03 to 12.96 ± 0.88). In the intervention group, at baseline, 41.5% were moderately malnourished which decreased to 24% at the end of the year. Similarly, severe undernutrition decreased from 8.69% to 3.16%, while 20.5% of malnourished children achieved normal nutritional status. In the

							control group, malnourished children showed minimal change in nutritional status.
3.	Bidira K, Tamiru D, Belachew T, (2022)	Italian Journal of Pediatrics	Effect of nutritional education on anthropometric deficits among pre-schoolaged children in south West Ethiopia: quasi-experimental study(12)	Quasi-experimental study	Nutrition education was conducted for 9 months in all intervention groups.	There is no program	The nutritional status of preschool children was significantly associated with nutritional education interventions [AOR = 0.566, 95% CI: (0.347, 0.923)], place of delivery [AOR = 0.724, 95% CI: (0.551, 0.951)], ARI in the last 2 weeks [AOR = 1.823, 95% CI: (1.226, 2.710)], drinking water sources [AOR = 0.624, 95% CI: (0.484, 0.805)] and household food security [AOR = 1.311, 95% CI: (1.030, 1.669)]. Nutrition education can effectively reduce the magnitude of undernutrition in preschool children.
4.	Makwela MS et al., (2024)	Children	The Effect of a Community-Based Complementary Feeding Education Program on the Nutritional Status of Infants in Polokwane Municipality, Limpopo Province, South Africa(13)	Quasi-experimental study	Caregiver-infant pairs (CIPs) in the intervention group (n = 95) received complementary feeding education and follow-up support via telephone for six months.	CIP in the control group (n = 94) received no intervention.	Children in the intervention group gained more weight after the intervention, were taller, and had a greater increase in mid-upper arm circumference (MUAC) than the control group. Significant weight and length gains were observed in the intervention group (difference in differences (DID) = 1.82 kg, $p < 0.001$ and (DID = 7.78 cm, $p < 0.01$), respectively. The intervention group showed a significant increase in MUAC of 1.68 cm ($p = 0.047$), with no significant effect on head circumference at the end of the study; DID (0.16 cm; $p = 0.950$). Community-based nutrition intervention programs can effectively improve the anthropometric nutritional status of children aged 3–12 months.
5.	Paudel R et al., (2025)	Journal of Nutrition	Impact of a Community-based Intervention	A quasi-experimental, nonrandomized	The provision of a 6-month nutritional intervention	There is no program	Mean z scores improved after 6 months of intervention, weight-for-age ($b = 0.49$ [95% CI,

		Educational and Behavior	n Program on Nutritional Status of Children Aged Under 5 Years With Undernutrition in Western Rural Nepal(14)	mized study using pre-test and post-test measures using paired t-tests and repeated measures analysis of identified changes in z-scores.	package includes super flour, cow's milk, nutritional education and counseling, and growth monitoring.		0.35-0.62]) and weight-for-height (b = 0.42 [95% CI, 0.20-0.63]), except for height-for-age (b = 0.30 [95% CI, 0.16-0.44]). Community-based nutrition interventions using local resources effectively reduce undernutrition.
6.	Jannat K et al., (2023)	Nutrients	The Effects of Yogurt Supplementation and Nutritional Education on Malnourished Infants: A Pilot RCT in Dhaka's Slums(15)	A three-arm pilot randomized controlled trial.	(1) Nutrition education for mothers; (2) nutrition education plus daily yoghurt supplement (50 g) for index children.	Regular care	Intent-to-treat analysis (N = 162) and complete case analysis (N = 127) did not show statistically significant differences between groups in LAZ or weight-for-age (WAZ). However, the yogurt group showed a greater change in linear growth compared to the control group (LAZ: mean difference 0.20, 95% CI: -0.06, 0.47, p-value 0.13), which was also slightly greater than the education-only group.
7.	Osero JOS and Osano EN, (2024)	Cogent Public Health	Effects of health education using mobile technologies on caregivers' knowledge of routine growth monitoring for children aged 9 to 24 months in Kenya(16)	Quasi-experimental study	Caregivers in intervention group 1, received health education (HE) messages sent via Short Text Messages (STM). Caregivers in intervention group 2 received HE messages using Voice Call (VC).	The control group received care as usual.	Caregivers in intervention groups 1 and 2 were more likely to know when their children should be taken for routine growth monitoring/ <i>Routine Growth Monitoring</i> RGM (OR = 3.000; 95% CI: 2.098 – 4.29), what was done during RGM visits to the child welfare clinic, benefits of RGM, and problems associated with failure to engage in RGM compared to those in the control group and at baseline. Health education using mobile technology increased caregivers' knowledge of RGM.
8.	Adugna G et al., (2024)	Human Nutrition &	Effect of nutrition education	A community-based	The nutrition education intervention	The control group did	After nutrition education, dietary diversity scores increased (from 26.7% to

