



Assessment of the Relationship between Dental College's Intakes and Management of the Dental Human Resources in Sudan, 2020

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Dentistry profession has expanded in recent years to cover a large set of prevention and treatment modalities due to increased demand of oral health services as result of change in population Demographics, the increased demand for dentists has led to establishment of many dental colleges with overall number of 32 dental colleges in Sudan, and average number of 1200 graduates in 2019 from 15 dental colleges. A descriptive cross sectional – institutional based study was carried out, Data was collected using secondary data including statistical records of MOH, Ministry of higher education and other related institutions, Also, a questionnaire was administered for convenience sample of dentists and dental students (100 dentists/100 dental students) in order to assess their career plans and possibility to serve inside Sudan, the quantitative data was analyzed using SPSS version 22 (confidence level of 95%). 45% of the total public sector dentists are in

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Khartoum and 33% of dentists based on career planning assessment won't work outside Khartoum irrespective to income. The career plan assessment showed that 61.3% of dental students have emigrational plans as well as 91% of dentists, with most of dentists were not satisfied about their employment status. The findings highlight that assigned dentists in both public and private sectors in Sudan are less than WHO recommended dentists population ratio, therefore number of working dentists in public and private sectors are very low in other different states than Khartoum, so it's important to set a rational annual students intake number in dental colleges rather than altering colleges numbers, also authorities should adopt decentralization strategies as well as Inter-sectoral collaboration between Ministry of Health (FMOH) and Ministry of Higher Education to establish strategies for dental student's intake, Furthermore comprehensive review of dental human resources in Sudan to be done in 2025 as there are new 16 dental colleges are going to graduate students for the first time.

Keywords: Health system; dentistry; dental students; dental colleges; human resources; dental education; dental training; oral health; higher education; career plan; job satisfaction.

1. INTRODUCTION

Dentistry as a profession is concerned with prevention and treatment of oral diseases and encompasses treatment and correcting patient's malformations of the jaws, misalignments of the teeth and birth anomalies, furthermore in early days of the profession both training and practice was unregulated and virtually unrestricted [1,2]. Practicing dentistry became regulated at different times in different countries through many regulations which aimed to serve two purposes: to restrict admission to the profession and to ensure safe and knowledgeable practice. Regarding the admission process, dental education was limited to medical students who generally performed dental work only within the context of their medical practices and the next step was the opening of formal dental schools, these dental schools provided the education necessary to enter into the profession until the founding of current dental colleges and internship programs for dental practice.

In Sudan the Health system has undergone rapid changes by facing numerous new challenges of changing demographics, disease patterns, emerging and reemerging diseases coupled with rising costs of health care delivery that forced a comprehensive review of health systems and their functioning [3]. Dentistry as one of the main health domains with indispensable service demands that concerns with wide range of preventive and surgical treatments has also been affected by health system strategies in Sudan in terms of numbers, quality, distribution and continuous education for health provides, since that Entry portal of dentists into health system starts officially with

enrollment into one year Internship program set by Sudan's medical council and Directorate of health human resources in Federal Ministry of Health , the internship program is composed of six training shifts including; Oral and Maxillofacial surgery, Periodontics, Pedodontics, Dental Public Health, Conservative & Endodontic and Prosthodontics [4]. The number of dental schools in recent years have raised to 35 dental colleges all over the country with an average number of 1200 dentists graduated on 2019 from 15 dental colleges, meanwhile most of the graduated dentists since 2020 have been out of the health system training pipeline due to lack of training center vacancies to accommodate fresh graduated dentists in internship; which indicates imbalance between number of graduates and available vacancies for training and employment [5], the lack of Co-ordination between the Human Resources Directorate In FMOH and the Ministry of Higher Education has affected organization process of dental graduate's numbers from newly established universities and ability to identify the problem co- factors in terms of continuous endorsement of new colleges establishment, its average annual intake, geographical distribution of these colleges and the available hospitals and dental care settings to accommodate dentists. Moreover, policy of "expansion and decentralization of higher education" adopted in 1994 including local postgraduate studies had aimed to increase production with focus on priority needs of certain regions to overcome the short coming in-service delivery in many de-privileged areas [3], the policy activated had served in some measure the strategy of establishment of Medical schools there remains a geographical distribution imbalance regarding number of dental colleges in Khartoum and dental colleges in other states,

taking into account the value of decentralization of dental schools for retention of dental staff as well as the role of colleges dental clinics in peripheral states to provide dental services for the state's local population.

