Original article

Global Dental Arch Dimension Norms and Sexual Disparities: An overview.

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Abstract

Background: The aim of the present study was to do an overview of the arch dimension for various populations. Also, to evaluate the various type of measurement methods and sexual disparities. Two reviewers independently performed the selection process and the quality of studies was assessed. *Method:* Studies published form January 2000 until October 2015 were identified in electronic databases: Pubmed, Scopus, Science direct, Web of Science, Medpilot and Medline using keywords.Criteria used included: observational studies, Arch size measured, Permanent dentition, Arch dimension investigated via plaster and digital dental models, measurement via calipers and computers software's. *Result:* The forest plots showed the continuous trend for the greater arch dimension for male in relation to female. The current overview showed the arch dimension and its disparities for various populations. *Conclusion:* The various methods to assess arch dimension should be carefully considered and well conducted as part of the clinical assessment of orthodontic treatment, since arch dimension could influence the diagnosis and treatment planning of orthodontist.

Keywords: Arch dimension; Arch width; Inter canine width; Interpremolar width; Intermolar width; Arch length.

Introduction

Malocclusion is a communal quandary in all inhabitants.[1] Although the nature of malocclusion varies in different population, but teeth size and arch length inconsistency are considered to be an important etiological factors.[2] The arch dimension is of preponderant importance in the various dental specialties such as Orthodontics, Prosthodontics, Forensic Dentistry and Dental Anthropology.

Nature has given an ideal balance between the maxillary and mandibular teeth size that should be attained for the ideal occlusion and aesthetics, especially in relation to the finishing phase in orthodontics.[3,4,5] There is obvious population variation in the pattern and magnitude of sexual dimorphism.[6,7,8]Teeth in relation to sexual dimorphism have been of prodigious importance to anthropologists and forensic odontologists as well as the focus of many studies for gender assessment.[9,10] Conventional caliper was used by researchers to investigate tooth dimension, to identify the sexual disparities through mesiodistal,[11,5,12,13] buccolingual[10,11,12,13] and diagonal crown[14] diameters of teeth. Geomorphometrics is the quantitative approach that refers to the morphology of an entity depends on landmarks. This technique resolves numerous problems accompanying with out-of-date methods of measurements.[15]The current overview showed the arch dimension and its disparities for various populations. The various methods to assess arch dimension should be carefully considered and well conducted as part of the clinical assessment of orthodontic treatment, since arch dimension could influence the diagnosis and treatment planning of orthodontist.

Material and Methods

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Two reviewers independently performed the selection process and the quality of studies was assessed. Studies published form January 2000 until October 2015 was identified in electronic databases: Table 1 show the Sought electronic databanks sources and Key word words used in data base search. Criteria used included: observational studies, Arch size measured, Permanent dentition, Arch dimension investigated via plaster and digital dental models, measurement via calipers and computers software's.

Table 1. Sought electronic databanks sources and Key word words used in data base search

Sought electronic databanks	Key word words
PubMed	Arch dimension
Medpilot	Arch width
Medline	Inter canine width
Scopus database	Interpremolar width
Science Direct	Intermolar width
Web of Science	Arch length

Ethical approval: This study was approved by local Ethics Committee prior the submission for publication.

Results

Figure 1,2,3,4,5 and 6[1,25-35] show the arch dimension width for Inter canine, Inter premolar, Inter molar of maxillary and mandibular arch respectively. Arch dimension has greater values for males in relation to females. The Forest plots show the continuous trend of under prediction of female arch width.

Figure 7 and 8[1,25-35] show the arch length of maxillary and mandibular arch respectively. Arch length has greater values for males in relation to females. The Forest plots show the continuous trend of under prediction of female arch length.

Figure 1. Maxillary Intercanine arch width means, standard deviation and Forest plot show the continuous trend of under prediction.