		Metabolism	on improving dietary diversity of children aged 6–23 months in Horo district, Oromia region, Ethiopia(17)	cluster randomized trial	lasted for three months and consisted of eight sessions. The education included information on complementary feeding, the importance of breastfeeding, knowledge of food diversity, and food diversity practices for mothers and caregivers of children aged 6–23 months.	not receive any nutritional education. But after the study ended, the control group received three days of training on dietary diversity.	56.2%) in the intervention group ($p = 0.05$) but not in the control group. Children's knowledge of food diversity between the two groups at baseline did not show any significant difference ($p = 0.548$), but there was a statistically significant difference ($p = 0.001$) at the end of the intervention. Children's positive attitudes towards food diversity showed no significant difference ($p = 0.480$) between the two groups at baseline, but the difference was statistically significant ($p = 0.001$) at the end of the intervention. Food insecurity status in the control and intervention groups did not show significance either before or after the intervention ($p > 0.05$).
--	--	------------	---	--------------------------	---	---	---

Table 1 presents a summary of the characteristics of the accepted studies, including the nature of the intervention, design, and some outcomes. Interventions were identified for further analysis based on the main nutrition-specific strategy, namely nutrition education or counseling. Six of the eight studies from the tabulation above showed that nutrition education had a direct impact or influence on improving the results of anthropometric measurements and nutritional status of children. While the other two studies showed an indirect impact or influence of nutrition education on the nutritional status of children, but had a significant effect on the determinants of nutritional status in children. Six studies were conducted with nutrition education interventions alone, but the other two studies were conducted with nutrition education interventions and added with other additional food interventions.

Research by Mardani RAD et al., B, Ansuya et al., Bidira K et al., and Makwela MS et al., was conducted by providing interventions in the form of nutrition education alone, the results of which showed a significant effect on increasing the results of anthropometric measurements and nutritional status in children. The nutrition education provided was in the form of knowledge about the nutritional status of children, child anthropometric indicators, self-efficacy, provision of additional food, and demonstrations of nutritious food preparation.(10–13). Mothers' knowledge and behavior in providing adequate food are very important to prevent the risk of undernutrition. Previous research conducted by Dewi (2016) on mothers who have stunted children aged 6-24 months found that there was a significant difference in the mean score of knowledge before and after intervention in both groups ($p = 0.006$; $p = 0.003$), there was a significant difference in the mean score of feeding practice before and after

intervention in both groups ($p = 0.002$; $p = 0.05$). This is in line with other studies showing that nutrition education has been proven effective in increasing mothers' knowledge and behavior in providing nutritious complementary foods, thus potentially reducing the rate of undernutrition in children. Nutrition education and counseling are very important for community-based interventions. Nutrition education and counseling will help mothers in providing timely breastfeeding, weaning, diversifying food, and the amount of food needed to feed children, which has a positive impact on children's nutritional status.

Research by Paudel R et al. and Jannat K et al., was conducted by providing interventions in the form of nutritional education and supplemented with the provision of additional foods such as super flour, cow's milk, and yogurt.(14,15). The results of the study showed the same thing, namely an increase in body weight or positive changes in the nutritional status of children. Research by Masri (2020) showed that providing additional food alone had no effect on nutritional status based on BB/U ($p = 0.078$). The combined intervention of providing additional food and nutritional counseling had an effect on the nutritional status of children aged 6-24 months ($p = 0.008$). However, there was no difference in the effect of the intervention of providing additional food with a combination of providing additional food and nutritional counseling on the nutritional status of children aged 6-24 months ($p = 0.356$). Milk and dairy products as a nutrient-dense source of macro and micronutrients play an important role in healthy human nutrition and development throughout life, especially in childhood. Cow's milk provides high-quality energy and protein, essential amino acids including lysine which are often limited in plant/cereal-based diets. Milk and dairy products can make a significant contribution to meeting the nutritional intake of calcium, magnesium, selenium, riboflavin, vitamin B12, and pantothenic acid. Milk can replace or complement staple foods, but excessive milk consumption can interfere with nutrient supply and the formation of eating habits. Like milk, yogurt is a nutrient-dense food and is included in the dairy or dairy product food group. Yogurt provides a beneficial contribution to micronutrient intake in children aged 4 months to 10 years. Consumption of yogurt that has an impact on increasing toddler weight is in line with Faradisa's (2025) study which showed a statistically significant increase in average post-intervention weight (from 10.3 kg to 10.46 kg; $p < 0.001$), indicating a positive impact of probiotic yogurt on child growth. These findings confirm that probiotic-rich foods can be an easily accessible and effective intervention to address undernutrition in children aged 4-5 years.

