Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/16047
DOI URL: http://dx.doi.org/10.21474/IJAR01/16047

RESEARCH ARTICLE

DESCRIPTION OF THE MANDIBLE IN PROTEIN-ENERGY MALNOURISHED (PEM) CHILDREN: A RAPID REVIEW

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Manuscript Info

Manuscript History
Received: 20 November 2022
Final Accepted: 24 December 2022
Published: January 2023

Key words:-
Mandible Growth, Bone Growth, Protein Energy Malnutrition

Abstract

Aim: The aim of the study is to describe the mandible of children with protein energy malnutrition.
Methods: This study was conducted by rapid review using online databases such as Pubmed, ScienceDirect, and Google Scholar reffered to PRISMA diagram which was carried out within the month February to May 2021. The inclusion criteria for this study were articles in English published between 2010-2021, and discussing the effects of protein energy malnutrition to the growth of the mandible.
Results: Five articles with cross sectional study design were screened in this study from a total of 97 articles identified. Mandibular size in individuals with protein energy malnutrition is smaller than in individuals with adequate nutrition.
Conclusions: Mandible of children with protein energy malnutrition is smaller than mandible of children with normal nutrition status.

Introduction:-

Protein-energy malnutrition (PEM) or also known as protein-energy under-nourishment (PEU) according to WHO is a nutritional disease in which a person experiences malnutrition caused by a lack of energy or protein intake. The severity and clinical picture of PEM show food deficiency in the form of marasmus and kwashiorkor[1]. PEM is a global issue that is still being suffered by many people in developing countries with varying degrees of severity in each country[2]. From research conducted by UNICEF in 2006, It was found that the number of children under five suffering from PEM in Africa is 35 million, while in South Asia it is 78 million[3]. In Indonesia, Basic Health Research Data (Riskesdas, 2010) reported the prevalence of PEM in Indonesia based on measurements of body weight for age is 17.9%, categorically, consisting of 13% undernutrition and 4.9% malnutrition respectively[4].

Chronic PEM, as well as low absorption of bone-forming minerals such as calcium and zinc, can cause bone growth retardation which is a determinant of body height[5]. In addition, PEM will also affect the growth of the jaw bones. This was proven by Garat's research (2007) whose results showed that there were differences in the length of the mandible, the length of the condylar processes, and the angular processes in research rats[6]. Mice with PEM have smaller jaws compared to normal rats[4]. The results of a study by Ahmed (2017) proved that children who suffer from malnutrition have different lengths, arch, and jaw widths compared to normal children[7]. This condition occurs because PEM has a very large influence on the speed of hard tissue development so it will cause a reduction in bone width and slow down the process of ossification in the center of bone growth[8]. Zaid and Ban conducted a

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study on 78 children with PEM compared to 80 children with normal nutrition, the results obtained were that the average mandibular posterior arch length of children with PEM was 21.1 mm meanwhile children with the normal condition were 22.4 mm. This indicates a significant difference in the length of the arches of the two groups of research subjects[9].

The mandibular bone is the place where the lower teeth are attached so that the disruption of mandibular growth can interfere with the mastication process[10]. This study aims to identify mandibular features in children with PEM so that they can be used as a basis for the prevention of mandibular growth disorders due to protein energy malnutrition.

Materials AndMethods:-

This research was a literature review, which is a systematic method for identifying, evaluating, and interpreting articles, research, and others. The method used in this research wass Rapid Review, which is a method of synthesizing evidence in a short time, generally carried out in under 5 weeks, concerning the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) guidelines[11,12]. Article searching was conducted through Pubmed, ScienceDirect, and Google Scholar in the last 15 years. The keyword combinations used in Pubmed are ('protein energi malnutrition' AND 'jaw) OR ('malnutrition' AND 'jaw) OR ('protein energi malnutrition' AND 'bone growth') OR ('protein energi malnutrition' AND 'mandible '). Whereas on Google Scholar and ScienceDirect, it is done using a combination of the keywords "Protein Energy Malnutrition", "Jaw", "Growth and Development", and "Mandible". Additional searching was carried out by selecting manually, namely by looking at the references to the articles that have been found.

