



Prevalence of Carabelli's trait among Iraqi population [Salahdin-Tikrit]

Ban Ismael Sedeeq¹, Ali Ghanim Abdullah^{2*}

¹ Department of Basic Science, College of Dentistry, Tikrit University, IRAQ

² Department of Oral & Maxillofacial Surgery, College of Dentistry, Tikrit University, IRAQ

*Corresponding author: Ali.okaili@gmail.com

Abstract

Morphological features of dental study have significant importance in anthropological researches. It provides numerous information on the dental variations within a specific population. This study is aiming to evaluate the Carabelli trait prevalence in the Iraqi population at province (Salahdin, Tikrit). 200 individuals aged 17-30 years (72 males and 128 females) were examined. A direct intraoral examination was performed. The Dahlberg classification system was dependent, and the impressions were taken to compare the clinical data with the study casts. The obtained data were compared with the clinical data. The prevalence of the trait was (59.5%) with a slightly different distribution between both males and females. Grade I was the most frequent configuration of (40.6%) comparing to grade III that has least frequent of (2.3%). The trait results of this study have different frequency comparing to other regions in the world, and considerably very close to the Iranian and Saudi Arabia population.

Keywords: Carabelli, trait

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INTRODUCTION

Teeth are a brilliant object for the investigation purposes of human variation. They have a great resistance to postmortem degradation and mechanical trauma. So, they generally have better preservation compared to bones in archaeologically derived human remains. Their morphological properties can be easily observed of the extracted samples from the remains of a skeletal-dental, cast reproduction, or dental impression and in the living person's mouth (Štamfelj, et al. 2006).

person's origin and sex can be established mainly from the dental anatomic features. The importance of a dental anatomical trait is depending on its repetition in a specific population (Subedi, et al. 2015, Simões, Cardoso, & Caldas, 2014).

The Carabelli trait is a high, tubercle and a groove or a pit. It is normally noticed when presents on the palatal surfaces of the mesio-palatal cusp of the maxillary deciduous second molar and maxillary permanent first and second molars (Al Shethri, 2011, Mosharraf, 2013, Kannapan, & Swaminathan, 20010).

In European dentitions, the Franz Carabelli described an additionally small cusp of maxillary first molars at the mesio-palatal line angle. In this regard, the cusp named as Carabelli or Carabelli's tubercle, or tuberculum anomaly of Georg Carabelli. So the term Carabelli's trait was customary used due to its size and

shape variations. And this terminology (Carabelli's cusp) must be used only in the case of real cusp (Hunter, et al. 2010; Adjanke, et al, 2017).

Consequently, Carabelli's trait is well-known having a heritable feature, and the growth of this trait influenced by multiple genes (Alvesalo, Nuutila, & Portin, 1975). It is rarely present on the upper first primary molars, or on the second or third upper permanent molars. This nonfunctioning mini cusp is usually present symmetrically on both sides of the maxillary arch (Sofaer, 1970).

On the other hand, cusp as can be said as a not clinically important, but considered to have minor importance in the dental industry, forensic odontology, and anthropology. This cusp appears to have no compensation in orthodontic molar bands. However, food debris is filled up the space between band and tooth, in which it results in early caries and periodontal diseases. Furthermore, the Carabelli groove is a sensitive area for dental caries, so, it does need to be remembered always during pit and fissure sealing. As well as, no accommodation of the molar removal forceps for this cusp and perhaps, consequently, result in molar teeth fracture (Kannapan, & Swaminathan, S. 2001).

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In the same context, continuous variation exhibited in expression when it is present, as it may either be present or absent expression (Sofaer, 1970). Whereas negative expressions of the trait for a pit and a groove are, while positive expressions for protuberance or a cusp (Alvesalo, Nuutila, & Portin, 1975).

The best presenting of the upper first molar of Carabelli's trait expression is noticed to be the genetic factors, and utilized in the population comparisons as a key teeth (Scott, et al. 2018). In the dental development studies of phylogenetic and ontogenetic, Carabelli's trait plays an important role because it has anthropologic and forensic value (Kraus, & Jordan, 1965). It is believed by some authors that the trait increases in frequency through evolution (Brabant, 1971), while the reduction process is holding by the other researchers (Hsu, et al. 1997).