Figure 2. Maxillary Interpremolararch width means, standard deviation and Forest plot show the continuous trend of under prediction.
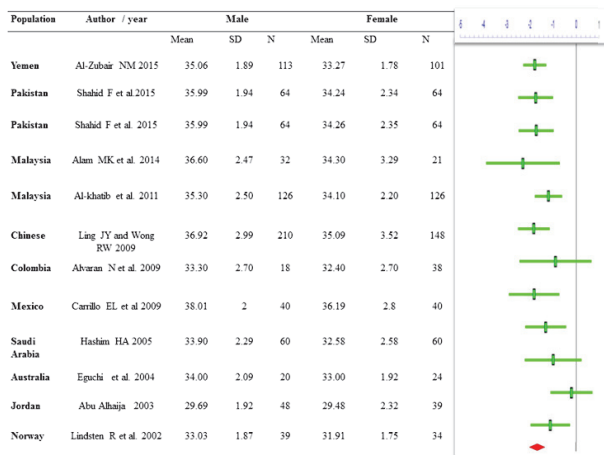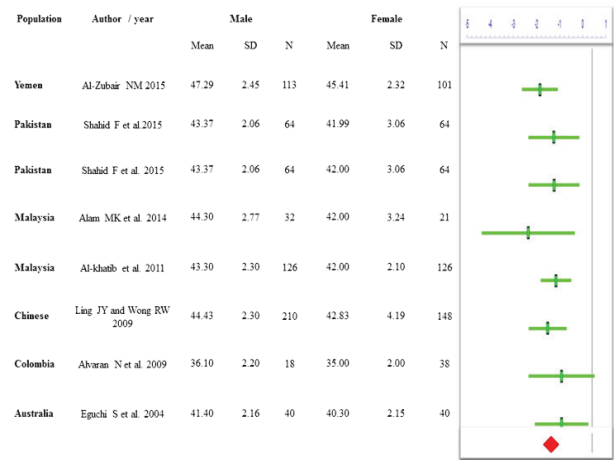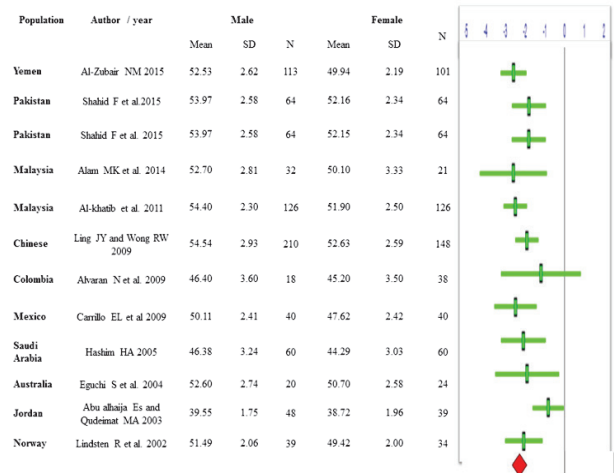

Figure 3. Maxillary Inter molar arch width means, standard deviation and forest plot show the continuous trend of under prediction.
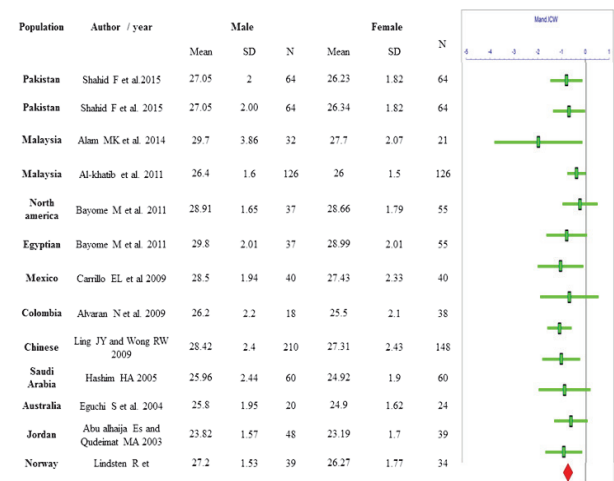

Figure 4. MandibularInter canine arch width means, standard deviation and forest plot show the continuous trend of under prediction.

Population	Author / year	Male Mean	SD	N	Female Mean	SD	N
Pakistan	Shahid F et al.2015	35.88	1.94	64	34.49	2.53	64
Pakistan	Shahid F et al. 2015	35.88	1.94	64	34.49	2.53	64
Malaysia	Alam MK et al. 2014	38	2.91	32	36	2.26	21
Malaysia	Al-khatib et al. 2011	34.9	2.1	126	34.3	2.2	126
Chinese	Ling JY and Wong RW 2009	36.59	2.77	210	35.11	2.52	148
Colombia	Alvaran N et al. 2009	30.8	1.8	18	30	1.7	38
Australia	Eguchi S et al. 2004	34	2.07	20	32.5	2.18	24

Figure 5. MandibularInter premolar arch width means, standard deviation and forest plot show the continuous trend of under prediction.