The inclusion criteria in this study were articles that discussed the relationship between PEM and mandibular bone growth, research was conducted on humans, and was in English. On the other hand, articles that were incomplete and discussed other malnutrition that affected mandibular bone growth were included in the exclusion criteria. Furthermore, articles that fit the inclusion criteria were then selected for analysis. The research was conducted for approximately 5 months, starting from January to May 2021. The data extracted from the articles consisted of the author's name, year of publication, journal name, research title, type of study design, study population, study results, and conclusions from the study were then analyzed descriptively.

Results:-

From searching through Pubmed, we found 20 articles, 18 articles from ScienceDirect, and 59 articles from Google Scholar searches. The total number of articles identified was 97 articles. The first screening was done by removing duplicate articles, then followed by reading the title and abstract of the article. The subsequent screening was carried out by adjusting the inclusion criteria, such as checking the year of publication and the language used, then the bibliography of each article was searched for manual selection. The final screening was done by reading the entire text. The screening process resulted in five articles that match with the criteria for review (Fig.1).

Fig. 1:- Prisma flow chart of article search results.

Articles that fit the inclusion criteria are presented in Table 1. All articles that fit the inclusion criteria used the cross-sectional method, with the following description; one article discusses malnutrition accompanied by the presence or absence of crowding, two articles discuss malnutrition through comparison of jaw size, and two articles discuss the presence or absence of malocclusion.

Table 1:- Articles used in research.

No	Author	Year	Journal	Title	Study Design
1	EsraaS etal	2016	IraqiOrthodontic Journal	TheAssociationbetween MalocclusionandNutritional Statusamong9-11YearsOld Children	CrossSectional
2	ZaidSaadi Hasan Ahmed etal	2015	InternationalJournal OfScienceand Research(IJSR)	TheEffectofNutritionalStatus onArchWidthandLengthofPermanentTeethamongFifteenYearsOldStudents	CrossSectional
3	ZaidSaadi Hasan Ahmed etal	2015	JournalofBaghdad CollegeofDentistry	TheEffectofNutritionalStatus onArchWidthandLengthofPrimaryTeethamoungFiveYearsOldKindergartenChildren	CrossSectional
4	ErikaB etal	2010	InternationalJournal OfEnvironmental Researchand Public Health	IsMalnutritionAssociatedwithCrowdinginPermanent Dentition?	CrossSectional
5	SaeedH etal	2014	DentalCollege Journal	IsthereanyrelationshipBetweenmalocclusionand Nutritionalpatternofchildren	CrossSectional

The results of data extraction from each article are presented in Table 2. Three of the five articles used in this study used 1,385 children as samples. The other two articles used 2,227 teenagers as samples. The PEM group identified in this study were individuals who had a BMI z-score < –2SD and a BMI growth chart according to the Centers of Disease Control.

Table 2:- The analysis results of the articles used in the study.

No	Author, Year	The study aim	The study population	Relationship between PEM and mandible	Conclusion
1.	EsraaS, et al. 2016	To evaluated the relationship between malocclusion and nutritional status of children aged 9-11	1. Gender • Males: 312 • Femlaes: 288 2. BMI • Normal Males: 184 Females: 164 • Obesity Males: 128 Females: 110 • PEM Females:14	1. There was no anterior cross bite in PEM children 2. Posterior crossbite was found in 2 girls with PEM 3. Crowded teeth were found in 4girls with PEM	1. The small number of crossbite cases in children with PEM is caused by a change in the size of the maxilla and mandible. 2. Cases of crowding teeth in girls with underweight are inconsistent with other studies,which state that there is

