Nor. Afr. J. Food Nutr. Res. 2021; 5(12): 79-92
https://www.najfnr.com
https://doi.org/10.51745/najfnr.5.12.79-92

REVIEW ARTICLE

Visualization of Nutrient-Related Clinical Practice Guidelines in Childhood

George Antonogeorgos [1*], Eirini Bathrellou [1], Matina Kouvari [1], Eirini Mamalaki [1], Dimitrios Poulimeneas [1], Mary Yannakoulia [1], Demosthenes B. Panagiotakos [1,2]

1 Department of Nutrition and Dietetics, School of Health Science and Education, Harokopio University, Athens, Greece.
2 Faculty of Health, University of Canberra, Australia.

Abstract

Obesity and diabetes rates have been rising to epidemic levels during the last decade, especially among young populations. Recommendations for clinicians and primary healthcare providers concerning the improvement of childhood nutrition and the healthcare of childhood nutrition-related diseases are of major interest. Clinical Practice Guidelines (CPGs) of the most updated evidence-based recommendations are useful tools that help clinicians in their practice. However, a gap has been observed between the suggested CPGs and their implementation in the context of everyday clinical practice. This could be merely attributed to the text format that is usually presented. In this review article, all the CPGs about the best dietary advice regarding energy and macronutrient intake in childhood and the most common chronic nutrition-related childhood diseases, i.e., obesity, dyslipidemia, and diabetes mellitus type 1 and 2, are summarized and visualized in an algorithmic format and practical examples are given. This could help healthcare providers to achieve a higher adoption rate of CPGs in clinical practice, thus, resulting in better management of children's health and improved clinical outcomes.

Keywords: nutrition, guidelines, algorithm, children.

Received: May 29, 2021 / Accepted: August27, 2021 / Published: August 31, 2021

1 Introduction

A remarkable increase in the prevalence of the most common nutrient-related chronic diseases in childhood, namely obesity, diabetes mellitus, and dyslipidemia, has been observed during the last two decades [1-4]. Thus, recommendations for clinicians and primary care providers for children about the best care for their patients with all the aforementioned chronic conditions are of great importance. The Institute of Medicine defines Clinical Practice Guidelines (CPG) as "statements that include recommendations intended to optimize patient care, that are informed by a systematic review of evidence and an assessment of the benefits and harms of alternative care options" [5]. Guidelines for both youth obesity and diabetes are available in the literature and agree on (i) the adherence to a healthful and culturally appropriate dietary pattern, (ii) the adoption of an active lifestyle, (iii) the promotion of adequate growth, and, when appropriate, (iv) weight reduction (up to 10% of initial weight) [6-8]. Although these modalities have been proven effective in the short term, lifestyle interventions in obese children have resulted in moderate weight reduction and poorly ameliorated glycemic and cardiovascular indices [9-14]. Similar results have been produced for children with diabetes [6, 15-17].

Although there is evidence that the provision of guidelines does improve clinical practice and does benefit patients, the effects are not optimum for them [18]. Thus, there is a clear gap between the suggested recommendations and their implementation in clinical practice. There are many reasons that this discrepancy could be attributed. Firstly, the lack of implementation of CPGs to everyday practice could be caused due to external barriers, such as financial issues, organizational problems (lacking the proper medical equipment and facilities), patients' environmental conditions far from the suggested ones in the guidelines, and negative provider's knowledge and attitudes towards the CPGs. Moreover, internal CPGs structural problems, for instance including an ambiguous format, many tables, and redundant clinical information are also an important factor preventing their full implementation in clinical practice [19, 20]. In a study regarding the barriers to implementation of national guidelines in general practitioners from the Netherlands, one of the most important factors identified, among others, was the characterization of the guidelines as unclear or ambiguous [21]. In other studies, however, it has been observed that guidelines were more likely to be followed when there are presented in specific actionable terms [22]. Thus, visualizing CPGs as algorithms could contribute to the improvement of their adherence by the primary healthcare provider. When CPGs are presented as algorithms, all the information is summarized in a step-by-step manner and all the necessary actions to be taken are clearly presented, minimizing the possibility of their misconception.

However, not all the CPGs for the optimum dietary advice in childhood or the management of childhood obesity, Diabetes Mellitus Type 1 and Type 2 (DMT1, DMT2 respectively), and dyslipidemia are summarized in algorithmic forms. Thus, the present review aims to present all the GPGs about the best dietary advice regarding energy and macronutrient intake of protein and fat in childhood, and the aforementioned common childhood chronic conditions in algorithms, in order to improve their understanding and to raise their implementation by the primary care provider. Moreover, an example of their implementation will be presented in real case scenarios for the clinical algorithms of childhood obesity, DMT1, DMT2, and dyslipidemia, to further enhance their practical use in everyday clinical practice.

* **Corresponding author:** George Antonogeorgos, Department of Nutrition and Dietetics, School of Health Science and Education, Harokopio University, Athens, Greece. Tel: (+30) 6974353854, E-mail: gantonogeorgos@gmail.com