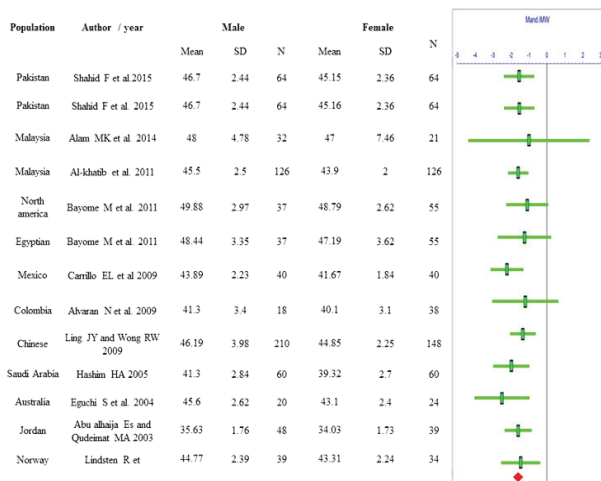| Population	Author / year	Male Mean	SD	N	Female Mean	SD	N
Pakistan	Shahid F et al.2015	46.7	2.44	64	45.15	2.36	64
Pakistan	Shahid F et al. 2015	46.7	2.44	64	45.16	2.36	64
Malaysia	Alam MK et al. 2014	48	4.78	32	47	7.46	21
Malaysia	Al-khatib et al. 2011	45.5	2.5	126	43.9	2	126
North america	Bayome M et al. 2011	49.88	2.97	37	48.79	2.62	55
Egyptian	Bayome M et al. 2011	48.44	3.35	37	47.19	3.62	55
Mexico	Carrillo EL et al 2009	43.89	2.23	40	41.67	1.84	40
Colombia	Alvaran N et al. 2009	41.3	3.4	18	40.1	3.1	38
Chinese	Ling JY and Wong RW 2009	46.19	3.98	210	44.85	2.25	148
Saudi Arabia	Hashim HA 2005	41.3	2.84	60	39.32	2.7	60
Australia	Eguchi S et al. 2004	45.6	2.62	20	43.1	2.4	24
Jordan	Abu alhaija Es and Qudeimat MA 2003	35.63	1.76	48	34.03	1.73	39
Norway	Lindsten R et	44.77	2.39	39	43.31	2.24	34

Figure 6. MandibularInter molar arch width means, standard deviation and forest plot show the continuous trend of under prediction.

Population	Author / year	Male Mean	SD	N	Female Mean	SD	N
Yemen	Al-Zubair NM 2015	42.62	2.32	113	42.3	2.43	101
Malaysia	Alam MK et al. 2014	77.40	5.74	32	74.50	4.47	21
Malaysia	Al-khatib et al. 2011	39.40	1.80	126	38.20	1.70	126
Mexico	Carrillo EL et al 2009	46.75	3.29	40	45.21	2.13	40
Saudi Arabia	Hashim HA 2005	74.01	4.49	60	72.36	3.33	60
Australia	Eguchi S et al. 2004	39.60	2.67	20	38.80	1.85	24
Jordan	Abu alhaija Es and Qudeimat MA 2003	25.52	1.53	48	24.73	2.42	39

Figure 7. Maxillary arch length means, standard deviation and forest plot show the continuous trend of under prediction.

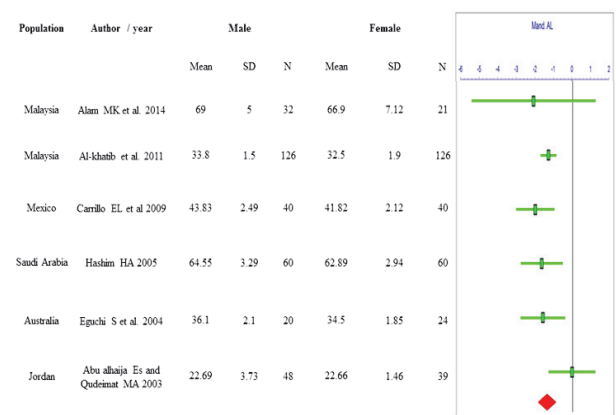| Population	Author / year	Male Mean	SD	N	Female Mean	SD	N
Malaysia	Alam MK et al. 2014	69	5	32	66.9	7.12	21
Malaysia	Al-khatib et al. 2011	33.8	1.5	126	32.5	1.9	126
Mexico	Carrillo EL et al 2009	43.83	2.49	40	41.82	2.12	40
Saudi Arabia	Hashim HA 2005	64.55	3.29	60	62.89	2.94	60
Australia	Eguchi S et al 2004	36.1	2.1	20	34.5	1.85	24
Jordan	Abu alhaija Es and Qudeimat MA 2003	22.69	3.73	48	22.66	1.46	39

