

Report of the National Investigation of Resources for Oral Health in China

Xiang Yu SUN^{1#}, Chao YUAN^{1#}, Xiao Zhe WANG¹, Xing WANG², Xi Ping FENG³, Bao Jun TAI⁴, De Yu HU⁵, Huan Cai LIN⁶, Bo WANG², Yan SI¹, Chun Xiao WANG⁷, Wen Sheng RONG¹, Wei Jian WANG¹, Xue Nan LIU^{1*}, Shu Guo ZHENG^{1*}

Objective: To investigate the current status and distribution of resources for oral health in China, by means of analysing national data from the National Investigation of Resources for Oral Health.

Methods: The National Investigation of Resources for Oral Health in China was performed in 2015, in parallel with the 4th National Oral Health Survey of China (2015 to 2016). A structured questionnaire on resources for oral health was used to collect the data of professional institutions and stomatological/dental workforce in each province. For each province, the local Investigation Group was responsible to summarise the status and distribution of institutions with stomatological/dental departments and stomatological/dental workforce. Descriptive analysis of resources for oral health was performed to learn about the number and percentage of each category both for each province and nationally. The ratio of number of stomatological/dental workforce to population was also calculated and compared with the criteria of the World Health Organisation (WHO).

Results: There were totally 75,399 stomatological/dental departments nationally in all professional institutions in the mainland of China, most of which were set in institutions of primary health care services. Institutions of private sectors accounted for a higher proportion (69.8%) which was over two-fold compared to that of public ones (30.2%). General hospitals were the major part of hospitals with stomatological/dental departments compared with stomatological/dental specialised hospitals. Stomatological/dental clinics were the majority of institutions of primary health care services, compared to community health care service centres/stations and township health care services. Amongst all professional institutions of public health with stomatological/dental departments, 35.0% were maternal and child health care services and 11.2% were institutions for prevention and control of oral diseases. The total number of stomatological/dental workforce in the country was 314,347, among whom 171,587 (54.6%) were stomatologists/dentists. The ratio of number of stomatologists/dentists to population was 1:7,768 nationally, which was lower than the WHO standard of 1:5,000.

Conclusion: The National Investigation of Resources for Oral Health in China exhibited the current status and distribution of resources for oral health over the country, whereas insufficiencies of stomatological/dental workforce and institutions and inequalities of their distribution were found nationally. This could provide some policy suggestions for the health authorities in China to promote oral health in the Chinese population in the future.

Key words: National Investigation of Resources for Oral Health, professional institutions, ratio of stomatologists/dentists to population stomatological/dental departments, stomatological/dental workforce
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1 Department of Preventive Dentistry, Peking University School and Hospital of Stomatology, National Engineering Laboratory for Digital and Material Technology of Stomatology, Beijing Key Laboratory of Digital Stomatology, Beijing, P.R. China.

2 Chinese Stomatological Association, Beijing, P.R. China.

3 Shanghai Ninth People's Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, P.R. China.

4 School & Hospital of Stomatology, Wuhan University, Wuhan, P.R. China.

5 West China School of Somatology, Sichuan University, Chengdu, P.R. China.

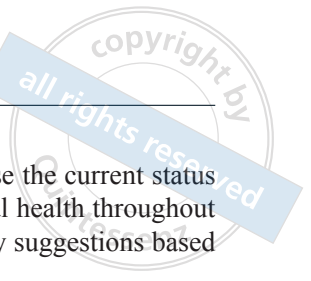
6 Guanghua School of Stomatology, Hospital of Stomatology, Sun Yet-sen University, Guangzhou, P.R. China.

7 Chinese Center for Disease Control and Prevention, Beijing, P.R. China.

These authors contributed equally to this study and share first authorship.

Corresponding authors: Dr Shu Guo ZHENG and Dr Xue Nan LIU, Department of Preventive Dentistry, Peking University School and Hospital of Stomatology, 22# Zhongguancun South Avenue, HaiDian District, Beijing 100081, P.R. China. Email: zhengsg86@gmail.com, lxn1968@163.com.

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Resources for oral health, which include professional institutions and stomatological/dental workforce, are very critical for the development of oral health care in the population. Since the new national policy of reform and opening-up in late 1970s, stomatology and dentistry in China has entered an unprecedented period of expeditious development, making the professional institutions distributed all over the urban and rural areas in China. As a result, there was a rapid growth in the number of stomatological/dental personnel, with recently more than 20,000 persons per year passing the national exam and obtaining the practising license of stomatologist/dentist or assistant stomatologist/dentist, a number almost four times than that when the new policy of reform and opening-up started. Although the number of oral health professionals is growing rapidly, unmet need is still a major problem, together with evidence of out-of-pocket payments and catastrophic expenditure for oral health care^{1,2}. In the meantime, a huge gap between the number of stomatological/dental workforce and the oral health needs of the Chinese population was also reported based on estimation by secondary analysis of data from the 3rd National Oral Health Survey of China³, making it necessary for us to fully overview the current structure and distribution of resources for oral health in the country.