The importance of assessment of the relationship between dental colleges intake and demands of the health system come from the fact of that in spite of clear expansion of both number of Dental Schools and number of new professionals that should contribute in saturation of the dental market, yet there is imbalance between actual needs in some areas and the annual graduate's number as result of improper management of dental manpower. Also qualified dentists pass through intake stage and training stage which affect the quality and availability of dental service as result of long clinical gap after graduation and delay of official engagement into health system.

2. MATERIALS AND METHODS

This is Descriptive cross sectional – institutional based study, which took place in Federal Ministry of Health (FMOH), Khartoum State Ministry of Health (SMOH), Sudan Medical Council and Ministry of Higher Education. The Curative medicine directorate and Directorate of Health Human Resources are the principal FMOH directorates concern with dental human resources management, also the Dental Department at Private Curative Institutions Directorate as well as Oral Health Directorate are the main relevant directorates at Khartoum State Ministry of Health.

2.1 Data Collection

The data was collected from existing secondary data including records of number of dental providers, facilities, regulations, dental facilities and regular college's intake from all dental training hospitals, colleges and relevant institution and directorates.

Self-administrative closed ended questionnaire was allocated to assess career plans of 200 dentists and dental students on which Quota sampling for participants selection was done based on categorization of (dentists / dental students) as well as type of dental colleges (governmental / Private), Pre testing was done to

ensure quality of career plan survey questionnaire.

2.2 Data Management

Data was entered, cleaned, and analyzed using SPSS version 22. Statistical records of Existing data were presented on frequency tables with percentages, graphs and charts.

Significance tests used: *chi-square test* for categorical variables and *t-test* for quantitative data, with Confidence level of 95% and P value 0.05 % or less which is considered statistically significant.

3. RESULTS

The Table 1 shows that high number of graduated dentists on waiting list with average of (37%) from total registered dentists and 6,431 are fully licensed (63%).

Table 1. Number of registered dentists at Sudan's medical council

Category	Number
Primary registration	3788 (37%)
Permanent registration	5928 (58%)
Specialists	503 (4.9%)
Total	10.219

Registered dentists and 6,431 are fully licensed (63%).

The Table 2 shows a total average of 200 general dentists assigned to work on behalf of 17 States ministries of health excluding Khartoum state, the table shows that most of these dentists are assigned in Gezira State (43.5%) and the least numbers in Middle and East Darfur states (only 2%).

The Table 3 shows lack of number of specialists in different states with total absence of specialist in 6 States including Middle Darfur, West Darfur, White Nile, Sennar, South Kordofan and Northern State.

The Fig 1. shows distribution of (25 dental colleges in Khartoum / 7 dental colleges in different 5 states including 2 in Red Sea, 2 in Al-Jazeera, North Darfur, River Nile and North kordofan).

Table 2. Number of general dentists in different states of Sudan

Num	Name of The state	Number of general practitioners
1	Northern State	8 (4%)
2	Gadareef	7 (3.5%)
3	Kassala	8 (4%)
4	Red sea	21 (10.5%)
5	Northern Kordofan	13 (6.5%)
6	Western Kordofan	5 (2.5%)
7	Southern Kordofan	2 (1%)
8	Jazeera State	87 (43.5%)
9	Blue Nile	5 (2.5%)
10	White Nile	4 (2%)
11	River Nile	5 (2.5%)
12	Sennar	11 (5.5%)
13	North Darfur	7 (3.5%)
14	West Darfur	6 (3%)
15	East Darfur	2 (1%)
16	South Darfur	7 (3.5%)
17	Middle Darfur	2 (1%)
Total		200

Table 3. Number of specialist’s dentists in different states of Sudan except khartoum