Only a groove of a Carabelli cusp was discovered in *Australopithecus* and Neanderthal male. Which is evidence that development in Carabelli's cusp was well evolved from being a simple form groove (Dahlberg, 1963). So, The clinical implications for the pit and groove forms denote a predilection site for dental caries. In which during the fixed orthodontic therapy an interference between the tubercle of Carabelli and banding techniques occur (Kannapan, & Swaminathan, 2001).

The establishing phylogenetic has benefited from the Carabelli's trait for relationships between populations of closely related (DE CASTRO, 1989). The cusp might compete the size of the main cusps, while another relative form consists of a tiny elevation, pit or groove. The previous studies regarding this trait pointed out a variation in the ethnic and sexual dimorphism expression in some cases.

This paper focuses on determining the prevalence and degree of expression of the Carabelli trait in permanent maxillary first molars in the Iraqi population.

MATERIALS AND METHODS

This descriptive research was conducted on the students of University of Tikrit, and also on the patients who attended the teaching hospital of the College of Dentistry—University of Tikrit. Two hundred people (72 males and 128 females) were examined, their age ranged from 17 to 30 year old. The study was lasted for three months (February 2018 until May 2018). The examined subjects had acknowledged about the study aim and a consent was taken before commencing the examination.

A direct oral inspection was carefully conducted on a dental chair utilizing the light of the chair for proper and clarity visual. Mirror and probe were used to examine the palatal exteriors of the mesio-palatal cusp of the right and left maxillary first molars. Any tooth with large restoration, fixed replacements, badly caries cusps, attrition or broken cusps, were excluded from the study.

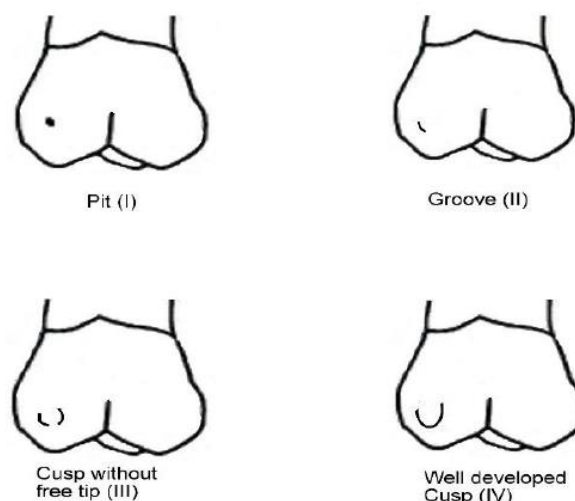


Fig. 1. Carabelli trait Classification (Goose, & Lee, 1971)

Alginate utilized as the impression material, and the casts fabricated from dental stone. The data were collected depending on both clinical examination and dental cast.

A recording for the extra cusp on maxillary first molars in case of presence and absence was performed. The unilateral and bilateral calculation of presences or absence of Carabelli cusp for both sexes was included in this study. The trait whether it is present or absent was scored directly, typically I-IV grade recorder. When Carabelli trait is present:

1. pit (I)
2. groove (II)
3. cusp without free tip of cusp (III)
4. cusp of well developed (IV)

The Goose and Lee classification of in 1971 (Goose, & Lee, 1971) has the largest approved Carabelli trait grade system, and is considered as the generally and commonly used due to two reasons; simplicity and accuracy (Dissanayake, Chandrasekera, & Wickramanyake, 2004). **Fig. 1** shows a diagram of the mentioned classification.

Absent trait is observed first when convex and smooth palatal surface of the mesio-palatal cusp of the upper first permanent molar. Meanwhile, pit trait was classified on a time of felt catch during the moving tip of the probe over the certain tooth surface. On the other hand, when a vertical running groove extended on the palatal surface of the cusp handled, then the classification of the trait was groove.

When the Carabelli's cusp has no free tip, and only the tubercle prominence perceived, it is then split from the tooth surface utilizing two grooves that are curved on both sides. In this case the trait was classified as a no free tip of cusp. The cusp has developed in a proper manner and is easily identified like it projected as an additional cusp. All data was collected and tabulated.