					no relationship between PEM and crowding teeth 3. Significant relationship between BMI and bad habits can be caused by symptoms of obesity such as respiratory problems and sleep apnea
2.	Zaid S, et al. 2015	Estimating the effect of nutrition on arch width and length in a 15-year-old child	167 youth aged 15 years: 1. 83 people suffer from malnutrition 2. 84 normal nutrition people	1. The mandibular inter-canine distance was significantly shorter in subjects with PEM than in normal subjects 2. The mandibular first inter-premolar distance was significantly shorter in subjects with PEM than in normal subjects 3. The mandibular second inter-premolar distance in subjects with PEM was significantly than in normal subjects shorter 4. The mandibular first inter-molar distance in subjects with PEM was significantly shorter than in normal subjects 5. The mandibular second inter-molar distance in subjects with PEM was significantly shorter than in normal subjects 6. The size of the mandibular anterior arch in subjects with PEM is significantly smaller than in normal subjects 7. The size of the	1. The size of the mandible in subjects with PEM is smaller than in normal subjects,meanwhile, the size of the maxilla is still larger than the mandible 2. The effect of PEM is seen in the inhibition of hard tissue growth and development. 3. PEM has the effect of reducing the width of the bones and slowing the emergence of ossification centers 4. The mean values of the width and length of the arches and the distance between the teeth in the maxilla and mandible were smaller in subjects with PEM compared to normal subjects.

				entire mandibular arch in subjects with PEM was significantly small compared to normal subjects	
3.	Zaid S, et al. 2015	Estimating the effect of nutrition on arch width and length in a 5-year-old child	158 children aged 5 years, consist of: 1. 78 people suffer from malnutrition 2. 80 normal nutrition people	1. The mandibular inter-canine distance was significantly shorter in subjects with PEM than in normal subjects 2. The mandibular inter-molar distance in subjects with PEM was significantly shorter than in normal subjects 3. The size of the mandibular anterior arch in subjects with PEM is significantly smaller than in normal subjects.	1. The mean values of the width and length of the arches for the maxilla and mandible in the PEM group were lower than those in the adequately nourished group in both genders. 2. PEM affects inhibiting hard tissue growth and development by reducing the width of the bone and slowing the emergence of ossification centers.
4	Erika B, et al. 2010	Investigate the relationship between nutritional status and the reduction space for the eruption of permanent teeth (tooth crowding)	2060 youth aged 12-15 years	There is a relationship between crowding teeth with low height-for-age and mouth-breathing habits	1. PEM affects mandibular size with or without oral bad habits 2. Oral bad-habits along with PEM will cause crowding teeth.
5	Saeed H, et al. 2014	Investigate the relationship between nutritional status and maloclusion	627 children aged 7-15 years, consist of: 1. 276 males 2. 349 females	There is a relationship between crowding teeth with low height-for-age and sucking habit.	1. PEM affects mandibular size with or without oral bad-habits 2. Oral bad-habits along with PEM cause crowding teeth.

Discussion:-

Bone is a hard tissue of the body that functions to form the body, protect the organs of the body, as a means of movement, storage of body salts, and as a supply of new blood cells from the bone marrow.Bone growth requires minerals and nutrients, one of which is a protein that functions to regulate hormone production as well as growth factors, and helps bone synthesis, so protein deficiency (protein malnutrition) can affect bone growth[13]. Protein-energy malnutrition is a condition in which the body experiences malnutrition caused by lack of protein micronutrients[15]. The study of Heinrichs et al. states that a lack of protein consumption results in a reduction in the number of chondrocytes in hypertrophied and proliferative areas so that the height and length of the bones are reduced[16]. Several previous studies have proven that PEM affects reducing the width and length of the normal jaw arch[9,12]. This causes a narrowing of space for the teeth to erupt[17,18].

Erika, et al. examined the relationship between nutritional status and reduced space in the mandible for the eruption of permanent teeth by observing whether there is crowding. From this study, it was found that there was crowding of permanent teeth in individuals with PEM, especially those with height-for-age disorders. On the other hand, research by Erika et al. did not find crowding of primary teeth in children under five years of age with PEM. The difference in the presence of crowded teeth in permanent and primary teeth is because children aged five years and under, have not experienced nutritional deficiencies for a long time which affect jaw size.The peak of jaw growth occurs at the age of 6-14 years in girls and 12-18 years in boys[19]. Erika et al. also concluded that there is a relationship between height-for-age and facial bone growth which can affect space for tooth eruption. Low height for age is closely related to the inhibition of facial bone growth. In addition, Erika et al found that crowding of teeth in individuals with PEM was accompanied by various other factors, such as mouth breathing habits, premature tooth loss, and socioeconomic status[20].