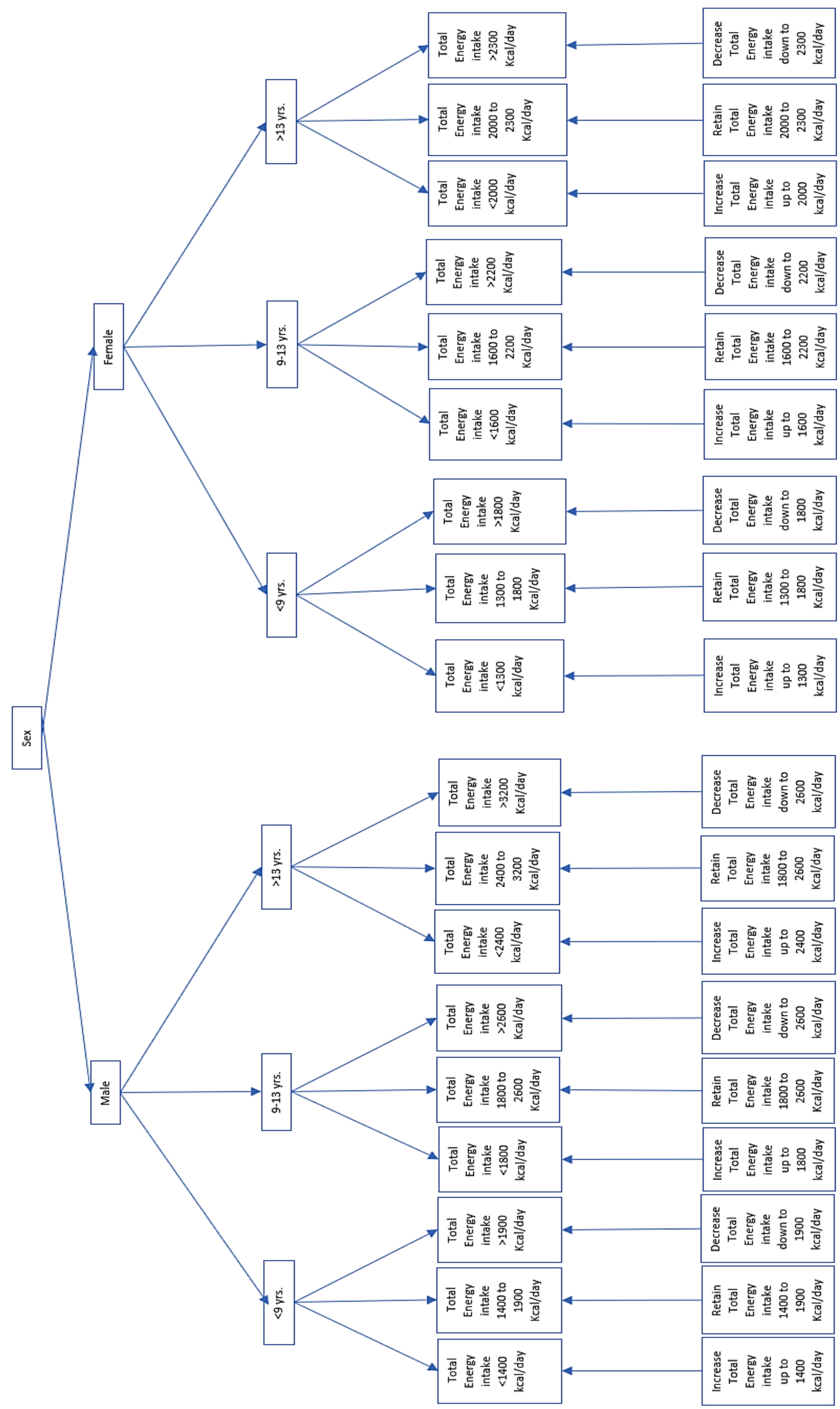

Figure 1: The energy consumption algorithm

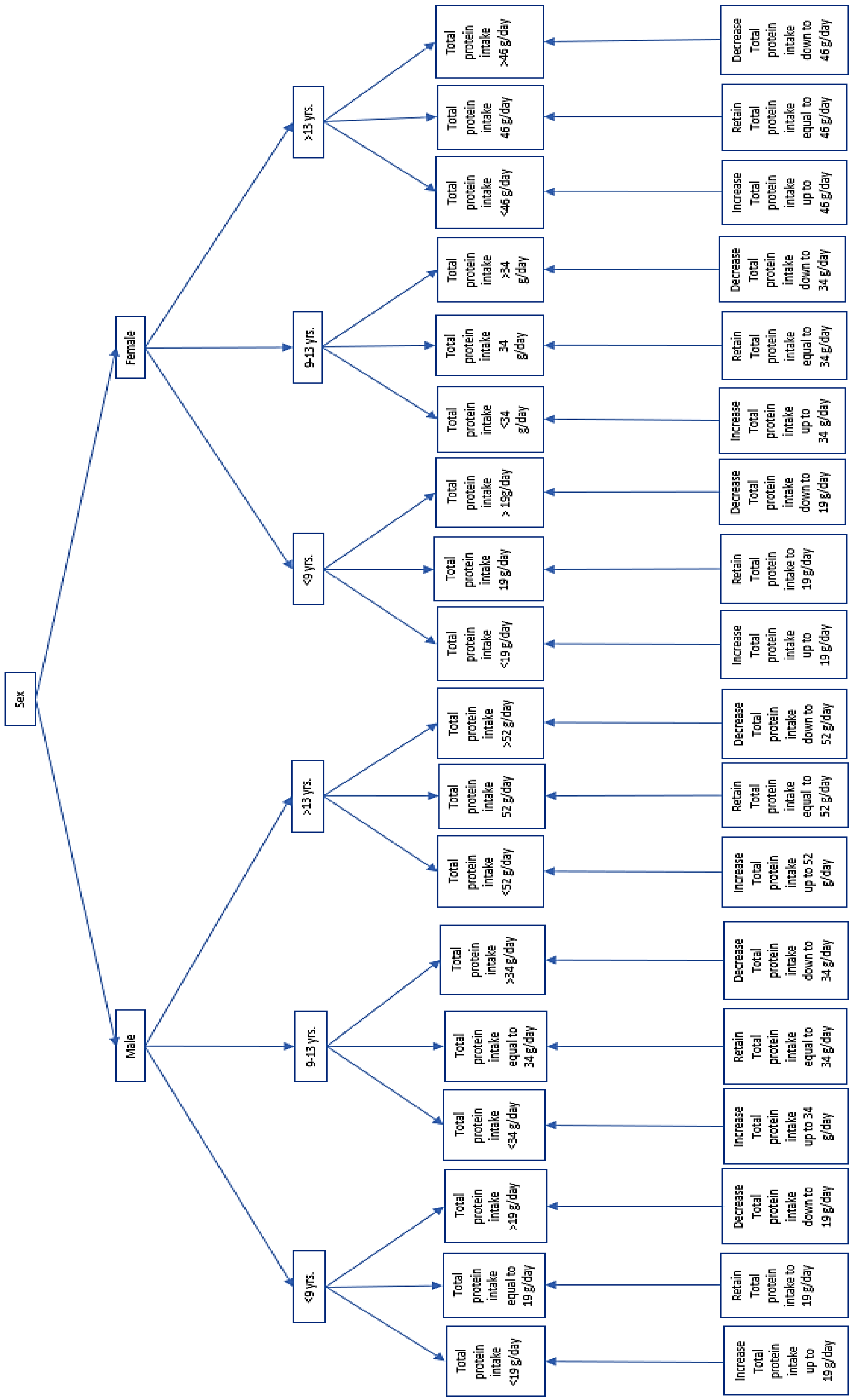

Figure 2: The protein consumption algorithm

2 Energy and macronutrient intake algorithms for childhood and adolescence

In Figures 1-3 the algorithms for energy consumption and macronutrient intake of protein and fat are presented. The algorithms incorporate the guidelines for the optimum macronutrient requirements in childhood according to gender and age category (up to 9 yrs., 9 to 13 yrs., 13 yrs. and older) as suggested by the National Academies of Sciences [23]: macronutrient intake below, between, and above the recommended cut-off values. If an individual is consuming less than the recommended calories and macronutrients the algorithms suggest increasing consumption to the recommended one; if an individual is consuming more, the algorithm suggests decreasing the energy and macronutrient intake to the recommended one, and if an individual is consuming the appropriate amount of calories and macronutrient intake the algorithm suggest to retain the same.

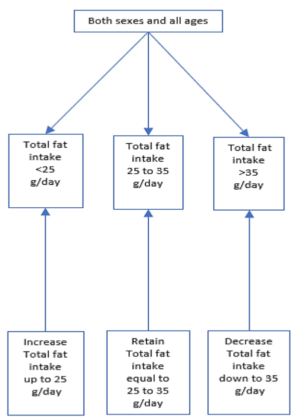

Figure 3: The fat consumption algorithm

3 Overweight and obesity management algorithm for childhood and adolescence

Figure 4 presents the algorithm for the management of an overweight or obese boy/girl. The algorithm is developed based on the most recent and well-established evidence regarding the recommendations a health care practitioner should give to a family in order to improve the weight status of an overweight/obese child/adolescent [24-50]. Each individual, according to its Body Mass Index (BMI) values and using the International Obesity Task Force (IOTF) cut-off values for obesity, will be categorized either as having a normal weight status or as being overweight or obese. Onwards, in the next algorithm step, input information regarding meal frequency and breakfast frequency consumption, weekly visits at restaurants and fast-food consumption, various dietary habits (fruits and vegetables, sweetened beverages, and energy-dense foods consumption), as well as information about daily physical activity and daily sedentary activity, will be assessed. At the last step of the algorithm, depending on the information processed in the second step, actions will be proposed to address the problem of increased weight status, e.g., if the individual is eating less than five servings of fruits/day the output of the algorithm will be to increase fruit and vegetable consumption up to 5 servings or otherwise. The added value of the algorithmic graphical presentation of the CPGs for overweight and obese children is the simplicity that they offer when a clinician has to provide clinical advice in his/her practice as well as the reassurance that all the necessary factors will be assessed and the most evident up-to-date advice will be administered to the overweight/obese child.

3.1 An example

Next, an example is presented regarding the application of the algorithm in a real-life case scenario: A 10-year old boy, with BMI of 23.6 Kg/m^2, who visits three times per week restaurants and fast foods and skips consuming breakfast daily, consumes three servings of fruits and vegetables, two sweetened beverages and one energy-dense food per day, eats two meals per day and, watches one-hour television and plays two hours video games daily while he is participating in a soccer team for one hour three times per week will be assessed by the algorithm. According to the IOTF classification, the boy is classified as obese, and therefore the algorithm suggests the following interventions: a) visit restaurants and fast food once per week or less b) limit sweetened beverages consumption c) limit energy-dense food product consumption d) increase breakfast frequency consumption to daily e) Increase meal frequency consumption and snacking to three or more per day f) increase the consumption of fruits and vegetables to at least five servings per day and g) increase daily physical activity to at least one hour daily and h) decrease sedentary activity to less than two hours per day.