Table 1. Presence and absence of Carabelli trait in both sexes

sex	Number of individuals with trait		Number of individuals without trait bilateral	Total number and percentage
	Unilateral	bilateral		
Male	11 15.3%	29 40.3%	32 44.4%	72 100 %
	55.6 %			
Female	32 25 %	47 36.7 %	49 38.3 %	128 100 %
	61.7 %			
Total	43 21.5 %	76 38 %	81 40.5 %	200 100 %
	59.5 %			



Fig. 2. Smooth mesiolabial surface cusp of first molar maxillary, [arrow]Representing absence of carabelli trait. [intraoral examination]



Fig. 3. Smooth mesiolabial surface cusp of first molar maxillary, [arrow]Representing absence of carabelli trait. [cast]



Fig. 4. Deep pit on the mesiolabial cusp of maxillary first molar, [arrow] representing negative Carabelli trait expression



Fig. 5. Groove on the mesiolabial cusp of maxillary first molar, [arrow] representing negative Carabelli trait expression.[intraoral examination]

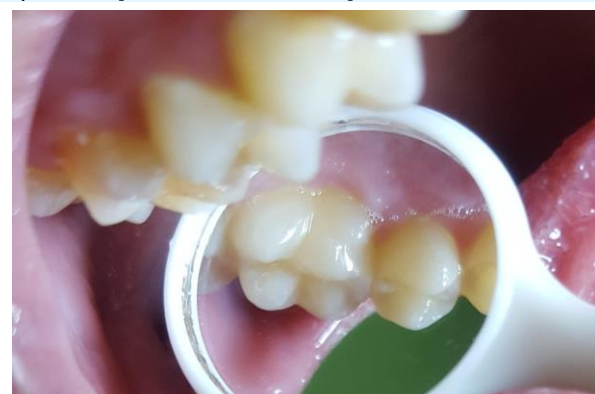


Fig. 6. Cusp without free tip on the mesiolabial cusp of maxillary first molar, [arrow] representing positive Carabelli trait expression

RESULTS

Among 200 individuals, it is found that 119 (59.5%) had Carabelli’s trait and only 81 (40.5%) without it. Different percentages of presence and absence of Carabelli trait for males and females was observed. In males they were 55.6 % and 44.4% respectively while 61.7 % and 38.3 % respectively for females as shown in **Table 1**.

The unilateral and bilateral presence of Carabelli’s trait found to be 40.3% and 15.3% in males while in female it presented as 36.7% and 25% respectively (**Table 1**).

Palatal aspect of mesiolabial cusp showed different images ranging from absence of Carabelli trait, small pit and deep pit, furrow, no free tip of cusp, cusp with better

development and large cusp are shown in **Figs. 2-8**, respectively.



Fig. 7. Well developed cusp on the mesiopalatal cusp of maxillary first molar, [arrow] representing positive Carabelli trait expression



Fig. 8. Bilateral large Carabelli cusps on the mesiopalatal cusps of maxillary first molars, [arrows] representing positive Carabelli trait expression

Using the grade in assessing the prevalence of different types of carabelli’s trait expression. The results of this study revealed that the expression of grade I bilaterally and unilaterally were 36 % and 46.7 % in male, while 41 % and 39.6 % in female. Furthermore, a percentage of 12 and 12.8 of bilaterally for Grade II in both sex, while, a percentage of 33.3 and 31.3 for male and female for unilaterally rwas recorder as can be seen in **Table 2**.

The results shows that 2.5 % of grade III bilaterally and 2.1 % unilaterally for male and female respectively. while grade IV recorded 52 % and 41% bilaterally and 20% and 25% is unilaterally in both sexes respectively. Among the four grades that considering the total samples listed in **Table 2**, it can be noticed that grade I occupied the highest percentage of 40.6 and grade III has the least percentage of 2.3 in both sexes, while Grade IV occupied the second degree of 34.5% and

grade II was the third at 22.4% which are shown in **Table 2**.

DISCUSSION

Teeth structure variations have gain a great of attention by the scientifics and researchers view point. In addition to that, relationships of inter trait over the decades have a beneficial method to categorize the belongs of individual in the populations (Kirthiga, et al. 2016).

In these studies, intra oral examination have been utilized by a number of researchers (Mosharraf, & Hajian, 2004). Other depends on dental cast on their study (Aminzadeh, et al. 2019).The advantages of Intra oral investigation are recording accuracy, appropriate teeth identification, and patients follow-up when required. Furthermore, It provide ensures the identification of racial and sexual of individual (Mosharraf, & Hajian, 2004). In this study, the examination of cast and intraoral were employed in irder to have a well reults precision.

diverse regions, counties and interracial in all over the world, The Carabelli trait distribution consider as a highly variable (Kamatham, & Nuvvula, 2014).Sarpangala and Devasya (Sarpangala, & Devasya, 2017).have defined Carabelli as a sort of attachment cusp, in which it happens oftenly in permanent first molars maxillary. However, it’s rarely occurred in primary tooth, due to over active dental laminaas it can be advised, however, unknown for aetiology of definitive. Size and shape may vary for this cusp, that composing of with or without pulpal dentine extension, enamel, (Sedano, et al. 2009

