The majority of children with cancer reside in low- and middle-income countries (LMICs) where malnutrition, both under- and over-nutrition, are highly prevalent.\[^1\] A child with cancer in an LMIC may often experience multiple comorbidities such as severe acute malnutrition, infectious disease, or micronutrient deficiencies at the time of diagnosis. Managing these concomitant conditions make it challenging for physicians to initiate treatment for cancer, maintain the recommended course of treatment, and avoid delays. Enhancing supportive care to include standard and proactive nutrition assessment and intervention becomes an essential component of medical care in order to maximize the treatment outcomes in LMICs.

The delivery of nutrition therapy to children with cancer, who live in LMIC, is further complicated by the complexity of factors impacting the delivery of cancer care [Figure 1]. These include social, environmental, and medical; each of which cannot be remediated solely by medical intervention alone. Overt nutrient deficiencies and access to food largely impact the extent to which nutritional interventions will be effective and sustained over the course of treatment. Moreover, access to and knowledge of optimal nutritional assessment and intervention among health care providers remains a significant barrier. An international nutrition survey conducted by the International Society for Pediatric Oncology (SIOP)-Pediatric Oncology Developing Countries (PODC) Nutrition Working Group found that access to nutritional resources was a barrier to the delivery of nutritional services in over half the institutions.\[^8\] Among institutions located in Asia, nearly 80% reported that the education of staff is a significant barrier to the delivery of nutritional care. These results underscore the need for nutrition education, especially in light of several recent studies demonstrating that remediation of poor nutritional status eliminates its negative impact on clinical outcomes.\[^1\[^9\] These investigations have helped frame the scope of the objectives of the SIOP-PODC Nutrition Working Group.

Malnutrition is India’s silent emergency with rates of malnutrition among India’s children almost twice those in Sub-Saharan Africa. Nearly, half of all India’s children are underweight, approximately 45% stunted, 20% severely malnourished, 75% are anemic, and 57% are Vitamin A deficient. More than one-third of children under 5 years of age and malnourished live in India.\[^10\] In the setting of malignancy, these statistics worsen.

The existing literature underscores the need for more education in the nutritional management of the child with cancer and has also demonstrated that improving poor nutrition can have an impact on clinical outcomes. In light of the prevalence of nutrition-related conditions among Indian children, the SIOP-PODC Nutrition Working Group prioritized India to serve as an international model for capacity building. In this issue of the Indian Journal of Cancer, we present the proceedings and publications of data presented at the first International SIOP-PODC Regional Nutrition Workshop conducted at Mumbai on September 27–28, 2014. The objectives of these planned series of regional capacity building workshops are: (1) to document the burden of nutritional morbidity and standards of local practice; (2) to provide education on “best-of-care” practices for nutritional interventions; (3) to offer a forum for sharing, collaboration, training, and mentorship in the conduct of nutrition research in pediatric oncology; (4) to identify and develop training opportunities locally, supported by the SIOP-PODC Working Group on Nutrition; and (5) to create an alliance of stakeholders by formation of local interest groups for continued capacity building, research, and education. In this special issue, we highlight the progress made in each of these domains thus far.

1. Document the burden of nutritional morbidity and standards of local practice in India. In this issue, Sharma et al. systematically describe the challenges associated with the delivery of nutritional care among 42 Indian health institutions. For the first time, the authors describe the current challenges facing clinicians at diagnosis and throughout treatment as well as local standards of practice in India. Importantly, the authors found that less than half (40%) of respondents routinely perform some form of nutritional assessment and approximately one-third utilized arm anthropometry. Two-third of institutions had access to dieticians, but even among those institutions with dieticians, there were inconsistencies in the delivery of nutrition education, inconsistent use of enteral and parenteral nutritional interventions due to lack of adequate staff, limited time and resources to deliver optimal nutritional therapy, and little knowledge as to how to deliver effective nutritional interventions. This special issue brings to light the high burden of malnutrition from geographically diverse institutions throughout India thereby confirming the need for increased capacity throughout the country.

**Figure 1:** Factors influencing the nutritional status of a child with cancer

---

*Correspondence to:* Dr. Arora B, E-mail: brijesh.aurora@gmail.com

---

\[^2\] Department of Pediatric Oncology, Tata Memorial Hospital, Mumbai, Maharashtra, India, \[^1\] Division of Pediatric Hematology/Oncology, Stem Cell Transplant, Columbia University Medical Center, \[^2\] Columbia University Medical Center, Institute of Human Nutrition, New York, USA.
2. To provide education on “best-of-care” practices for nutritional interventions. The workshop provided education and training to 255 participants from approximately 100 centers across India. Of these, 75% participants received complete or partial scholarship. The workshop delivered two parallel sessions to address two groups of participants that included advanced nutritional education for doctors or trained nutritionists and basic nutritional education for nurses, social workers, and counselors. The basic session provided training for individuals who often fill in for dieticians in centers with no dietician and provide nutrition education to children and their families. The lectures were reflective of the medical environment in India with case discussions focusing on the assessment of nutritional status, definition of nutritional risk, and recommended nutritional interventions considering the Indian and LMIC setting.