Figure 8. Mandibular arch length means, standard deviation and forest plot show the continuous trend of under prediction.

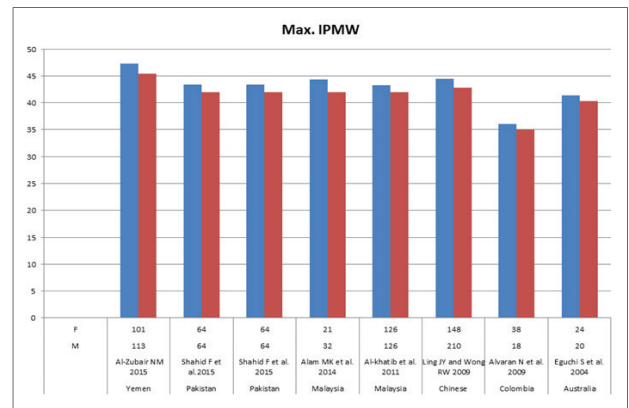Figure 9. Bar chart showing the gender disparities for maxillaryIntercanine arch width.

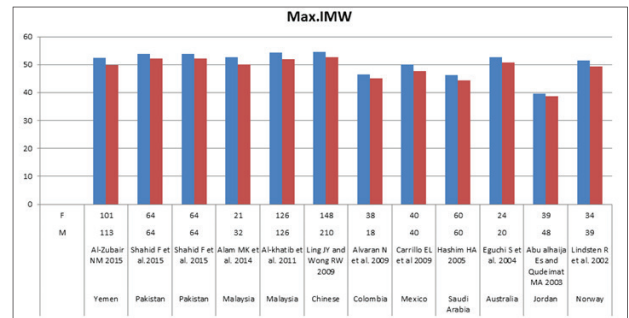Figure 10. Bar chart showing the gender disparities for maxillary Interpremolararch width.

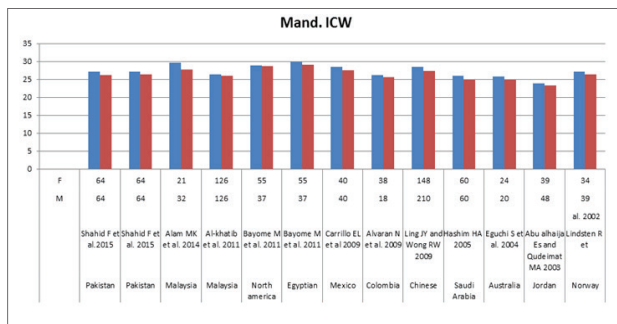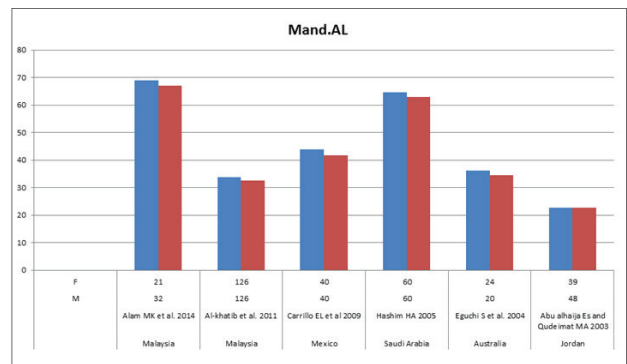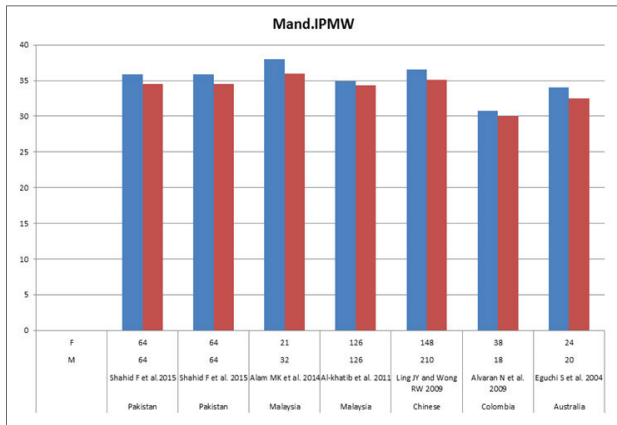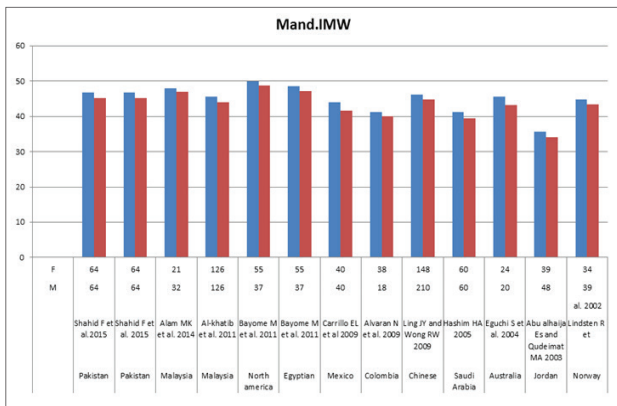Figure 11. Bar chart showing the gender disparities formaxillary Inter molar arch width.