Num	Name of the state	Number of specialists	Num	Name of the state	Number of specialists
1	Northern state	0 (0%)	10	White Nile	0 (0%)
2	Gadareef	1 (5.2%)	11	River Nile	1 (5.2%)
3	Kassala	1 (5.2%)	12	Sennar	0 (0%)
4	Red sea	1 (5.2%)	13	North darfur	2 (10.5%)
5	Northern kordofan	2 (10.5%)	14	West darfur	0 (0%)
6	Western kordofan	1 (5.2%)	15	East darfur	1 (5%)
7	Southern kordofan	0 (0%)	16	South darfur	1 (5%)
8	Jazeera state	7 (36.8%)	17	Middle darfur	0 (0%)
9	Blue Nile	1 (5.2%)	Total		19

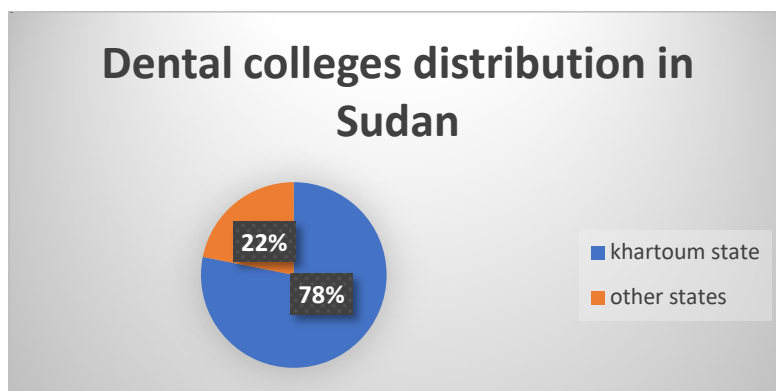


Fig. 1. Dental College’s distribution in Sudan

The Fig. 2 shows that private sector dominance with 23 dental colleges from total of 32 colleges.

governmental sector (the number of private intake student = Public Accommodates / 2).

The Table 4 shows the average of public accommodation intake on first grade at

The Table 5 shows the average intake at private colleges in 2019 excluding the foreign students,

Table 4. Governmental dental colleges, average intake and geographical location

Num	Name of college	Average intake (2019)	Target intake number (2020)	Location (state)
1	University of Khartoum	82 (17.9%)	50 (14.9%)	Khartoum
2	University of Gezira	50 (10.9%)	35 (10.4%)	Gezira
3	Neelain University	60 (13.1%)	40 (11.9%)	Khartoum
4	Sudan University of Science and technology	60 (13.1%)	60 (17.9%)	Khartoum
5	University of Shendi	60 (13.1%)	60 (17.9%)	River Nile
6	University of Red Sea	-	-	Red Sea
7	Alzaeim Alazhari University	50 (10.9%)	50 (14.9%)	Khartoum (Bahri)
8	Alfasher University	35 (7.6%)	40 (11.9%)	Northern Darfur
9	Kordofan University	60 (13.1%)	-	North Kordofan
Total		457	335	

Table 5. Private dental colleges, average intake and target and geographical location

Num	Name of college	The target intake number (2019)	Average intake		Location
			Male	Female	
1	Alrebat university	103 (5.1%)	19	84	Khartoum
2	Karary university	85 (4.2%)	15	70	Khartoum (Omdurman)
3	International university of africa	85 (4.2%)	9	76	Khartoum
4	Sudan international university	108 (5.4%)	39	69	Khartoum
5	University of science and technology	66 (3.3%)	15	51	Khartoum (Omdurman)
6	University of medical science and technology	94 (4.7%)	2	4	Khartoum
7	The national university	113 (5.6%)	9	20	Khartoum
8	Al-Razy univrsty	188 (9.4%)	20	58	Khartoum
9	University of garden city	71 (3.5%)	2	2	Khartoum
10	Ibn sina university	122 (6.1%)	7	21	Khartoum
11	The Nile university	103 (5.1%)	2	13	Khartoum (Bahri)
12	Albayan college	75 (3.7%)	7	25	Khartoum
13	Al-menhal academy of science	56 (2.8%)	2	2	Khartoum (Bahri)
14	Al-Yarmook College	56 (2.8%)	5	12	Khartoum
15	Iqra college of science and technology	47 (2.3%)	3	9	Jazeera state (Fadasi)
16	East Sudan college for medical sciences and technology	75 (3.7%)	3	18	Red Sea state (Portsudan)
17	Nahda college	71 (3.5%)	2	6	Khartoum
18	Nepta college	71 (3.5%)	6	7	Khartoum
19	Al-Fajr college of science and technology	71 (3.5%)	1	6	Khartoum
20	Hayat college	71 (3.5%)	4	11	Khartoum
21	Imperial college	75 (3.7%)	18	57	Khartoum
22	Al-Madaien college	113 (5.6%)	1	13	Khartoum
23	Riyadh international college	66 (3.3%)	1	7	Khartoum
Total		1985 (Actual Target)			

mature learning students and direct applicants of the program according to Higher Education Ministry.