4 Dyslipidemia management algorithm for childhood and adolescence

Figure 5 presents the algorithm for the management of a child with dyslipidemia. If a child has recent blood LDL-C levels > 130 mg/dL or total cholesterol (TC) levels > 200 mg/dL is classified by the algorithm as having dyslipidemia. Then according to the absolute value of LDL-C, if a value of more than 250 mg/dL was found, he/she should be referred immediately to a pediatric lipid specialist for individualized care. If LDL-C values are less than the threshold of 250 mg/dL, then a child is classified according to age (more or less than ten years) and his level of Cardiovascular Disease Risk (CVD) risk. After that step, the output of the algorithm (final step) suggests either pharmacotherapy or lifestyle changes or both [51, 52].

4.1 An example

A boy, 12 years old, who is overweight and has a parent who is taking treatment for dyslipidemia, with LDL-C values of 170 mg/dL will be assessed using the algorithm. According to the LDL-C values, the boy is been categorized as having dyslipidemia and further categorized in the next algorithm step as a child with age more than 10 years who is at -risk of CVD and needs to be treated at first with lifestyle changes (diet modifications- high diet in fibers, high diet in polyunsaturated and monosaturated fats,

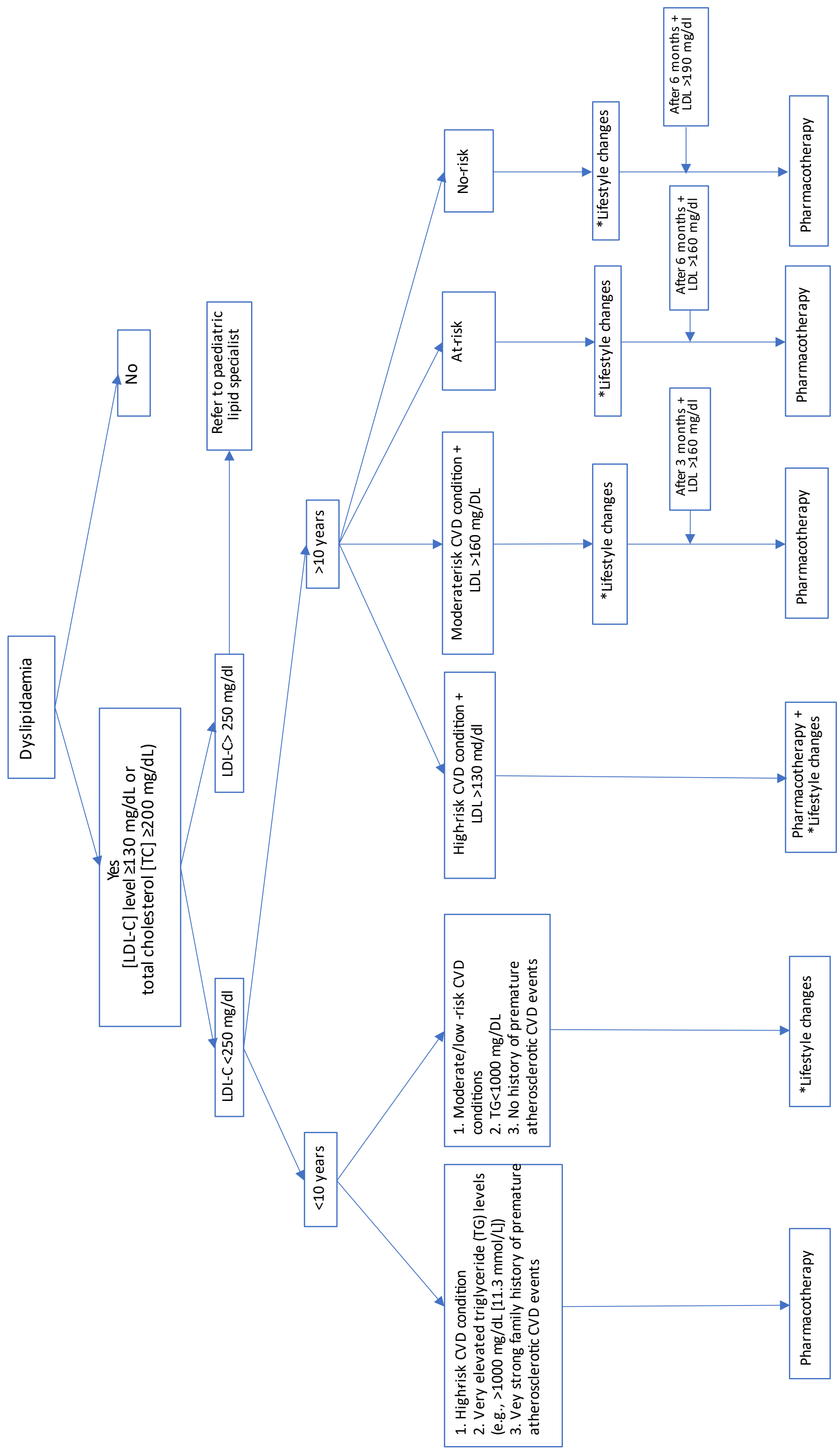

Figure 4: The childhood obesity management algorithm

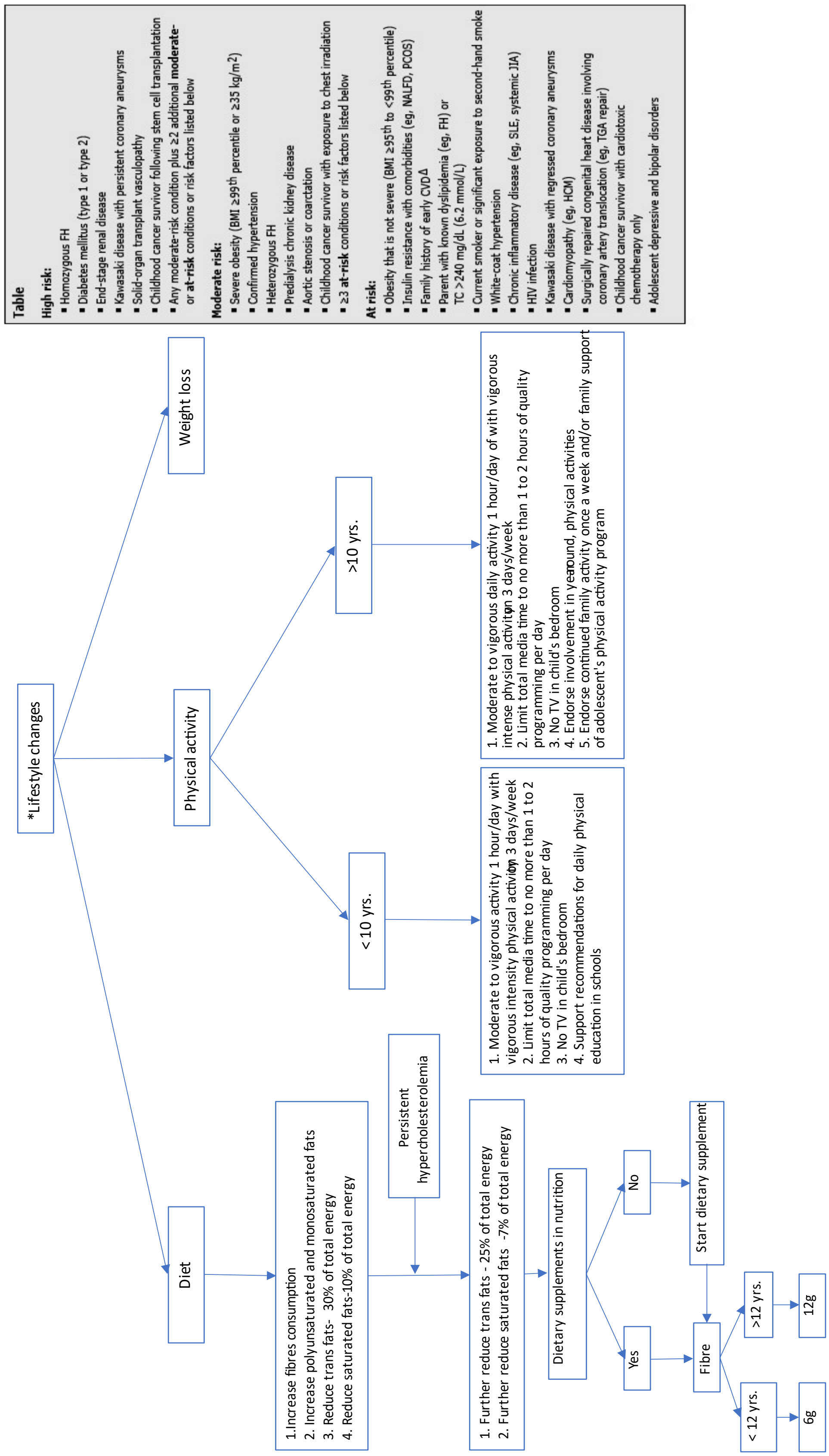

Figure 5: The Childhood Dyslipidemia management algorithm

devoid of trans fats- 30% of total energy and low saturated fats- 10% of total energy, 1 hour/day of moderate to vigorous daily activity, with vigorous intense physical activity on 3 days/week, no TV in bedroom and total media time to no more than 1 to 2 hours of quality programming per day and dietary supplementation with fiber supplementation 6g per day). If after three months LDL-C continues to stay at levels > 160 mg/dL further dietary changes should be implemented (further restrict fat intake and devoid trans fats- 25% of total energy and low saturated fats up to 7% of total energy) and pharmacotherapy should be considered.