Research by Osero and Osano (2024), and also research by Adugna G et al., (2024) showed that there was an indirect effect of nutrition education on the nutritional status of children. Nutrition education had an effect on increasing the knowledge of mothers of children regarding routine growth monitoring and food diversity. However, both studies have not shown results that increased knowledge also has an impact on increasing the attitudes and practices of mothers of children regarding routine growth monitoring and food diversity at home. Nutrition education is considered to have a significant effect on increasing food diversity in line with research from [Kuchenbecker](#) (2017) although not significant in the average z-score of height by age. There is a significant relationship between growth monitoring in the Covid-19 pandemic era and the nutritional status of children ($p = 0.010$). This study is closely related to the parameters used by mothers continuously for child growth guidelines. Nutrition education interventions for mothers show that households have a more diverse diet. Low dietary

diversity scores were identified as a significant predictor of stunting. Minimum dietary diversity is met if a child has received food from 4 or more food groups from the seven WHO food groups in the last 24 hours. Inadequate food and low dietary quality in terms of dietary diversity and micronutrient availability have a significant negative relationship with child growth.

There are many intervention options to reduce undernutrition in children and affect maternal knowledge, feeding practices, and affect the nutritional status of children. Each intervention has a different level of influence depending on the content of the intervention carried out, based on the general nutritional references that have been set, the targets aimed at, and the focus of the problems to be solved. In general, nutrition education for mothers or caregivers of children affects knowledge about the content of nutritional science delivered through interventions, with the hope that it can also improve the attitudes and practices of maternal parenting patterns that have an impact on improving the nutritional status of children.

The limitations in this literature review research are: 1) the intervention methods used are not all the same but still use the intervention method in the form of nutritional education in each article analyzed; 2) the measurement of indicators does not all have a direct effect on the nutritional status of children, but there are several articles that explain the effect of nutritional education on factors that are indirectly related to the nutritional status of children, these differences have been explained above.

CONCLUSION

This systematic review shows that nutrition education has a significant influence on knowledge and has the potential to significantly influence changes in nutritional status in children. Nutrition education can be carried out with various methods and curriculum content that is adjusted to the targets and objectives. In implementing nutrition education, an appropriate strategy is needed to empower mothers and the community to be more actively involved in the intervention. The findings of this study indicate the need for more nutrition education interventions as an effort to prevent and reduce undernutrition in children.

BIBLIOGRAPHY

- Department of Health and Social Services States of Alaska. Early Childhood Nutrition. 2011;72.
- UN. SDGs Report 2023 [Internet]. The Sustainable development Goals Report 2023: Special Edition. 2023. p. 80. Available from: <https://unstats.un.org/sdgs/report/2023/>
- Kanmodi KK, Amzat J, Aminu K. Theories, determinants, and intervention models and approaches on inequalities of undernutrition under one hundred five: A literature review. *Heal Sci Reports*. 2024;7(5).
- Ghodsi D, Omidvar N, Nikooyeh B, Roustae R, Shakibazadeh E, Al-Jawaldeh A. Effectiveness of community nutrition-specific interventions on improving malnutrition of children under 5 years of age in the eastern Mediterranean region: A systematic review and meta-analysis. *Int J Environ Res Public Health*. 2021;18(15).
- Amoah WW, Kobi D, Tabong PT-N, Kukeba MW, Alhassan Y, Achaliwie F, et al. Factors Contributing to Malnutrition among Children Under 5 Years at St. Elizabeth Catholic Hospital, Ahafo Hwidiem. *Clin Med Insights Pediatr*. 2024;18.
- Saleem AF, Mahmud S, Baig-Ansari N, Zaidi AKM. Impact of Maternal Education about Complementary Feeding on Their Infants' Nutritional Outcomes in Low- and Middle-