The Fig. 3 shows dominance of dental student's intake in Khartoum state compared to other states which represent only 13% of total students in Sudan (8% governmental, 5% private).

The Table 6 shows that total of 16 colleges have released graduates up to December 2020 including the last batch graduation year (1240 graduates) only 111 are from out of khartoum + number of graduates on the past years respectively.

The Table 7 shows number of working dentists on governmental sector with only 8 specialists

assigned on the Oral Health Directorate of Khartoum State (only 4% of all dental staff are specialists).

The Table 8 shows the working staff number on Khartoum dental teaching hospital has average of 28.4% of total working staff as house officer intake recently, total of 185 dentists in Military hospitals that contribute to dental service coverage for military staff families and thereby staff accommodation.

The Table 9 shows the number of dental clinics and canters in Khartoum state with focus in Khartoum localities which own 45% of dental clinics and 81.5% of dental centers from total of 629 dental private facilities in Khartoum state.

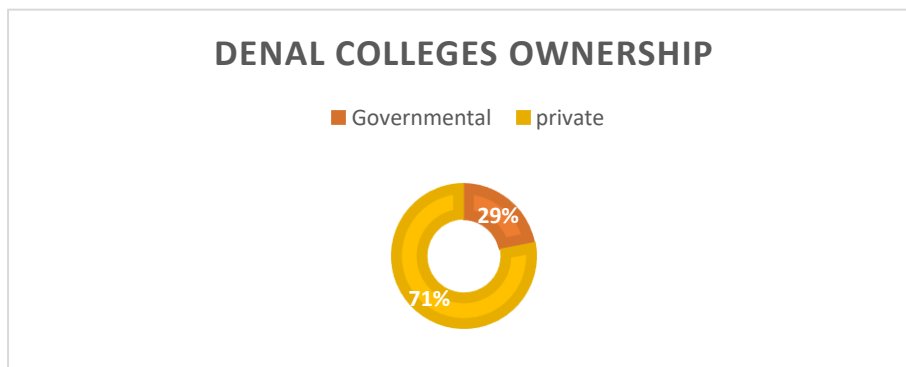


Fig. 2. Dental colleges ownership

Table 6. Number of recently graduated dentists from dental colleges

College	Number of graduates on recent years	College	Number of graduates on recent years
University of Khartoum	139 (2020) / 135 / 121	Sudan intentional university	85 (2020) /80 / 59
Karary University	84 (2020) / 69 / 70	University of medical science and technology	29 (2020) / 48 / 60
Neelain University	79 (2020) / 59 / 39	University of science and technology	69 (2020) / 73 / 70
University of Gezira	85 (2020) / 95/45 (Gezira State)	Nationl University	110 (2020) /120 /90
National Rebat University	80 (2019) / 64 / 93	Alrazy University	97 (2020) / 109 / 60
Nahda University	42 (2020) / 6	East Sudan college (Red Sea State)	26 (2019)
Ibn Sina University	85 (2019) / 73 / 78	International University of Africa	125 (2019) (57 Sudanese) / 82 (69 Sudanese) /
Al-Yarmook college	70 (2020) / 45 / 40		
Nile University	35 (2020) /28 /25		