5 DMT2 and DMT1 management algorithm for childhood and adolescence

Figure 6 illustrates the DMT2 management algorithm. According to the algorithm if a child has DMT2 and his blood glucose (BG) levels are higher than 250 mg/dL, or its glycated hemoglobin A1c (HbA1c) values are higher than 8.5%, he/she should continue insulin treatment, metformin, and lifestyle program, otherwise, he/she should continue only metformin and lifestyle program. Children who are treated with insulin, metformin, and lifestyle program should monitor HbA1c every three months and if HbA1 values are less than 7%, the current treatment should be continued and effort should be put in order to wean off insulin; otherwise, if HbA1c values are more than 7%, pharmacotherapy should be intensified by adding a triple regimen to the pharmacotherapy. If only metformin and lifestyle program is the current DMT2 treatment and HbA1c levels after three months are below 7%, then the algorithm suggests continuing the current treatment and monitor HbA1 levels every three months. Otherwise (HbA1c levels more than 7%) the treatment should be intensified by adding insulin therapy and BG levels should be monitored daily, followed by the appropriate adjustments to insulin dose, for optimum BG levels to be achieved (figure 7) [53, 54].

5.1 An example

A 13-year-old boy, with a history of DMT2, has current BG values of 270 mg/dL and HbA1c values of 8.9%, and he is taking insulin and metformin. According to the algorithm, the boy should continue the current treatment, should monitor his BG daily and adjust his insulin doses correspondingly, and should monitor his HbA1c levels every three months. If then his HbA1c levels are below 7%, the boy should continue the same treatment and try to wean off insulin, if possible, while every three months should check his HbA1c levels. If HbA1c levels are above 7%, a triple agent should be added to the pharmacotherapy, along with the necessary lifestyle program (weight loss, if necessary, dietary advice such as decreasing portion size, substitute carbohydrate-rich foods for fruit or vegetables, eliminate sweetened beverages and reduce the frequency of eating out, increase physical activity at least for one hour per day and decrease sedentary activity to no more than two hours per day).

Figure 7 presents the childhood DMT1 management algorithm. According to the algorithm, if a child has DMT1, the algorithm is assessing information about the insulin regimen that he is receiving and information about his nutrition, mainly assessing the carbohydrate consistency and the nutritional content. If the child does not follow any meal planning program with basic or advanced carbohydrate counting, or his diet does not include carbohydrates mainly from fruits, vegetables, whole grains, legumes, low-fat milk, and it is not characterized by a variety of healthy foods and elimination of the consumption of foods with added sugar, the algorithm suggests making the appropriate changes either in nutritional content or meal planning. Otherwise, the next step in the algorithm is assessing the HbA1c levels, and if it is less than 7.5%, the algorithm suggests to continue with the same combination of insulin regimen and nutrition; otherwise, if HbA1c levels are above 7.5%, the insulin regimen and nutrition should be adjusted accordingly (figure 8) [55].

5.2 An example

A 15-year-old girl has DMT1 and does not follow any meal plan. According to the algorithm, the girl should make the appropriate changes in meal planning (basic carbohydrate counting) and to the macronutrient content of her diet (eating carbohydrates from fruits, vegetables, whole grains, legumes, and low-fat milk, replacement of saturated fats with mono- and polyunsaturated fatty acids, minimization of trans fatty acids consumption). In the next step, if the girl changes her dietary choices, her HbA1c levels are being assessed, and if the values are below 7.5 %, the girl should continue the dietary plan; otherwise, the appropriate adjustment in her diet and/or her insulin regimen should be made.

6 Discussion

This review presents the most updated CPGs regarding the recommended daily energy and macronutrient requirements in childhood and adolescence in the form of visualized algorithms. Furthermore, the up-to-date CPGs for the most common chronic nutrient-related conditions in childhood – obesity, dyslipidemia, and DMT1, and DMT2, are also summarized and presented in this review in algorithmic form. Thus, our work aims to enhance the adoption and the compliance of CPGs from any healthcare provider related to children (dietitians, pediatricians, nurses) in order to further improve their nutrition and the management of these diseases.

Many of the CPGs are provided in a textual format, while often tables are included within them. However, clinicians find it tedious and time-consuming to read CPGs in textual form. In the study of T. Sinuff *et al*., referring to Canadian intensive care units' physicians and nurses' perceptions about practicing CPGs, it has been documented, that algorithms, tables, and graphs are more preferred rather than text and sentences [56]. Many physicians meet many obstacles when they seek CPGs in order to make a decision using a well-known and very reliable evidence-based medicine systematic review and metanalysis database, the Cochrane Library, mainly difficulties locating the site and find the appropriate content [57]. Time is also a constraint during clinical practice. The study by Ely *et al*. has shown that physicians may quit the search for a clinical answer after a very short period, approximately two minutes [58].