However, for a very long time it was difficult to obtain the accurate data of the number and distribution of health resources for oral health in China, as they were not completely separated from the health resources for general health. By virtue of organisational structure and survey resources of the 4th National Oral Health Survey of China (2015 to 2016), performed under the guidance of the National Health Commission and led by the Chinese Stomatological Association (CSA), the National Investigation of Resources for Oral Health in China was successfully performed. The Health Commission of each province, the Chinese Centre for Disease Control (CDC), 35 stomatological/dental schools and hospitals nationwide, and a number of local Centres for Disease Control and Prevention, all contributed to the organising and implement of this national investigation. This investigation provided us a great opportunity to better understand the current status and distribution of resources for oral health in the country and would undoubtedly provide a valuable reference for the development of stomatology and dentistry in the future, which would also be helpful to meet the ever-growing needs and demands for oral health care nationally in China³.

Thus, this report was aimed to analyse the national data from the National Investigation of Resources for

Oral Health in China, so as to realise the current status and distribution of resources for oral health throughout the country and provide some policy suggestions based on the findings.

Materials and methods

Data resource

This cross-sectional study used data from the National Investigation of Resources for Oral Health in China (2015), in which all 31 provinces, autonomous regions and municipalities of the mainland of China had participated. A structured questionnaire on resources for oral health was used to collect the data of professional institutions and stomatological/dental workforce in each province. Unified training with all the involved procedures was carried out before the survey commenced. For each province, the local Investigation Group, with help from the local Health Commission, stomatological/dental schools and hospitals in the province, and the local Centres for Disease Control and Prevention in some places, was responsible to summarise the following six items: (1) the number of professional institutions with stomatological/dental departments (including hospitals, institutions of primary health care services, professional institutions of public health, and other health institutions); (2) the number of public/private sectors with stomatological/dental departments; (3) the number of hospitals with stomatological/dental departments (including stomatological/dental specialised hospitals, stomatological/dental departments in general hospitals, and stomatological/dental departments in other hospitals); (4) the number of stomatological/dental departments in institutions of primary health care services (including community health care service centres/stations, township health care services, and stomatological/dental clinics); (5) the number of stomatological/dental departments in professional institutions of public health (including maternal and child health care services, institutions for prevention and control of oral diseases, and other institutions of public health); (6) the information of all registered stomatological/dental personnel (including stomatologists/dentists, stomatological/dental nurses and technicians). Then data from all 31 provinces in the mainland of China were submitted to the National Investigation Group to establish the National Database of Resources for Oral Health using EpiData v3.1 software. The definitions of the terms used in the investigation were listed in Supplementary Table 1. Ethical clearance was approved by the Stomatological Ethics Committee

Table 1 The number and distribution of all professional institutions with stomatological/dental departments in each province of the mainland of China.

Provinces (municipalities/autonomous regions)	Total	Hospitals		Institutions of primary health care services		Professional institutions of public health		Other health institutions	
		N	%	N	%	N	%	N	%
National	75,399	15,712	20.8	55,030	73.0	2,169	2.9	2,488	3.3
Beijing	2,847	639	22.4	1,562	54.9	646	22.6	0	0.0
Tianjin	970	295	30.4	477	49.2	36	3.7	162	16.7
Hebei	6,475	941	14.5	5,472	84.5	62	1.0	0	0.0
Shanxi	2,488	546	22.0	1,852	74.4	37	1.5	53	2.1
Inner Mongolia	1,897	407	21.5	1,408	74.2	44	2.3	38	2.0
Liaoning	5,043	2,235	44.3	2,745	54.5	63	1.2	0	0.0
Jilin	2,823	307	10.9	2,176	77.1	52	1.8	288	10.2
Heilongjiang	2,511	844	33.6	1,616	64.3	49	2.0	2	0.1
Shanghai	1,140	151	13.2	940	82.5	34	3.0	15	1.3
Jiangsu	2,838	497	17.5	2,281	80.4	45	1.6	15	0.5
Zhejiang	4,298	605	14.1	3,057	71.1	88	2.0	548	12.8
Anhui	1,751	410	23.5	1,165	66.5	48	2.7	128	7.3
Fujian	1,912	257	13.4	1,564	81.8	44	2.3	47	2.5
Jiangxi	1,665	281	16.9	1,363	81.9	21	1.2	0	0.0
Shandong	6,506	1,086	16.7	5,404	83.1	16	0.2	0	0.0
Henan	4,722	1,085	23.0	3,446	73.0	96	2.0	95	2.0
Hubei	2,797	524	18.7	2,223	79.5	49	1.8	1	0.0
Hunan	2,247	561	25.0	1,389	61.8	29	1.3	268	11.9
Guangdong	5,258	821	15.6	4,106	78.1	104	2.0	227	4.3
Guangxi	2237	206	9.2	1,998	89.3	33	1.5	0	0.0
Hainan	557	38	6.8	503	90.3	5	0.9	11	2.0
Chongqing	1,707	411	24.1	1,025	60.0	141	8.3	130	7.6
Sichuan	2,941	545	18.5	2,203	74.9	190	6.5	3	0.1
Guizhou	868	340	39.2	511	58.9	15	1.7	2	0.2
Yunnan	1,319	374	28.4	931	70.5	14	1.1	0	0.0
Tibet	72	47	65.3	25	34.7	0	0.0	0	0.0
Shaanxi	2,543	624	24.5	1,492	58.7	118	4.6	309	12.2
Gansu	1,248	233	18.7	889	71.2	66	5.3	60	4.8
Qinghai	264	105	39.8	156	59.1	3	1.1	0	0.0
Ningxia	315	81	25.7	188	59.7	5	1.6	41	13.0
Xinjiang	1,140	216	18.9	863	75.7	16	1.5	45	3.9