In the present study, the results clarified that 119 (59.5%) of 200 examined individual had Carabelli trait and 81 (40.5%) had not. These results were in a good agreement with the finding of Al Shethri (Al Shethri, 2011).Who concluded that the majority of the population of Saudi own expression degree of Carabelli trait, and their prevalence were about 57.6%. More over, they are very close to the results of Kaviani et al. (Kaviani, et al. 2013).In Kaviani et al. 61% of their study were performed on patients denoted to the dental school of Islamic Azad University of Tahrán. The similarity between the results of the current study and the previous one in (Al Shethri, 2011).and,(Kaviani, et al. 2013).may refere to the geographical proximity of these countries, or similarity in

Table 2. Different carabelli trait grade of males and females that shaown as unilaterally and bilaterally

Grade	Bilateral			Unilateral			Total percentage
	Male	Female	mean	Male	Female	mean	
Grade I	9 36 %	16 41 %	38 %	7 46.7 %	19 39.6 %	43.2 %	40.6 %
Grade II	3 12 %	5 12.8 %	12.4 %	5 33.3 %	15 31.3 %	32.3%	22.4 %
Grade III	0 0 %	2 5.1 %	2.5 %	0 0 %	2 4.2 %	2.1 %	2.3 %
Grade IV	13 52 %	16 41 %	46.5 %	3 20 %	12 25 %	22.5 %	34.5 %

the genes expression, or because of mating that occurred throughout history among the members of these countries.

Other studies that performed in various of countries and places rather than that mentioned earlier had recorded different results. Whereas 17.43 % of the selected population had presence of Carabelli trait in Nigeria (Falomo, 2002). On the other side, it was present 29.7% of the study population in Pakistan (Khan, Khan, & Khattak, 2011). 65.34 % in the contemporary study population in Hungary (Mavrodisz, et al. 2007). Amongst Jordanian population, Carabelli's trait prevalence in maxillary first was 65.0% (Khraisat, et al. 2007). The expression was 52.2% in Malaysian population (Rusmah, 1992).

The broad variation in the figures of prevalence in different racial groups may be attributed to the differences in the criteria of the assessment employed. Or it can be related to the differences in the genetic control of the trait. Pedersen (Pederson, 1949) has come out with a conclusion that in Eastern Greenland Eskimos the Carabelli's cusp and pit are essentially nonexistent, and it has the lowest occurrence number for any ethnic or local group. Dahlberg (Dahlberg, 1963) has found in a Caucasians first permanent molar a high frequency of the mentioned type of trait in the shape of prominent cusps.

The males and females shown a little difference in the percentages of presence and absence of Carabelli's trait. In male, the percentages are 55.6 and 44.4 respectively, whereas 61.7% and 38.3 % in female. As shown in **Table 1** the percentage of Carabelli's trait expression in female was slightly higher than male. The distribution of Carabelli's trait among females and males is perhaps refers to a sexual dimorphism in the trait. This output was disagreed with both Mosharraf (Mosharraf, 2013) that published results on Iranian adolescents, and Dissanayake et al. (Dissanayake, et al. 2004) whose studied the prevalence of Carabelli's trait in the

Sinhalese, in which their findings suggested similarity between males and females results.

The bilateralism was higher than unilateralism in both male and female as listed in **Table 1**. These consequences were agreed with Mosharraf (Mosharraf, 2013). & Talabani et al. (Talabani, et al. 2015) whose their study was at university of Sulaimani-school of dentistry, the sample was dental students. Generally, bilateral and symmetrical is seen for Carabelli's trait in grades expression for each outstanding dental arch (Khamis, et al. 2006). In spite of majority of researches that reported on a large frequency of traits' bilateral and symmetric expressions, it could be found as well few asymmetry percentage, for case considering grades expression or absence /presence (Marado, & Campanacho, 2013). An assumption can be said on tantamount information of genetic on each sides, with a predicted symmetry results in both expression and presence. Furthermore, environmental effects might result in asymmetry of individual odontogeny (Van Dongen, & Gangestad, 2011).