The workshop organizing committee developed several educational tools to enhance the delivery of nutritional knowledge and training of clinicians. Education materials included: (a) A SIOP-PODC nutrition training manual that contained all lectures to serve as subsequent reference material; (b) Training digital versatile disk with video recorded lectures in an easily searchable format for continued learning; and (c) This special issue of Indian Journal of Cancer with peer-reviewed manuscripts written by faculty, attendees representing a range of Indian centers’, and the work of nongovernmental organizations (NGOs) dedicated to the field of pediatric oncology nutrition.

This special issue presents a wide range of nutritional topics from clinicians and investigators located around the globe. The manuscripts from Drs. Barr and Rogers provide an excellent overview and introduction to the wide array of variables impacting nutritional statuses such as body composition, nutrition genomics, and micronutrient status. Both Drs. Barr and Rogers highlight the gaps in the existing literature and identify fertile areas for research opportunities. From our invited dieticians, Ms. Viani and Schoefield, write comprehensive manuscripts of the implementation of nutritional care during cancer treatment, particularly highlighting areas of nutritional intervention that may be modified based on the resources of the center. Finally, Dr. Catharine Fleming presents a blueprint for the identification and implementation of nutrition services during cancer therapy. Dr. Fleming describes the need for an adaptable algorithm and presents an adaptable tool that is undergoing validation through the SIOP-PODC Nutrition Working Group. The review on metabolic syndrome in oncology centers in India found that the prevalence of malnutrition at diagnosis ranged from 40% to 85%. The prevalence appeared to be dependent upon the tools used to determine nutritional status and the study population. The observations are similar to previously published studies from India [Table 1] and those reported other LMICs.

Shah et al. described the nutritional status among 1693 children and adolescents representing the largest nutritional study in India performed to date. The authors found that mid-upper arm circumference (MUAC) is the most sensitive tool for the detection of under nutrition and body mass index; albumin and triceps skin fold thickness have insignificant incremental value over MUAC alone. This finding concurs with the recommendations from the SIOP-PODC Nutrition Working Group that MUAC is the optimal nutritional assessment tool due to its sensitivity, low cost, and efficiency. Bakhshi et al. further showed that high malnutrition rates are more prevalent in younger children with solid tumors and those coming from rural community.

Trench et al. elegantly describe the impact of malnutrition on mortality of children with ALL. The authors observed a significant difference in outcome between children ≤5th centile for age and those above 10th centile as per the Center for Disease Control criteria, (event free survival: 57.1%: 69.6%, respectively (P = 0.004)). These findings concur with similar studies performed in HIC.[16] Radhakrishnan et al. from Southern India reported that provision of nutrition during patients’ stay was able to effectively remediate the high incidence of malnutrition within their center. The authors should be commended for this report as the importance of remediating poor nutritional status and improving access to food has been found to have a significant effect on clinical outcomes in an LMIC.[1,17,18]

### Table 1: Prevalence of malnutrition in India

<table>
<thead>
<tr>
<th>Author</th>
<th>Region of India</th>
<th>Number</th>
<th>Weight/Arm anthropometry (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kumar et al., 2000</td>
<td>North</td>
<td>25</td>
<td>48</td>
</tr>
<tr>
<td>Jain et al., 2003</td>
<td>North</td>
<td>44</td>
<td>56</td>
</tr>
<tr>
<td>Linga et al., 2012</td>
<td>South</td>
<td>34</td>
<td>53</td>
</tr>
<tr>
<td>Roy et al., 2013</td>
<td>East</td>
<td>159</td>
<td>64</td>
</tr>
<tr>
<td>Tandon et al., 2016</td>
<td>North</td>
<td>50</td>
<td>66</td>
</tr>
<tr>
<td>Shah et al., 2016</td>
<td>West</td>
<td>1693</td>
<td>38</td>
</tr>
<tr>
<td>Bakhshi et al., 2016</td>
<td>North</td>
<td>690</td>
<td>41</td>
</tr>
<tr>
<td>Trehan et al., 2016</td>
<td>North</td>
<td>733</td>
<td>53</td>
</tr>
<tr>
<td>Radhakrishnan et al., 2016</td>
<td>South</td>
<td>295</td>
<td>44</td>
</tr>
</tbody>
</table>