Saeed et al conducted a study by looking at the presence or absence of malocclusion caused by a narrowing of the jaw space in individual with PEM. Saeed et al had previously conducted literature observations which found that research animals suffering from PEM experienced reduced jaw size and space for teeth to erupt, causing crowding of teeth. [21]. However, further research by Saeed et al found no relationship between malnutrition and malocclusion in humans. In that study it was found that malnutrition can cause malocclusion only when it is accompanied by the habit of thumb sucking as a child[22].Based on the research of Erika et al and Saeed et al, it can be concluded that PEM can cause a smaller jaw arch size without causing crowding teeth/malocclusion. Thus, malocclusion will only occur if PEM sufferers have bad habits and other predisposing factors.

Esraa S, et al. through their research on the relationship between malocclusion and nutritional status in children aged 9-11 years which was conducted by investigating whether there is crowding due to jaw constriction and crossbite, proving that there is no significant relationship between BMI with anterior and posterior crossbite and almost no cases of anterior or posterior crossbite were found in children with PEM cases. Cases of crossbite detected in children with PEM are caused by a decrease in the size of the mandibular and maxillary arches that occur simultaneously, not only in the maxilla or mandible[23].Thus, this is relevant to the results of a study by Zaid, et al who concluded that the size of the mandible and maxilla in the PEM group was lower compared to the normal nutrition group[9,12].

Zaid et al conducted a study on 167 adolescents aged 15 years who were divided into groups of protein energy malnutrition and adequate nutrition groups based on BMI. The age of 15 years is a critical human phase where the influence and history of malnutrition can be seen[24,25]. In addition, this age is also a period when the growth of permanent teeth is complete and the peak of jaw growth takes place. In their research, Zaid et al took digital images of the mandible and maxilla to measure the distance between the incisor, canine, premolar, and molar teeth, as well as the width and length of the mandibular arch in the PEM group and the normal nutritional group.The results of their research concluded that the average spacing between teeth and the width of the arches in PEM patients were shorter than those of normal nutritional children. This reduction in the width and length of the arch occurs in the maxilla and mandible simultaneously. Furthermore, Zaid, et al found that although jaw size varies for each individual, in general, the maxillary arch is still larger than the mandible[12]. Differences in jaw size depend on the severity of malnutrition for each individual. PEM can affect the inhibition of the speed of growth and development of hard tissue, which will ultimately affect the size of the width of the bone and slow down the ossification center[25,26]. The same thing was obtained from the second study by Zaid et al on the mandible of 158 children aged 5 years. Zaid found that the distance between the canines and molars, as well as the maxillary and mandibular anterior arches was shorter in the group of children with PEM[9].

The conclusion of this study is that the width and arch of the mandible in children with PEM are smaller than children with normal nutrition.Changes in jaw size in children with PEM occur in the maxilla and mandible simultaneously. Smaller mandibular size in PEM children may be accompanied by crowding and malocclusion if they have oral bad habits such as thumb sucking or mouth breathing.

References:-

1. Singh P, Kesharwani RK, Keservani RK. Protein, carbohydrates, and fats: EnergyMetabolism.[Internet].SustainedEnergyforEnhancedHumanFunctions and Activity. Elsevier Inc.; 2017:103–115. Available from:http://dx.doi.org/10.1016/B978-0-12-805413-0.00006-5
2. WorldHealthOrganization.LevelsandTrendsinChildMalnutrition.2016:1–8.