Table 7. Public sector's dental workforce in Khartoum state

Num	Name of Locality	Total Number of dental clinics	Number of general practitioner dentists + contractors dentists + National service dentists	Number of specialists	Total dentists = 182	Categories of working clinics		
						Hospital clinic	Referential center	Small unit
1	Khartoum	28 (17%)	54 (31%)	3 (37.5%)	57 (31%)	3 (11%)	21(28%)	4 (7.4%)
2	Jabal Awleya	24 (14.7%)	27 (15.5%)	-	27 (14.8%)	2 (7.4%)	12 (16%)	10 (18.5%)
3	Bahri	31 (19%)	29 (16.6%)	4 (50%)	33 (18.1%)	5 (18.5%)	11(14.6%)	15 (27.7%)
4	East Nile	22 (13.4%)	18 (10.3%)	-	18 (9.8%)	5 (18.5%)	6 (8%)	7 (12.9%)
5	Um Bada	22 (13.4%)	10 (5.7%)	-	10 (5.4%)	3 (11%)	7 (9.3%)	9 (16.6%)
6	Karary	18 (11%)	21(12%)	-	21(11.5%)	5 (18.5%)	8 (10.6%)	5 (9.2%)
7	Omdurman	18 (11%)	15 (8.6%)	1 (12.5%)	16 (8.7%)	4(14.8%)	10 (13.3%)	4 (7.4%)
Total		163	174	8	182	27	75	54

Table 8. Khartoum major dental hospitals workforce

Name of Hospital	Number of general dentists	Number of registrars	Number of specialists	Average house officers intake monthly	Total
Khartoum dental teaching hospital	25 (14.2%)	50 (28.4%)	51(28.9%)	50 (28.4%)	176
Military Hospitals (Armed Forces + police)	40 (Omdurman) / 20 (Police) (32.4%)	15 (Omdurman)/ 12 (police) (14.5%)	14 (Omdurman) / 14 (police) (15.1%)	70 (37.8%)	185
HajAl-safi Hospital	20 (58.8%)	13 (38.2%)	1 (2.9%)	20 per month (not constant)	34
Total				140	395

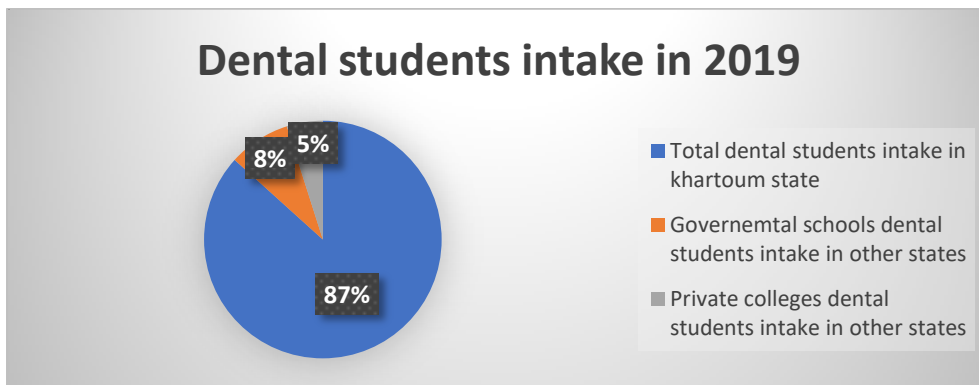


Fig. 3. Dental college’s intake in 2019 in Khartoum state compared to other states

Table 9. Private dental clinics and centers in Khartoum state

Main city	Number of general practitioners	Number of specialists	Number of dental clinics	Number of dental centers
Khartoum	210 (45.2%)	39 (43.8%)	249 (45%)	62 (81.5%)
Bahri	129 (27.8%)	19 (21.3%)	148 (26.7%)	6 (7.8%)
Omdurman	125 (26.9%)	31 (34.8%)	156 (28.2%)	8 (10.5%)
Total	464	89	553	76

Table 10 shows number of specialists assigned to public sector or having dental centers and clinics with a proportion of 89.5% in Khartoum state excluding those working on higher education institutions or part time contractors in private centers.

The Table 11 shows that total number of dentists have official jobs in public sector across Sudan.

The Fig. 4. shows marked variation in number of public sector assigned dentists in Khartoum state compared to other 17 states (Khartoum

state = 174 GP & 8 specialists) 45% / (other states = 200 GP & 19 specialists) 55%.

The Fig. 5 showed that (89.5%) of total specialists in Khartoum state compared to other states.

4. DISCUSSION

The aim of the study was to assess the relationship between dental college intake and Management of dental human resources in Sudan.