The present study considered the total sample. Grade I occupied the highest percentage of 40.6, meanwhile, grade III has the least percentage of 2.3. These results were agreed with Subedi et al. (Subedi, et al. 2015) for grade I and disagreed for grade III. In the degree expression pattern of the Carabelli trait has wide distinctions in various countries and ethnicity.

CONCLUSION

Carabelli trait expression of the nominated Iraqi populace have included more than half of the population. Grade I [pit] occupied the highest percentage, meanwhile grade III [cusp without free tip] was the least. The calculation of the originality of a single human ethnicity is implied in expression degree and the existence of the trait study.

REFERENCES

- Adjanke, A., Kokou, T. O. N. A., Toko, I. I., & Gbeassor, M. (2017). Effects of Technological Treatments of Dietary Palm Kernel Meal on Feed Intake, Growth and Body Composition of *Oreochromis Niloticus* Reared in Concrete Tanks. *The International Journal of Biotechnology*, 6(1), 11-18.
- Al Shethri, S. (2011). The prevalence of the Carabelli cusp in selected Saudi population. *King Saud University Journal of Dental Sciences*, 2(1-2), 13-16.
- Al Shethri, S. (2011). The prevalence of the Carabelli cusp in selected Saudi population. *King Saud University Journal of Dental Sciences*, 2(1-2), 13-16.
- Alvesalo, L., Nuutila, M., & Portin, P. (1975). The cusp of Carabelli: Occurrence in first upper molars and evaluation of its heritability. *Acta Odontologica Scandinavica*, 33(4), 191-197.
- Aminzadeh, A., Jafarzadeh, S., Aminzadeh, A., & Ghodousi, A. (2019). Prevalence and Distribution of Carabelli Cusp in Maxillary Molars in Deciduous and Permanent Dentition and Its Relation to Tooth Size in a Group of Iranian Adult and Pediatric Dental Patients. *International Journal of Medical Toxicology and Forensic Medicine*, 8(1), 11-14.