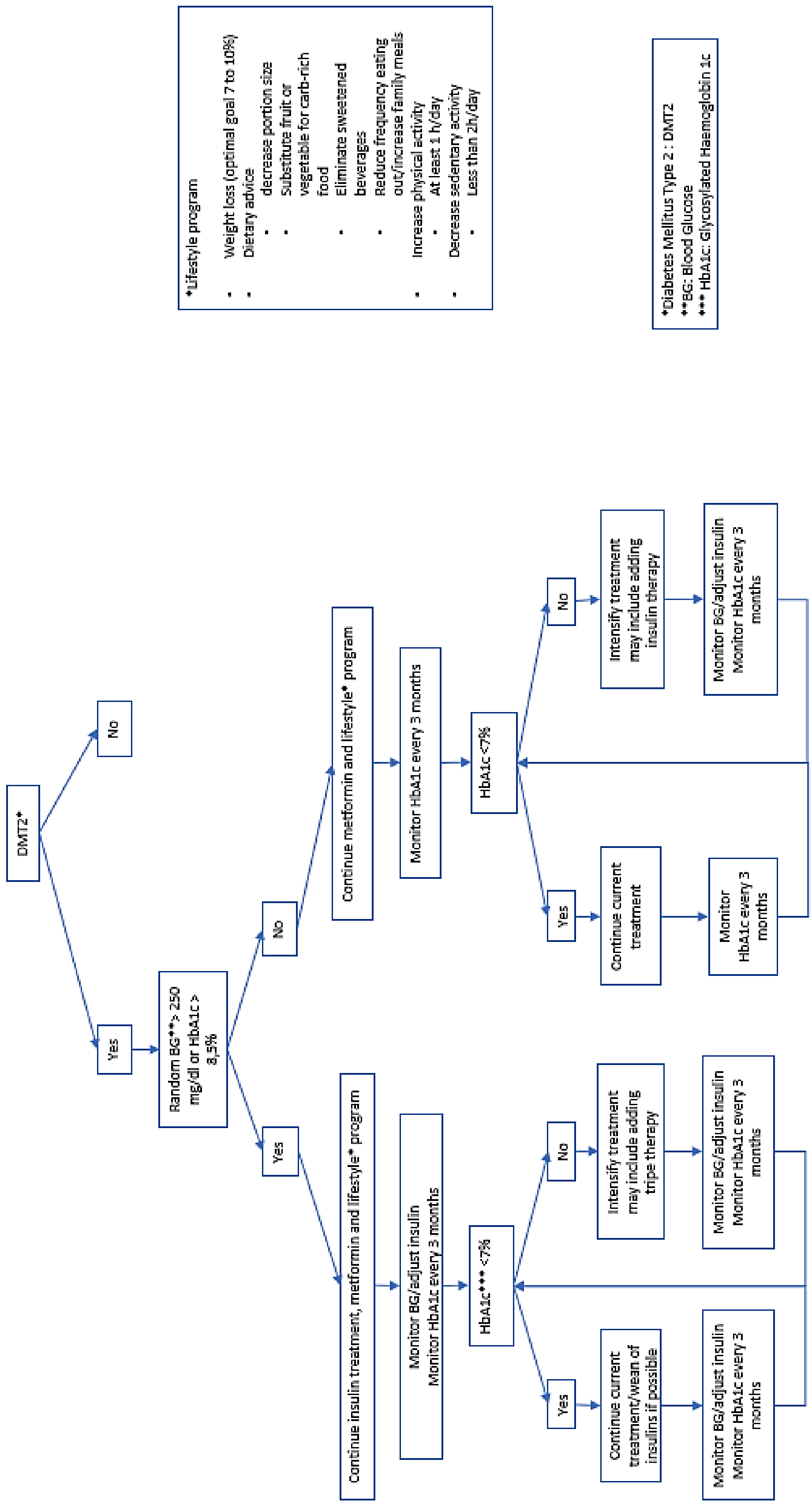

Figure 6: The Diabetes Mellitus Type 2 management algorithm

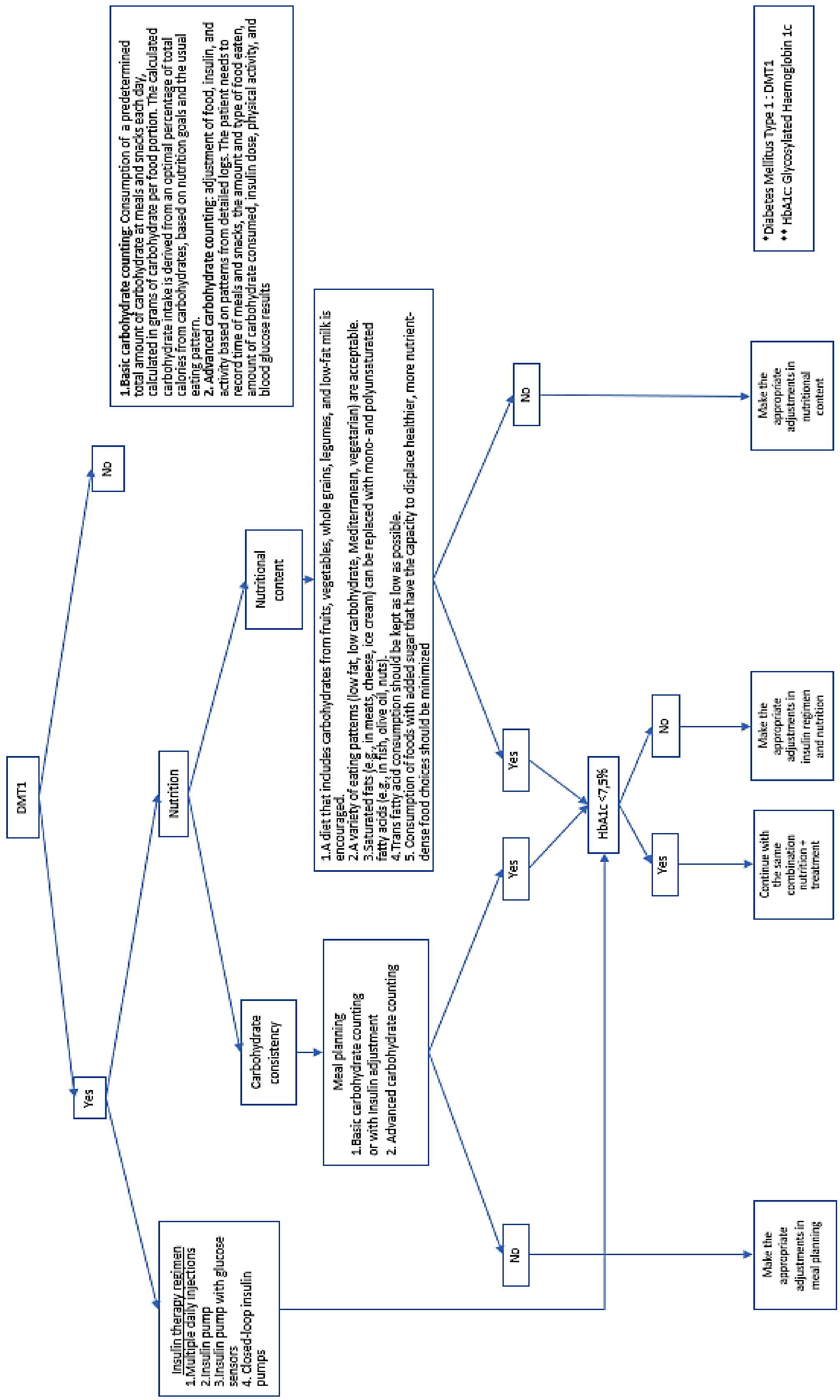

Figure 7: The Diabetes Mellitus Type 1 management algorithm

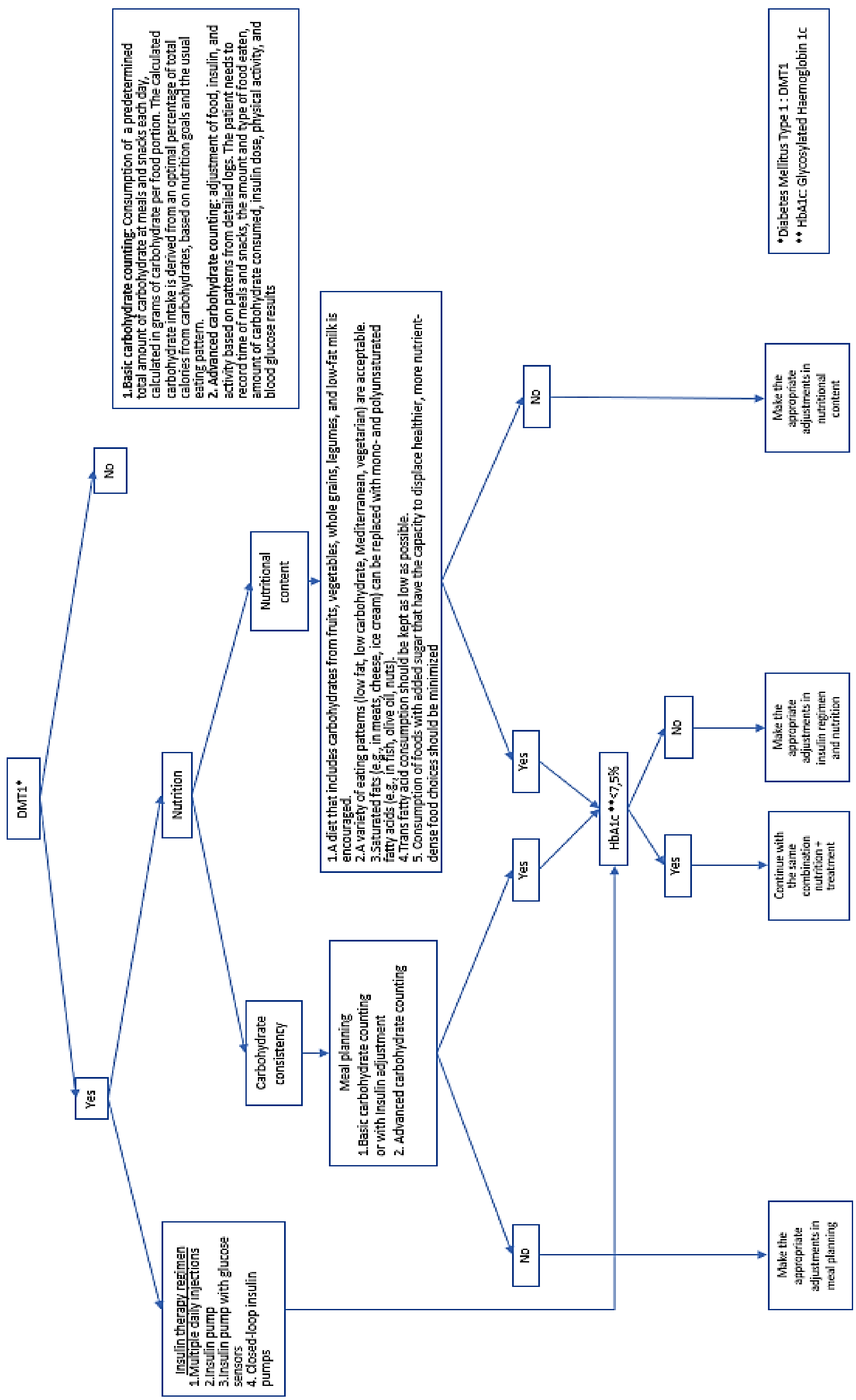

Figure 8: The Diabetes Mellitus Type 1 management algorithm

Thus, the format used to retrieve the appropriate information during clinical practice is of great importance almost at the same level as its reliability.