Mand. ICW

F	64	64	21	126	55	55	40	38	148	60	24	39	34
M	64	64	32	126	37	37	40	18	210	60	20	48	39 al. 2002
	Shahid F et al.2015	Shahid F et al. 2015	Alam MK et al. 2014	Al-khatib et al. 2011	Bayome M et al. 2011	Bayome M et al. 2011	Carrillo EL et al 2009	Alvaran N et al. 2009	Ling JY and Wong RW 2009	Hashim HA 2005	Eguchi S et al. 2004	Abu alhaija Es and Qudeimat MA 2003	Lindsten R et
	Pakistan	Pakistan	Malaysia	Malaysia	North america	Egyptian	Mexico	Colombia	Chinese	Saudi Arabia	Australia	Jordan	Norway

Figure 12.Bar chart showing the gender disparities formandibularInter canine arch width.

Mand.IPMW

F	64	64	21	126	148	38	24
M	64	64	32	126	210	18	20
	Shahid F et al.2015	Shahid F et al. 2015	Alam MK et al. 2014	Al-khatib et al. 2011	Ling JY and Wong RW 2009	Alvaran N et al. 2009	Eguchi S et al. 2004
	Pakistan	Pakistan	Malaysia	Malaysia	Chinese	Colombia	Australia

Figure 13. Bar chart showing the gender disparities for mandibularInter premolar arch width.

Mand.IMW

F	64	64	21	126	55	55	40	38	148	60	24	39	34
M	64	64	32	126	37	37	40	18	210	60	20	48	39 al. 2002
	Shahid F et al.2015	Shahid F et al. 2015	Alam MK et al. 2014	Al-khatib et al. 2011	Bayome M et al. 2011	Bayome M et al. 2011	Carrillo EL et al 2009	Alvaran N et al. 2009	Ling JY and Wong RW 2009	Hashim HA 2005	Eguchi S et al. 2004	Abu alhaija Es and Qudeimat MA 2003	Lindsten R et
	Pakistan	Pakistan	Malaysia	Malaysia	North america	Egyptian	Mexico	Colombia	Chinese	Saudi Arabia	Australia	Jordan	Norway

Figure 14. Bar chart showing the gender disparities for mandibularInter molar arch width.

Max.AL

F	101	21	126	40	60	24	39
M	113	32	126	40	60	20	48
	Al-Zubair NM 2015	Alam MK et al. 2014	Al-khatib et al. 2011	Carrillo EL et al 2009	Hashim HA 2005	Eguchi S et al. 2004	Abu alhaija Es and Qudeimat MA 2003
	Yemen	Malaysia	Malaysia	Mexico	Saudi Arabia	Australia	Jordan

Figure 15.Bar chart showing the gender disparities formaxillary arch length.