- Brabant, H. (1971). Hérité et denture humaine. *Bulletins et Mémoires de la Société d'Anthropologie de Paris*, 7(3), 329-362.
- Dahlberg, A. A. (1963). Analysis of the American Indian dentition. In *Dental anthropology* (pp. 149-177). Pergamon.
- De Castro, J. M. B. (1989). The Carabelli trait in human prehistoric populations of the Canary Islands. *Human Biology*, 117-131.
- Dissanayake, U., Chandrasekera, M. S., & Wickramanyake, E. R. (2004). The prevalence and mode of inheritance of Carabelli trait in the Sinhalese.
- Falomo, O. O. (2002). The cusps of Carabelli: frequency, distribution, size and clinical significance in Nigeria. *West African journal of medicine*, 21(4), 322-324.
- Goose, D. H., & Lee, G. T. R. (1971). The mode of inheritance of Carabelli's trait. *Human biology*, 64-69.
- Hsu, J. W., Tsai, P. L., Hsiao, T. H., Chang, H. P., Lin, L. M., Liu, K. M.,... & Ferguson, D. (1997). The effect of shovel trait on Carabelli's trait in Taiwan Chinese and Aboriginal populations. *Journal of Forensic Science*, 42(5), 802-806.
- Hunter, J. P., Guatelli-Steinberg, D., Weston, T. C., Durner, R., & Betsinger, T. K. (2010). Model of tooth morphogenesis predicts Carabelli cusp expression, size, and symmetry in humans. *PloS one*, 5(7), e11844.
- Kamatham, R., & Nuvvula, S. (2014). Expression of Carabelli trait in children from Southern India-A cross sectional study. *Journal of Forensic Dental Sciences*, 6(1), 51.
- Kannapan, J. G., & Swaminathan, S. (2001). A study on a dental morphological variation. Tubercle of Carabelli. *Indian journal of dental research: official publication of Indian Society for Dental Research*, 12(3), 145-149.
- Kaviani, R., Mackinejad, S. A., Rakhshan, V., & Falsafi, M. (2013). Evaluating prevalence of talon and Carabelli's cusps in tooth examination of patients referred to Dental School of Islamic Azad University of Tehran: A 2-year study. 551-557.
- Khamis, M. F., Taylor, J. A., Samsudin, A. R., & Townsend, G. C. (2006). Variation in dental crown morphology in Malaysian populations. *Dental Anthropology Journal*, 19(2), 49-60.
- Khan, D. B., Khan, M. A., & Khattak, M. (2011). Prevalence of cusp of carabelli in permanent teeth in a group from Khyber Pakhtunkhwa, Pakistan. *Pakistan Oral & Dental Journal*, 31(2).
- Khraisat, A., Taha, S. T., Jung, R. E., Hattar, S., Smadi, L., Al-Omari, I. K., & Jarbawi, M. (2007). Prevalence, association, and sexual dimorphism of Carabelli's molar and shovel incisor traits amongst Jordanian population. *Odonto-stomatologie tropicale= Tropical dental journal*, 30(119), 17-21.
- Kirthiga, M., Manju, M., Praveen, R., & Umesh, W. (2016). Ethnic Association of Cusp of Carabelli trait and shoveling trait in an Indian population. *Journal of clinical and diagnostic research: JCDR*, 10(3), ZC78.
- Kraus, B. S., & Jordan, R. E. (1965). The human dentition before birth. *Lea & Febiger*.
- Marado, L. M., & Campanacho, V. (2013). Carabelli's trait: Definition and review of a commonly used dental non-metric variable. *Cadernos do GEEvH*, 2(1), 24-39.
- Mavrodisz, K., Rózsa, N., Budai, M., Soós, A., Pap, I., & Tarján, I. (2007). Prevalence of accessory tooth cusps in a contemporary and ancestral Hungarian population. *The European Journal of Orthodontics*, 29(2), 166-169.
- Mosharraf, R. (2013). Prevalence of the carabelli trait in Iranian adolescents. *SRM Journal of Research in Dental Sciences*, 4(1), 12.
- Mosharraf, R., & Hajian, F. (2004). Occlusal morphology of the mandibular first and second premolars in Iranian adolescents. *Dental Anthropology Journal*, 17(3), 94-96.
- Pederson, P. O. (1949). The East Greenland Eskimo dentition. Numerical variations and anatomy. A contribution to comparative ethnic odontography. *Copenhagen: Meddelsers om Grnland*, 141, 4.
- Rusmah, M. (1992). The cusp of Carabelli in Malaysians. *Odonto-stomatologie tropicale= Tropical dental journal*, 15(1), 13.
- Sarpangala, M., & Devasya, A. (2017). Occurrence of Cusp of Carabelli in Primary Second Molar Series of three Cases. *Journal of clinical and diagnostic research: JCDR*, 11(3), ZR01.
- Scott, G. R., Turner II, C. G., Townsend, G. C., & Martínón-Torres, M. (2018). *The anthropology of modern human teeth: Dental morphology and its variation in recent and fossil Homo sapiens (Vol. 79)*. Cambridge University Press.
- Sedano, H. O., Ocampo-Acosta, F., Naranjo-Corona, R. I., & Torres-Arellano, M. E. (2009). Multiple dens invaginatus, mulberry molar and conical teeth. Case report and genetic considerations. *Med Oral Patol Oral Cir Bucal*, 14(2), 69-72.

- Simões, R. J., Cardoso, H. F., & Caldas, I. M. (2014). Prevalence of talon cusps in a Portuguese population: Forensic identification significance of a rare trait. *Dental research journal*, 11(1), 45.
- Sofaer, J. A. (1970). Dental morphologic variation and the Hardy-Weinberg law. *Journal of dental research*, 49(6), 1505-1508.
- Štamfelj, I., Štefančič, M., Gašperšič, D., & Cvetko, E. (2006). Carabelli's Trait in Contemporary Slovenes and Inhabitants of a Medieval Settlement (Središče by the Drava River). *Collegium antropologicum*, 30(2), 421-428.
- Subedi, N., Sah, S., Chataut, T. P., Paudel, S., & Pradhan, A. (2015). The prevalence of the Carabelli trait in selected Nepalese population. *Journal of Advances in Medicine and Medical Research*, 285-291.
- Talabani, R. M., Muhammad Saeed, H. M., Hamagharib, D. S., & Khursheed, D. I. (2015). Prevalence of cusp of Carabelli in permanent teeth in a group of dental student of school of dentistry at university of Sulaimani. *IOSR J Dent and Med Sci*, 14(9), 21-5.
- Van Dongen, S., & Gangestad, S. W. (2011). Human fluctuating asymmetry in relation to health and quality: a meta-analysis. *Evolution and Human behavior*, 32(6), 380-398.
- Vodanović, M., Zukanović, A., Galić, I., Harvey, L., Pavičin, I. S., Dumančić, J.,... & Brkić, H. (2013). Carabelli's trait in Croatian populations over 1800 years. *Homo*, 64(4), 273-285.