In this work, a model-centric approach was selected in order to visualize the CPGs. There are two approaches when CPGs are been visualized: a) a model-centric and b) a document-centric approach [59]. In the model-centric approach, no direct relationship exists between the model and the original document of the CPGs, while the document-centric approach is more text-oriented, in which mark-up tools are applied in the guidelines' text resulting in a mixed-format. The most known and vastly applied type of model-centric approach is the clinical algorithm maps format, which has been chosen for the visualization of the CPGs reviews[60]. The major advantage of using flowcharts is that clinicians are aware of them and they do not require further learning effort, in order to be implemented in their clinical practice. However, most of the time, they are spacious and due to this, a clinician could lose the complete overview of the subject. In our work, an effort was put to minimize the length of the algorithms in each subject, to be totally comprehensible by everyone who applies them in his daily practice.

The use of CPGs in algorithmic form is very common for the appropriate assessment and care for many pathological conditions, both in adulthood and in childhood. Especially in childhood, many CPGs are presented in the format of an algorithm, either for the diagnosis of a variety of disorders, such as inborn anomalies of metabolism [61], or the management of several conditions, such as constipation [62]. However, to the best of our knowledge, although CPGs for nutrient intake and nutrient-related chronic metabolic conditions are well established in the literature, this work is the first one that summarizes and presents them in algorithmic form, in order to further increase their adoption in everyday clinical practice.

7 Conclusions

In this review, a visualization of the most updated CPGs for the recommended macronutrient intake regarding energy, protein, and lipids, in childhood and the current CPGs for the optimum management of childhood obesity, dyslipidemia, and DMT1 and DMT2, is presented. The visualization of the CPGs in an algorithmic format will help healthcare providers to achieve a higher adoption rate of them in its clinical practice, thus, resulting in improved clinical outcomes and improved healthcare for children suffering from nutrition-related diseases.

Author contribution: A M.Y and D.B.P conceived the presented idea. G.A is the principal author of the manuscript and developed the algorithms. D.B.P, E.B, M.Y co-authored the manuscript and participated in the development of the algorithms. E.M and DP carefully reviewed the manuscript and gave valuable feedback. All authors read and approved the final manuscript. All authors have read and agreed to the published version of the manuscript.

Funding: This work has received funding from the European Union's Horizon 2020 Research and Innovation Program through the NUTRISHIELD project (https://nutrishield-project.eu/) under Grant Agreement No 818110. This paper reflects only the authors' views; the European Union is not liable for any use that may be made of the information contained therein.

Conflict of interest: The authors declare no conflicts of interest.

ORCID: George ANTONOGEORGOS: 0000-0002-0515-7256

References

[1] Abarca-Gómez, L., Abdeen, Z. A., Hamid, Z. A., Abu-Rmeileh, N. M., Acosta-Cazares, B., Acuin, C., Adams, R. J., Aekplakorn, W., Afsana, K., Aguilar-Salinas, C. A., Agyemang, C., Ahmadvand, A., Ahrens, W., Ajlouni, K., Akhtaeva, N., Al-Hazzaa, H. M., Al-Othman, A. R., Al-Raddadi, R., Al Buhairan, F., … Ezzati, M. (2017). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: A pooled analysis of 2416 population-based measurement studies in 128·9 million children, adolescents, and adults. *The Lancet*, *390* (10113), 2627-2642. https://doi.org/10.1016/S0140-6736(17)32129-3

[2] Reilly, J. J., El-Hamdouchi, A., Diouf, A., Monyeki, A., & Somda, S. A. (2018). Determining the worldwide prevalence of obesity. *The Lancet*, *391*(10132), 1773-1774. https://doi.org/10.1016/s0140-6736(18)30794-3

[3] Centers for Disease Control and Prevention. (2010). *Prevalence of Abnormal Lipid Levels Among Youths—United States, 1999—2006*. *59* (02); Morbidity and Mortality Weekly Report (MMWR), pp. 29–33. https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5902a1.htm?as=i5nxema5or1fv2wfgg4oohdx

[4] Dabelea, D., Mayer-Davis, E. J., Saydah, S., Imperatore, G., Linder, B., Divers, J., Bell, R., Badaru, A., Talton, J. W., Crume, T., Liese, A. D., Merchant, A. T., Lawrence, J. M., Reynolds, K., Dolan, L., Liu, L. L., & Hamman, R. F. (2014). Prevalence of type 1 and type 2 diabetes among children and adolescents from 2001 to 2009. *JAMA*, *311* (17), 1778. https://doi.org/10.1001/jama.2014.3201

[5] Panagiotopoulos, C., Hadjiyannakis, S., & Henderson, M. (2018). Type 2 Diabetes in Children and Adolescents. *Canadian Journal of Diabetes*, *42*, S247–S254. https://doi.org/10.1016/j.jcjd.2017.10.037

[6] Institute of Medicine. (2011). *Clinical Practice Guidelines We Can Trust*. The National Academies Press. https://doi.org/10.17226/13058

[7] American Diabetes Association. (2018). 12. Children and Adolescents: Standards of Medical Care in Diabetes—2018. *Diabetes Care*, *41* (Supplement 1), S126. https://doi.org/10.2337/dc18-S012

[8] Smart, C. E., Annan, F., Higgins, L. A., Jelleryd, E., Lopez, M., & Acerini, C. L. (2018). ISPAD clinical practice consensus guidelines 2018: Nutritional management in children and adolescents with diabetes. *Pediatric Diabetes*, *19*, 136-154. https://doi.org/10.1111/pedi.12738

[9] Styne, D. M., Arslanian, S. A., Connor, E. L., Farooqi, I. S., Murad, M. H., Silverstein, J. H., & Yanovski, J. A. (2017). Pediatric obesity—Assessment, treatment, and prevention: An Endocrine Society clinical practice guideline. *The Journal of Clinical Endocrinology & Metabolism*, *102*(3), 709-757. https://doi.org/10.1210/jc.2016-2573

[10] Ho, M., Garnett, S. P., Baur, L., Burrows, T., Stewart, L., Neve, M., & Collins, C. (2012). Effectiveness of lifestyle interventions in child obesity: Systematic review with meta-analysis. *PEDIATRICS*, *130* (6), e1647-e1671. https://doi.org/10.1542/peds.2012-1176

[11] Bahia, L., Schaan, C. W., Sparrenberger, K., Abreu, G. D., Barufaldi, L. A., Coutinho, W., & Schaan, B. D. (2019). Overview of meta-analysis on prevention and treatment of childhood obesity. *Jornal de Pediatria*, *95* (4), 385-400. https://doi.org/10.1016/j.jped.2018.07.009

[12] Lien, A. S., Tsai, J., Lee, J., Wu, M., Jiang, Y., & Yen, H. (2017). A systematic review and meta-analysis of the effect of lifestyle modification on metabolic control in overweight children. *Evidence-Based Complementary and Alternative Medicine*, *2017*,1-12. https://doi.org/10.1155/2017/5681909

[13] Elvsaas, I. K., Giske, L., Fure, B., & Juvet, L. K. (2017). Multicomponent lifestyle interventions for treating overweight and obesity in children and adolescents: A systematic review and meta-analyses. *Journal of Obesity*, *2017*, 1-14. https://doi.org/10.1155/2017/5021902