Table 10. Total number of specialists in Khartoum state compared to other states assigned in public sector / owning private centers

State	Number of specialists
Khartoum state	162 (89.5%)
Other states	19 (10.5%)
Total	181

Table 11. Total dentists workforce of public sector in Sudan

The place	Number
Khartoum dental teaching Hospital	176 (22%)
Military Hospitals (Omdurman + Police)	185 (23%)
Haj Alsafi Hospital	34 (4.2%)
Primary health care centers in Khartoum	182 (23%)
States public sector total dentists	219 (27.5%)
Total	796

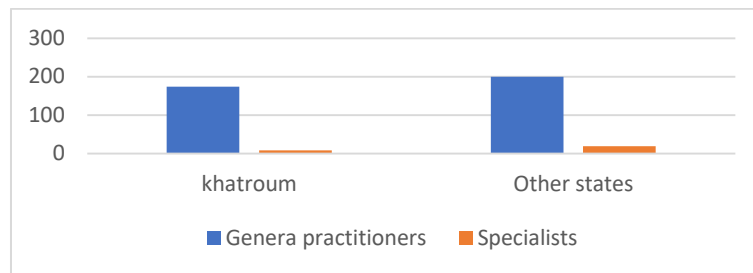


Fig. 4. Public sector working dental staff in Khartoum state (PHC dental clinics) compared to other different states

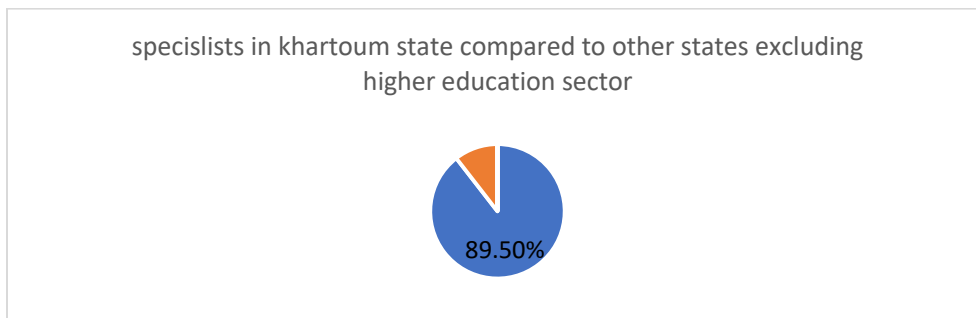


Fig. 5. Total number of specialists in Khartoum state

The assessment covers all the dental related institutions that concern with the process of dental human resources management in term of allocation of dentists, staffing for service delivery, practice license regulations at national level, moreover the assessment of both number and student's intake system at dental education's facilities in Sudan in order to evaluate the suitability of graduates and students' number in relation to health system demands. Data was collected using the existing information including regulations, records and available Data Base at the FMOH and SMOH health's directorates to assess the numbers of working dental staff in Sudan (National Level) and Khartoum state (Centric level), Staff distribution throughout the country, furthermore data from Ministry of Higher Education to assess number of dental students and colleges in Sudan compared to Medical council's total number of registered licensed dentists and by using WHO standardized Dentists: population ratio. Also, a questionnaire was allocated to 100 dental students and same number dentists to assess their career plans based on level of satisfaction, giving us a clue about predicted future of dental staff availability and practicing desires and conditions based on career challenges and obstacles, thereby convenient policies to be set on behalf of the dental human resources and dental service delivery and sustainability. The

results of the study shows a total number of 10.219 registered dentists at Sudan Medical (Table 1), accordingly total number of dentists in Sudan in relation to total population number is two times more that WHO recommends [6] as dentists population ratio is 1:4290 (Table 11), taking into account 37% of total dentists are primarily registered dentists which means they are not fully licensed to practice dentistry without supervision due to factors related to internship programs waiting lists and lack of training vacancies, taking into account supervision needs specialists assigned in public sector to supervise, meanwhile total number of specialists working on behalf of public sector in different states than Khartoum are 10.5% from all over assigned working specialists at public sector (Table 3) and the rest proportion of 89.5% belong to those practicing dentistry in Khartoum (Fig. 2), hence only 62.9%of registered dentists are fully licensed to practice dentistry according to the Council's report (Table 1), taking into account that total number of population in Sudan estimated to be 43,849,260 in 2020 [4], with regard to the fact of that ; statistical record of Sudan medical council needs further update and recategorization since immigrants dentists and non-practicing dentists for different purposes haven't been delisted from the councils records, therefore calculation of the ratio is more significant by inclusion of only assigned public