NA=Not available; BMI=Body mass index; WFH=Weight for height
Two studies reported on the burden of malnutrition among survivors, which is among the first of such data from an LMIC setting. Among 159 survivors of ALL, Srivastava et al. found that overall prevalence of overweight/obesity was 26.4%, and these children had lower levels of serum adiponectin. A larger study performed among 648 survivors of childhood cancer from all across India found the prevalence of obesity/overweight and undernutrition to be 13.4% and 28.8%, respectively, in child and adolescent survivors and 8.5% and 28.8%, respectively, in adult survivors. The study corroborated the published literature by finding that older age survivors of ALL and brain tumors had increased the risk of obesity.[19] The prevalence of obesity/overweight was lower in this cohort when compared to Western literature, which may have been due to underlying undernutrition in India.

4. Identify and develop training opportunities locally for conduct through SIOP-PODC committee. Prior to the workshop, there were virtually no training fellowships for nutritionists to get formal training in pediatric nutrition or specialized training in pediatric oncology. The SIOP-PODC Nutrition Workshop established a regional effort to develop training opportunities for current and future nutritionists working in pediatric oncology. The first postgraduate course in pediatric nutrition has been started by Sir Vithaldas Thackersey College of Home Science, Mumbai. Through this program at Shreemati Nathibai Damodar Thackersey Women's University, students undergo 1–2 months training in pediatric oncology at Tata Memorial Hospital, Mumbai, after completing basic pediatric training. Further, Tata Memorial Hospital with SIOP-PODC has been able to initiate SIOP-PODC regional training fellowships in pediatric oncology. The first such fellowship program trained 24 students from ten centers in India in April 2015. The second fellowship in 2016 is expected to train 50 students from leading centers throughout India.

5. To create an alliance of stakeholders by formation of local interest groups. The workshop led to formation of the “National Interest Group for Childhood Cancer Nutrition” (NIGccN) with the objective of systematically and collectively addressing improving access to food and reducing malnutrition in children with cancer across all stakeholders. The group is led by three organizations (CanKids-Kidscan, Cuddles Foundation, and Tata Memorial Hospital) and supported by SIOP-PODC Nutrition Working Group, United Nations Children’s Fund (UNICEF), Indian Cooperative Oncology Network (ICON), and PHO Chapter of IAP. NIGccN plans to improve the delivery of nutritional services through provision of nutritional supplements, nutrition equipment and resources, disseminate local guidelines and educational resources for parents, conduct education workshops for providers and parents, and support research on locally relevant issues. The overarching goal of NIGccN is to train or support the salary of dieticians covering 100 key centers in India by 2017 so that there is, at least, one trained nutritionist for every 250 children with cancer. Currently, ten centers have a trained nutritionist as a result of these efforts.

In conclusion, the SIOP-PODC Nutrition Working Group’s Indian model has been successful in providing education to a large number of pediatric oncology clinicians, establishing training programs, advancing the documentation of local standards and burden of malnutrition, and cultivating a local research agenda in nutrition. Importantly, this effort has stimulated interest and dedication from key stakeholders to form a local alliance to maintain momentum and continue to build local capacity in the future. It is clear that this multi-faceted Indian approach that integrates collaboration with international and national NGOs, local pediatric oncology centers, national and international societies, international universities, and governmental agencies, is necessary to remediate malnutrition in pediatric oncology. Based on the Indian model, SIOP-PODC Nutrition Working Group has already conducted similar workshops in Amman, Jordan and Sao Paulo, and Brazil, and has established the foundation for capacity building in these regions. With this foundation in place, the SIOP-PODC Nutrition Working Group aims to expand this model to other parts of Asia, Africa, and Latin America. Nutritional therapy is one aspect of supportive care that has gone largely neglected until now.[20] Cancer therapy works best in a well-nourished child; malnutrition should not reduce the incredible strides achieved for the treatment of childhood cancer.

Acknowledgments
We would like to thank the organizing committee for their participation in this event. The SIOP-PODC Nutrition Working Group would like to recognize nutricia and Josephine Garvey for their global support of this initiative. We would also like to recognize the efforts of CanKids-Kidscan, Cuddles Foundation, ICON, PHO Chapter of IAP, UNICEF, and Childhood Cancer International. Finally, there are countless individuals who worked tirelessly on this annual workshop.

References

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

**Access this article online**

<table>
<thead>
<tr>
<th>Quick Response Code:</th>
<th>Website:</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOI: 10.4103/0019-509X.175836</td>
<td></td>
</tr>
</tbody>
</table>

**How to cite this article:** Arora B, Ladas EJ. International nutrition capacity building - A global SIOP-PODC model from IndiaSynovial sarcoma of the omentum: A rare entity. Indian J Cancer 2015;52:163-6.