[14] Pillay, J., Armstrong, M. J., Butalia, S., Donovan, L. E., Sigal, R. J., Chordiya, P., Dhakal, S., Vandermeer, B., Hartling, L., Nuspl, M., Featherstone, R., & Dryden, D. M. (2015). Behavioral Programs for Type 1 Diabetes Mellitus. *Annals of Internal Medicine*, *163* (11), 836–847. https://doi.org/10.7326/M15-1399

[15] McGavock, J., Dart, A., & Wicklow, B. (2014). Lifestyle therapy for the treatment of youth with type 2 diabetes. *Current Diabetes Reports*, *15* (1). https://doi.org/10.1007/s11892-014-0568-z

[16] Nansel, T. R., Laffel, L. M., Haynie, D. L., Mehta, S. N., Lipsky, L. M., Volkening, L. K., Butler, D. A., Higgins, L. A., & Liu, A. (2015). Improving dietary quality in youth with type 1 diabetes: Randomized clinical trial of a family-based behavioral intervention. *International Journal of Behavioral Nutrition and Physical Activity*, *12* (1). https://doi.org/10.1186/s12966-015-0214-4

[17] Giguère, A., Légaré, F., Grimshaw, J., Turcotte, S., Fiander, M., Grudniewicz, A., Makosso-Kallyth, S., Wolf, F. M., Farmer, A. P., & Gagnon, M. (2012). Printed educational materials: Effects on professional practice and healthcare outcomes. *Cochrane Database of Systematic Reviews*. https://doi.org/10.1002/14651858.cd004398.pub3

[18] Baradaran-Seyed, Z., Nedjat, S., Yazdizadeh, B., Nedjat, S., & Majdzadeh, R. (2013). Barriers of clinical practice guidelines development and implementation in developing countries: a case study in Iran. *International journal of preventive medicine*, *4* (3), 340–348. PMID: 23626892

[19] Jin, Y., Li, Z., Han, F., Huang, D., Huang, Q., Cao, Y., Weng, H., Zeng, X., Wang, X., & Shang, H. (2019). Barriers and enablers for the implementation of clinical practice guidelines in China: A mixed-method study. *BMJ Open*, *9* (9), e026328. https://doi.org/10.1136/bmjopen-2018-026328

[20] Lugtenberg, M., Zegers-van Schaick, J. M., Westert, G. P., & Burgers, J. S. (2009). Why don't physicians adhere to guideline recommendations in practice? An analysis of barriers among Dutch general practitioners. *Implementation Science*, *4* (1), 54. https://doi.org/10.1186/1748-5908-4-54

[21] Grol, R., Dalhuijsen, J., Thomas, S., Veld, C. I., Rutten, G., & Mokkink, H. (1998). Attributes of clinical guidelines that influence use of guidelines in general practice: Observational study. *BMJ*, *317* (7162), 858-861. https://doi.org/10.1136/bmj.317.7162.858

[22] Lupton, J. R., Brooks, J. A., Butte, N. F., Caballero, B., Flatt, J. P., & Fried, S. K. (2002). Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids. *National Academy Press: Washington, DC, USA*, *5*, 589-768. Available at: https://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=s10490

[23] Whitlock, E. P., O'Connor, E. A., Williams, S. B., Beil, T. L., & Lutz, K. W. (2010). Effectiveness of weight management interventions in children: A targeted systematic review for the USPSTF. *PEDIATRICS*, *125* (2), e396-e418. https://doi.org/10.1542/peds.2009-1955

[24] Paeratakul, S., Ferdinand, D. P., Champagne, C. M., Ryan, D. H., & Bray, G. A. (2003). Fast-food consumption among US adults and children: Dietary and nutrient intake profile. *Journal of the American Dietetic Association*, *103* (10), 1332-1338. https://doi.org/10.1016/s0002-8223(03)01086-1

[25] Diliberti, N., Bordi, P. L., Conklin, M. T., Roe, L. S., & Rolls, B. J. (2004). Increased portion size leads to increased energy intake in a restaurant meal. *Obesity Research*, *12* (3), 562-568. https://doi.org/10.1038/oby.2004.64

[26] Bowman, S. A., Gortmaker, S. L., Ebbeling, C. B., Pereira, M. A., & Ludwig, D. S. (2003). Effects of fast-food consumption on energy intake and diet quality among children in a national household survey. *PEDIATRICS*, *113* (1), 112-118. https://doi.org/10.1542/peds.113.1.112

[27] French, S., Story, M., Neumark-Sztainer, D., Fulkerson, J., & Hannan, P. (2001). Fast food restaurant use among adolescents: Associations with nutrient intake, food choices and behavioral and psychosocial variables. *International Journal of Obesity*, *25* (12), 1823-1833. https://doi.org/10.1038/sj.ijo.0801820

[28] Nielsen, S. (2002). Trends in food locations and sources among adolescents and young adults. *Preventive*

Medicine, *35* (2), 107-113. https://doi.org/10.1006/pmed.2002.1037

[29] Schmidt, M., Affenito, S. G., Striegel-Moore, R., Khoury, P. R., Barton, B., Crawford, P., Kronsberg, S., Schreiber, G., Obarzanek, E., & Daniels, S. (2005). Fast-food intake and diet quality in black and white girls. *Archives of Pediatrics & Adolescent Medicine*, *159* (7), 626. https://doi.org/10.1001/archpedi.159.7.626

[30] Thompson, O. M., Ballew, C., Resnicow, K., Must, A., Bandini, L. G., Cyr, H., & Dietz, W. H. (2003). Food purchased away from home as a predictor of change in BMI Z-score among girls. *International Journal of Obesity*, *28*(2), 282-289. https://doi.org/10.1038/sj.ijo.0802538

[31] Pereira, M. A., Kartashov, A. I., Ebbeling, C. B., Van Horn, L., Slattery, M. L., Jacobs, D. R., & Ludwig, D. S. (2005). Fast-food habits, weight gain, and insulin resistance (the CARDIA study): 15-year prospective analysis. *The Lancet*, *365* (9453), 36-42. https://doi.org/10.1016/s0140-6736(04)17663-0

[32] Brownell, K. D., Farley, T., Willett, W. C., Popkin, B. M., Chaloupka, F. J., Thompson, J. W., & Ludwig, D. S. (2009). The public health and economic benefits of taxing sugar-sweetened beverages. *The New England journal of medicine*, *361* (16), 1599–1605. https://doi.org/10.1056/NEJMhpr0905723

[33] Malik, V. S., Pan, A., Willett, W. C., & Hu, F. B. (2013). Sugar-sweetened beverages and weight gain in children and adults: A systematic review and meta-analysis. *The American Journal of Clinical Nutrition*, *98* (4), 1084-1102. https://doi.org/10.3945/ajcn.113.058362

[34] Trumbo, P. R., & Rivers, C. R. (2014). Systematic review of the evidence for an association between sugar-sweetened beverage consumption and risk of obesity. *Nutrition Reviews*, *72* (9), 566-574. https://doi.org/10.1111/nure.12128

[35] Lewis, C. J., Park, Y. K., Dexter, P. B., & Yetley, E. A. (1992). Nutrient intakes and body weights of persons consuming high and moderate levels of added sugars. *Journal of the American Dietetic Association*, *92* (6), 708–713. https://doi.org/10.1016/S0002-8223(21)00711-2

[36] Rolls, B. J., Engell, D., & Birch, L. L. (2000). Serving portion size influences 5-Year-Old but No. 3-Year-Old children's food intakes. *Journal of the American Dietetic Association*, *100* (2), 232-234. https://doi.org/10.1016/s0002-8223(00)00070-5

[37] Krebs, N. F., Himes, J. H., Jacobson, D., Nicklas, T. A., Guilday, P., & Styne, D. (2007). Assessment of Child and Adolescent Overweight and Obesity. *Pediatrics*, *120* (Supplement 4), S193. https://doi.org/10.1542/peds.2007-2329D

[38] Naude, C. E., Visser, M. E., Nguyen, K. A., Durao, S., & Schoonees, A. (2018). Effects of total fat intake on bodyweight in children. *Cochrane Database of Systematic Reviews*. https://doi.org/10.1002/14651858.cd012960