3. UNICEF.ProgressforChildren,Areportcardonnutrition.UnicefData[Internet].2006;(4). Available from:http://www.unicef.org/media/files/PFC2012_A_report_card_on_adoles
4. DepartemenKesehatanRI.LaporanNasionalRiset Kesehatan Dasar(RISKESDAS)tahun2010.Lap Nas. 2010:1–446.
5. DeOnis,Mercedes,BlossnerM &WHO.DatabaseonChildGrowthandMalnutrition.1997.
6. Garat JA, Lopez L, Martin A, Pani M, Ruiz Holgado M. Meheris H, Gonzales S. Alterationsofendochondralossification in mandibularcondylecausedby protein undernourishment in growingrats. J. Bone. 2007;9:6. doi:10.1016/j.bone.2007.09.006
7. Ahmed ZSH, Diab ZS. The effect of nutritional status on arch width and length of permanent teeth among fifteen years old students. IJSR. 2017;6(4):1-6
8. InstituteTHQ.Protein-EnergyMalnutritionDefinition.MerckCo,Inc.2007:263.
9. DiabBS,AhmedZSH.Theeffectofnutritionalstatusonmesiodistalandbucco-lingual(palatal) diameters of primary teeth among five years old kindergarten children. JBaghdadCollDent. 2016;28(2):152–7.
10. BreelandG,AktarAPB.Anatomy,HeadandNeck,Mandible[Internet].TreasureIsland:StatPearls Publishing. 2022. Available from:https://www.ncbi.nlm.nih.gov/books/NBK532292/
11. LibraryTU.SystematicReviews&OtherReviewTypes[Internet].templeuniversitylibrary. 2021 [cited 2021 Mar 2]. Available from: https://guides.temple.edu/c.php?g=78618&p=4156608
12. DiabBS,AhmedZSH.Theeffectofnutritionalstatusonmesiodistalandbucco/lingualor palatal diameters of permanent teeth among fifteen years old students. J BaghdadColl Dent. 2016;28(2):108–14.
13. TortoraGJBD.PrinciplesofAnatomyandPhysiology.JohnWiley&Sons,Inv.2014;14:631–631
14. UNICEF.WhatisMalnutrition?TheStateofTheWorld'sChildren.1998.
15. da Silva K de C, Silva CR de S, Costa R de C da S, de Moraes SRA. How does proteinmalnutritionorfooddeprivationinterferewiththegrowthoftheepiphysealplateinanimals? Int JMorphol. 2013;31(2):584–9.
16. Luke DA, Tonge CH, Reid DJ. Metrical analysis of growth changes in the jaws and teeth ofnormal,proteindeficientandcaloriedeficientpigs.UnivNewcastleuponTyne,DentSch.1979:449–57.
17. TongeCH,McCanceR.Normaldevelopmentofthejawsandteethinpigs,andthedelaandmalocclusion produced by calorie deficiencies. Univ Newcastle-upon-Tyne Dent SchNewcastle-upon-TyneSidneySussexColl Cambridge.1973:1–22.
18. OchoaBK,NandaRS.Comparisonofmaxillaryandmandibulargrowth.AmJOrthodDentofacOrthop. 2004;125(2):148–59.
19. ThomazEBAF,CangussuMCT,daSilvaAAM,AssisAMO.Ismalnutritionassociatedwithcrowdinginpermanentdentition?IntJEnvironResPublicHealth.2010;7(9):3531–44.
20. DiOrioLP,MillerSA,NaviaJM.Theseparateeffectsofproteinandcaloriemalnutritionon thedevelopmentandgrowthofratbonesandteeth.JNutr.1973;103(6):856–65.
21. LingstroP,MoynihanP.Nutrition,Saliva,andOralHealth.9007(03):9007.
22. JasimES,GarmaNMH,NahidhM.Theassociationbetweenmalocclusionandnutritionalstatus among9-11yearsoldchildren. 2016;12(1):13–9.
23. KhanSH,HasanN,AnjumS,RafiqueT.Isthereanyrelationshipbetweenmalocclusionandnutritional pattern ofchildren?2014;4(2):9–13.
24. WarrenJJ,KarenWG,MarshallTA.Factorsassociatedwithdentalcariesexperiencein 1-year-old children. Natl Inst Heal [Internet]. 2008;23(1):1–7. Available from:https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3624763/pdf/nihms412728.pdf
25. HarrisEF,PotterRH,LinJ.Seculartrendintoothsizeinurbanchineseassessedfromtwo-generationfamilydata.2001;318(May2000):312–8.
26. AlippiRM,MetaMD,OliveraI,BozziniC,SchneiderP,MetaIF,etal.Effectofprotein-energymalnutrition inearlylifeonthedimensionsandbonequalityoftheadultratmandible.2002;47:47–53.