- income Households: A Community-based Randomized Interventional Study in Karachi, Pakistan. *J Heal Popul Nutr*. 2014;32(4):623–33.
- Khattak UK, Iqbal SP, Ghazanfar H. The Role of Parents' Literacy in Malnutrition of Children Under the Age of Five Years in a Semi-Urban Community of Pakistan: A Case-Control Study. *Cureus*. 2017;9(6).
- Alderman H, Behrman JR, Glewwe P, Fernald L, Walker S. Evidence of Impact of Interventions on Growth and Development during Early and Middle Childhood. In: Bundy DAP, Silva N de, Horton S, Jamison DT, Patton GC, editors. Washington (DC); 2017.
- Demiris G, Oliver D, Washington K. Defining and Analyzing the Problem. In 2019. p. 27–39.
- Mardani RAD, Wu WR, Hajri Z, Thoyibah Z, Yolanda H, Huang HC. Effect of a Nutritional Education Program on Children's Undernutrition in Indonesia: A Randomized Controlled Trial. *J Pediatr Heal Care*. 2024;38(4):552–63.
- BA, Nayak BS, BU, NR, N SY, Mundkur SC. Impact of a home-based nutritional intervention program on nutritional status of preschool children: a cluster randomized controlled trial. *BMC Public Health* [Internet]. 2023;23(1):1–10. Available from: <https://doi.org/10.1186/s12889-022-14900-4>
- Bidira K, Tamiru D, Belachew T. Effect of nutritional education on anthropometric deficits among pre-school aged children in south West Ethiopia: quasi-experimental study. *Ital J Pediatr*. 2022;48(1):1–12.
- Makwela MS, Mushaphi LF, Makhado L. The Effect of a Community-Based Complementary Feeding Education Program on the Nutritional Status of Infants in Polokwane Municipality, Limpopo Province, South Africa. *Children*. 2024;11(12):1–14.
- Paudel R, Gurung YB, Khatri B, Poudyal AK, Acharya D, Upadhyaya DP, et al. Impact of a Community-based Intervention Program on Nutritional Status of Children Aged Under 5 Years With Undernutrition in Western Rural Nepal. *J Nutr Educ Behav* [Internet]. 2025;000(000). Available from: <https://doi.org/10.1016/j.jneb.2025.03.003>
- Jannat K, Agho KE, Parvez SM, Rahman M, Thomson R, Amin MB, et al. The Effects of Yogurt Supplementation and Nutritional Education on Malnourished Infants: A Pilot RCT in Dhaka's Slums. *Nutrients*. 2023;15(13).
- Osero JOS, Osano EN. Effects of Mobile Health Technologies on Uptake of Routine Growth Monitoring among Caregivers of Children Aged 9 to 18 Months in Kenya. *J Prim Care Community Heal* [Internet]. 2021;12(1). Available from: <https://doi.org/10.1080/27707571.2025.2461181>
- Adugna G, Egata G, Fufa DA, Desta DT. Effect of nutrition education on improving dietary diversity of children aged 6–23 months in Horo district, Oromia region, Ethiopia. *Hum Nutr Metab*. 2024;35(January).
- Rachmah Q, Astina J, Atmaka DR, Khairani L. The Effect of Educational Intervention Based on Theory of Planned Behavior Approach on Complementary Feeding: A Randomized Controlled Trial. *Int J Pediatr (United Kingdom)*. 2023;2023.
- Masri E, Sari WK, Yensasnidar Y. Effectiveness of Providing Additional Food and Nutrition Counseling in Improving the Nutritional Status of Children. *J Kesehat PERINTIS (Perintis's Heal Journal)*. 2021;7(2):28–35.
- F.A.O. Milk and dairy products in human nutrition. *Nutrition and Biochemistry of Milk/maintenance*. 2013.
- Garcia MT, Granado FS, Cardoso MA. Alimentação complementar e estado nutricional de crianças menores de dois anos atendidas no Programa Saúde da Família em Acrelândia, Acre, Amazônia Ocidental Brasileira. *Cad Saude Publica*. 2011;27(2):305–16.
- Williams EB, Hooper B, Spiro A, Stanner S. The contribution of yogurt to nutrient intakes across the life course. *Nutr Bull* [Internet]. 2015;40(1):9–32. Available from:

<https://doi.org/10.1111/nbu.12130>

- Faradisa RR, Retnaningsih R, Alfitri R. The Impact of Probiotic Yogurt Supplementation on Weight Gain Among Preschool Children: Evidence from an Early Childhood Education Setting in Indonesia. 2022;09(02):217–34.
- Kuchenbecker J, Reinbott A, Mtimuni B, Krawinkel MB, Jordan I. Nutrition education improves dietary diversity of children 6-23 months at community-level: Results from a cluster randomized controlled trial in Malawi. PLOS One. 2017;12(4):1–19.
- Sari MGK, Widyaningsih V, Wardani MM, Murasmita A, Ghufroon AA. The Relationship between Monitoring the Growth of Children During the COVID-19 Pandemic and Mothers' Knowledge of Complementary Feeding with Nutritional Status. SEMAR (Journal of Science, Technology and Arts for Society). 2021;10(1):70.
- Reinbott A, Schelling A, Kuchenbecker J, Jeremias T, Russell I, Kevanna O, et al. Nutrition education linked to agricultural interventions improving child dietary diversity in rural Cambodia. Br J Nutr. 2016;116(8):1457–68.
- Fekadu Y, Mesfin A, Haile D, Stoecker BJ. Factors associated with nutritional status of infants and young children in Somali Region, Ethiopia: A cross-sectional study Global health. BMC Public Health [Internet]. 2015;15(1):1–9. Available from: <http://dx.doi.org/10.1186/s12889-015-2190-7>.