[39] McCrory, M. A., Fuss, P. J., Hays, N. P., Vinken, A. G., Greenberg, A. S., & Roberts, S. B. (1999). Overeating in America: Association between restaurant food consumption and body fatness in healthy adult men and women ages 19 to 80. *Obesity Research*, *7* (6), 564-571. https://doi.org/10.1002/j.1550-8528.1999.tb00715.x

[40] Bazzano, L. A., He, J., Ogden, L. G., Loria, C. M., Vupputuri, S., Myers, L., & Whelton, P. K. (2002). Fruit and vegetable intake and risk of cardiovascular disease in US adults: The first national health and nutrition examination survey epidemiologic follow-up study. *The American Journal of Clinical Nutrition*, *76* (1), 93-99. https://doi.org/10.1093/ajcn/76.1.93

[41] Maskarinec, G., Novotny, R., & Tasaki, K. (2000). Dietary patterns are associated with body mass index in multiethnic women. *The Journal of Nutrition*, *130* (12), 3068-3072. https://doi.org/10.1093/jn/130.12.3068

[42] Wolfe, W. S., Campbell, C. C., Frongillo, E. A., Haas, J. D., & Melnik, T. A. (1994). Overweight schoolchildren in New York State: Prevalence and characteristics. *American Journal of Public Health*, *84*(5), 807-813. https://doi.org/10.2105/ajph.84.5.807

[43] Gibson, S., & O'Sullivan, K. (1995). Breakfast cereal consumption patterns and nutrient intakes of British schoolchildren. *Journal of the Royal Society of Health*, *115* (6), 366-370. https://doi.org/10.1177/146642409511500608

[44] Ortega, R. M., Requejo, A. M., López-Sobaler, A. M., Quintas, M. E., Andrés, P., Redondo, M. R., Navia, B., López-Bonilla, M. D., & Rivas, T. (1998). Difference in the breakfast habits of overweight/obese and normal weight schoolchildren. *International journal for vitamin and nutrition research*. *68* (2), 125–132. PMID: 9565828

[45] Pastore, D. R., Fisher, M., & Friedman, S. B. (1996). Abnormalities in weight status, eating attitudes, and eating behaviors among urban high school students. *Journal of Adolescent Health*, *18* (5), 312-319. https://doi.org/10.1016/1054-139x(95)00321-i

[46] Summerbell, C. D., Moody, R. C., Shanks, J., Stock, M. J., & Geissler, C. (1996). Relationship between feeding pattern and body mass index in 220 free-living people in four age groups. *European Journal of Clinical Nutrition*, *50* (8), 513–519. PMID: 8863011

[47] Wyatt, H. R., Grunwald, G. K., Mosca, C. L., Klem, M. L., Wing, R. R., & Hill, J. O. (2002). Long-term weight loss and breakfast in subjects in the national weight control registry. *Obesity Research*, *10* (2), 78-82. https://doi.org/10.1038/oby.2002.13

[48] Murphy, J. M. (1998). The relationship of school breakfast to psychosocial and academic functioning: cross-sectional and longitudinal observations in an inner-city school

Sample. *Archives of Pediatrics & Adolescent Medicine*, *152* (9), 899. https://doi.org/10.1001/archpedi.152.9.899

[49] Ross, M. M., Kolbash, S., Cohen, G. M., & Skelton, J. A. (2010). Multidisciplinary treatment of pediatric obesity: Nutrition evaluation and management. *Nutrition in Clinical Practice*, *25* (4), 327-334. https://doi.org/10.1177/0884533610373771

[50] Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents, & National Heart, Lung, and Blood Institute. (2012). Expert panel on integrated guidelines for cardiovascular health and risk reduction in children and adolescents: Full report. Available at: https://www.nhlbi.nih.gov/health-topics/all-publications-and-resources/expert-panel-integrated-guidelines-cardiovascular

[51] De Ferranti, S. D., Steinberger, J., Ameduri, R., Baker, A., Gooding, H., Kelly, A. S., Mietus-Snyder, M., Mitsnefes, M. M., Peterson, A. L., St-Pierre, J., Urbina, E. M., Zachariah, J. P., & Zaidi, A. N. (2019). Cardiovascular risk reduction in high-risk pediatric patients: A scientific statement from the American Heart Association. *Circulation*, *139* (13). https://doi.org/10.1161/cir.0000000000000618

[52] Arslanian, S., Bacha, F., Grey, M., Marcus, M. D., White, N. H., & Zeitler, P. (2018). Evaluation and management of youth-onset type 2 diabetes: A position statement by the American Diabetes Association. *Diabetes Care*, *41* (12), 2648-2668. https://doi.org/10.2337/dci18-0052

[53] Tamborlane, W. V., Barrientos-Pérez, M., Fainberg, U., Frimer-Larsen, H., Hafez, M., Hale, P. M., Jalaludin, M. Y., Kovarenko, M., Libman, I., Lynch, J. L., Rao, P., Shehadeh, N., Turan, S., Weghuber, D., & Barrett, T. (2019). Liraglutide in Children and Adolescents with Type 2 Diabetes. *New England Journal of Medicine*, *381* (7), 637–646. https://doi.org/10.1056/NEJMoa1903822

[54] Nuttall, F. Q. (1993). Carbohydrate and dietary management of individuals with insulin-requiring diabetes. *Diabetes Care*, *16* (7), 1039-1042. https://doi.org/10.2337/diacare.16.7.1039

[55] Evert, A. B., Boucher, J. L., Cypress, M., Dunbar, S. A., Franz, M. J., Mayer-Davis, E. J., Neumiller, J. J., Nwankwo, R., Verdi, C. L., Urbanski, P., & Yancy, W. S. (2013). Nutrition therapy recommendations for the management of adults with diabetes. *Diabetes Care*, *37* (Supplement_1), S120-S143. https://doi.org/10.2337/dc14-s120

[56] Sinuff, T., Eva, K. W., Meade, M., Dodek, P., Heyland, D., & Cook, D. (2007). Clinical practice guidelines in the intensive care unit: A survey of Canadian clinicians' attitudes. *Canadian Journal of Anesthesia*, *54* (9), 728-736. https://doi.org/10.1007/bf03026869

[57] Rosenbaum, S. E., Glenton, C., & Cracknell, J. (2008). User experiences of evidence-based online resources for health professionals: User testing of the Cochrane library. *BMC Medical Informatics and Decision Making*, *8* (1). https://doi.org/10.1186/1472-6947-8-34

[58] Ely, J. W., Osheroff, J. A., Ebell, M. H., Bergus, G. R., Levy, B. T., Chambliss, M. L., & Evans, E. R. (1999). Analysis of questions asked by family doctors regarding patient care. *BMJ*, *319* (7206), 358-361. https://doi.org/10.1136/bmj.319.7206.358

[59] Leong, T. Y., Kaiser, K., & Miksch, S. (2007). Free and open source enabling technologies for patient-centric, guideline-based clinical decision support: a survey. *Yearbook of medical informatics*, 74–86. PMID: 17700908

[60] Hadorn, D. C. (1995). Use of algorithms in clinical practice guideline development: Methodology perspectives. *AHCPR Pub*, *9* (95), 93-104.

[61] Koens, L. H., de Vries, J. J., Vansenne, F., de Koning, T. J., & Tijssen, M. A. J. (2021). How to detect late-onset inborn errors of metabolism in patients with movement disorders – A modern diagnostic approach. *Parkinsonism & Related Disorders*, *85*, 124–132. https://doi.org/10.1016/j.parkreldis.2021.02.029

[62] Bolia, R., Safe, M., Southwell, B. R., King, S. K., & Oliver, M. R. (2020). Paediatric constipation for general paediatricians: Review using a case-based and evidence-based approach. *Journal of Paediatrics and Child Health*, *56* (11), 1708-1718. https://doi.org/10.1111/jpc.14720

Cite this article as: Antonogeorgos, G., Bathrellou, E., Kouvari, M., Mamalaki, E., Poulimeneas, D., Yannakoulia, M., Panagiotakos, B. D. (2021). Visualization of Nutrient-Related Clinical Practice Guidelines in Childhood. *The North African Journal of Food and Nutrition Research,* 5(12): 79-92. https://doi.org/10.51745/najfnr.5.12.79-92