Mand.AL

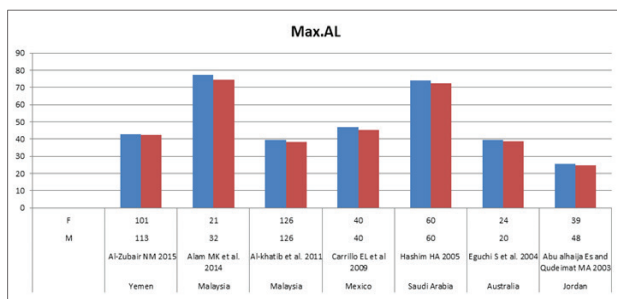|						
F	21	126	40	60	24	39
M	32	126	40	60	20	48
	Alam MK et al. 2014	Al-khatib et al. 2011	Carrillo EL et al 2009	Hashim HA 2005	Eguchi S et al. 2004	Abu alhaija Es and Qudeimat MA 2003
	Malaysia	Malaysia	Mexico	Saudi Arabia	Australia	Jordan

Figure 16. Bar chart showing the gender disparities formandibular arch length.

Discussion

During the mixed dentition, prediction of the mesiodistal dimensions of unerupted permanent teeth is of great importance in diagnosis and treatment planning. Correct assessment of the size of the unerupted tooth allows improved treatment plan to deal with tooth size/arch length discrepancies.[16] For mixed dentition tooth size and arch dimension analysis direct measurement methods including hand-held calipers, graphs and scale to record dimensions and tooth size on dental casts have been used.[17] Recent development in technology has made it possible that the dental cast can be reproduced in the form of digital dental model.[17,18] These digital model studies provide more accurate and reliable tools for obtaining measurements and carrying out dental analysis.[19,20] Moreover, they have additional benefits, such as accessibility of the images produced, reduction in storage costs and the ability to analyze images by using sophisticated software's.[19,21]

In orthodontic treatment the arch form and shape are usually modified to achieve the treatment goals by the various forms of wires used in the treatment course. The patient's existing arch form appears to be the best guide for the stability of the arch form after treatment.[1]

The arch size and shape are of scrupulous importance in dentistry. Thus a diversity of diagnostic and analytical indices had been anticipated to help and forecast dental arch development and help out through treatment planning.[22] For the relieving of crowding and adjustment of arch length, the dental arch expansion is one of the methods to solve the problem by non-extraction orthodontic treatment. After dental arch expansion, to avoid the relapse is most controversial.[23]The researchers put together the indices and techniques using tooth size to calculate the perfect interpremolar and intermolar arch width to get an ideal expansion of arches in order to

avoid relapse and to alleviate the crowding.[24] The current review investigates the arch size of various populations which show the population variation, along with the sexual disparities.

As the Figure 9, 10, 11, 12,13 and 14,[1,25-35] show the arch dimension width for Inter canine, Inter premolar, Inter molar of maxillary and mandibular arch respectively. Arch dimension has greater values mean value for males in relation to females.[1,5, 25-37]Figure 15 and 16[1,25-35] show the arch length of maxillary and mandibular arch respectively.[1,5, 25-37] Arch length has greater values mean value for males in relation to females with the exception of Jordanians. Therefore the before dental arch expansion and growth modification the gender difference need to be had in consideration.

Conclusion

In conclusion, the dental arch dimension has been measured by various hand held and digital models. All the methods showed the sexual disparities in the dental arch dimension. Arch dimension investigated via plaster and digital dental models, measurement via calipers and computers software's. The current overview showed the arch dimension and its disparities for various populations. Therefore, various methods to assess arch dimension should be carefully considered and well conducted as part of the clinical assessment of orthodontic treatment, since arch dimension could influence the diagnosis and treatment planning of orthodontist.

Conflict of interest: The authors declared no conflict of interest

Authors' contributions:

Data gathering and idea owner of this study: Rafiqul Islam

Study design: Rafiqul Islam, Mohammad Khursheed Alam

Data gathering: Mohammad Khursheed Alam, Fazal Shahid

Writing and submitting manuscript: Rafiqul Islam, Mohammad Khursheed Alam

Editing and approval of final draft: Fazal Shahid , Mohd Fadhli Khamis

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