and private sector dentists in Sudan as giving a ratio of 1:33050 dentists to population which is apparently five times less than WHO recommends (Table 11), Nevertheless this is cannot be conclusive since many dentists work as part time dentists have no official job contracts but still more significant than the ratio based on Registered dentists in Sudan Medical council, however the WHO dentist's population ratio is extremely affected by distribution of dentists, urban vs. rural area's treatment needs, oral epidemiological data invariable places and appropriate infrastructure for practicing, since still in Sudan there is some states localities are under covered with dental services due to either lack of facilities or improper distribution of working dentists regardless of their total count, on comparing Sudan's findings to results obtained by San Martin study [7] Sudan disagree with San Martin reports as there is less dentists population ratio compared to Brazil which has twice dentists number than WHO recommends, meanwhile according to assigned dentists to population ratio Sudan still has less ratio compared to India which has 1 dentist per 10000 population, as reported by Sanklap Yadav [8]. The total Numbers of dentists in Khartoum state assigned to public sectors are 45% of the total number of dental staff in Sudan (Fig. 1.), which clearly indicates that there is centric allocation of Dentists in Sudan which may be due to job vacancies, opportunities and payment offers which indicate Misdistribution of dental workforce through the country , taking into account 33% of working dentists based on career planning Questionnaire results won't work outside Khartoum state irrespective to income, meanwhile 37% will travel to peripheral state in case of salaries above 80.000 SDG as shown in (Fig. 1) . By comparing dentist's distribution finding in Sudan to Sank alp Yadav study finding in India [8], Sudan has lower number of Dentists across the various sections of the population compared to India on which higher dentists number in urban areas, The distribution of Dentists in different states of Sudan is very low compared to Khartoum state as averagely half of the public sector dentists are found to serve in Khartoum's primary health care settings (Table 4) and state's hospitals (Table 5) ,meanwhile the rest are allocated in the other 17 states (Fig. 1), taking into account that 22% of these 17 states general practitioners are found in the eight western states (Table 2), meanwhile middle states like Aljazeera has 43.5% of the total number of general practitioners dentists over 17 states (Table 2) which indicates uneven

distribution of dental workforce. Misdistribution in Sudan belongs to factors like conflicts, lack of job opportunities and living conditions burdens. In addition to that number of specialists in different states except Khartoum whose assigned to public sector are about 70% of the total number of specialists (Table 3),meanwhile the specialists working in peripheral states are only 3% of total specialists assigned in Sudan medical council (Table 1) and most of assigned specialists are working in Khartoum state(Fig. 2), which has direct impact in distribution policies of dental interns and residents in different states due to their supervisory played role and consequently lack of proper dental service, and if compared to Brazilian study of San Martin we found that the demographic structure is different in Brazil where 55% of dentists are found in Southern states and 10% in Northeast region, yet better distribution compared to Sudan which has average of half of public sector worker dentists in Khartoum state [9].

5. CONCLUSION

The findings of this study highlight that:

- Sudan registered number of dentists is apparently more than WHO recommended dentists: population ratio in total, but still number of working dentists on behalf of public and private sectors is very low relative to total population number. Severe shortage of dentists in other states, since most of assigned dentists is working in Khartoum state with total absence of specialists in some other states which affected training of dental house officers and service delivery into these areas.
- The number of students intake in dental colleges in Sudan is not based on actual geographical needs, so total number of governmental and private dental colleges must to expanded to cover 11 states that have no dental college at all.
- Setting of rational annual intake number at these college because its more vital for needs coverage than colleges number, also the study showed that the dental internship program is centric based, due to lack of vacancies and supervision in other states, therefore

possibility of retention of dentists at the peripheral states is markedly compromised. Moreover, 62.9% (6431 dentists) of the total registered dentists at Sudan's Medical Council are fully licensed dentists who are able to work solely without supervision needs, and thereby fully sub serve the need of the health system whenever possible.

- The current demand will be minimized to 1/3 recommended value by giving a ratio of Dentist in every 21,536 through the current graduates in 2019 from only half of total established colleges.
- The study showed that most of dentists are not satisfied about their employment status and most of them consider migration as front option, also most of dental students at governmental colleges may serve in peripheral states in case of proper settings, as well as some dentists consider career shift from dental domain as principal plan.

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CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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