Table 2 The number and distribution of public/private sectors with stomatological/dental departments in each province of the mainland of China.

Provinces (municipalities/ autonomous regions)	Total	Public sectors		Private sectors	
		N	%	N	%
National	54,857	16,542	30.2	38,315	69.8
Beijing	1,737	322	18.5	1,415	81.5
Tianjin	581	153	26.3	428	73.7
Hebei	941	615	65.4	326	34.6
Shanxi	1,822	377	20.7	1,445	79.3
Inner Mongolia	1,263	308	24.4	955	75.6
Liaoning	2,246	516	23.0	1,730	77.0
Jilin	2,541	366	14.4	2,175	85.6
Heilongjiang	2,511	1,250	49.8	1,261	50.2
Shanghai	755	18	2.4	737	97.6
Jiangsu	1,560	30	1.9	1,530	98.1
Zhejiang	4,167	1,370	32.9	2,797	67.1
Anhui	1,212	387	31.9	825	68.1
Fujian	1,459	372	25.5	1,087	74.5
Jiangxi	1,652	398	24.1	1,254	75.9
Shandong	2,530	209	8.3	2,321	91.7
Henan	4,722	2,010	42.6	2,712	57.4
Hubei	2,797	1,282	45.8	1,515	54.2
Hunan	1,449	344	23.7	1,105	76.3
Guangdong	5,258	1,685	32.0	3,573	68.0
Guangxi	2,237	635	28.4	1,602	71.6
Hainan	546	97	17.8	449	82.2
Chongqing	1,577	609	38.6	968	61.4
Sichuan	2,938	1,141	38.8	1,797	61.2
Guizhou	813	245	30.1	568	69.9
Yunnan	1,319	441	33.4	878	66.6
Tibet	72	55	76.4	17	23.6
Shaanxi	1,531	313	20.4	1,218	79.6
Gansu	1,248	489	39.2	759	60.8
Qinghai	240	152	63.3	88	36.7
Ningxia	65	29	44.6	36	55.4
Xinjiang	1,068	324	30.3	744	69.7

Table 3 The number and distribution of hospitals with stomatological/dental departments in each province of the mainland of China.

Provinces (municipalities/ autonomous regions)	Total	Stomatological/dental specialised hospitals		Stomatological/dental depart- ments in general hospitals		Stomatological/dental depart- ments in other hospitals	
		N	%	N	%	N	%
National	15,712	552	3.5	11,600	73.8	3,560	22.7
Beijing	639	19	3.0	275	43.0	345	54.0
Tianjin	295	7	2.4	160	54.2	128	43.4
Hebei	941	17	1.8	735	78.1	189	20.1
Shanxi	546	50	9.2	353	64.7	143	26.2
Inner Mongolia	407	21	5.2	232	57.0	154	37.8
Liaoning	2,235	21	0.9	2,016	90.2	198	8.9
Jilin	307	26	8.5	219	71.3	62	20.2
Heilongjiang	844	20	2.4	669	79.3	155	18.4
Shanghai	151	2	1.3	134	88.7	15	9.9
Jiangsu	497	29	5.8	468	94.2	0	0.0
Zhejiang	605	58	9.6	337	55.7	210	34.7
Anhui	410	15	3.7	333	81.2	62	15.1
Fujian	257	7	2.7	168	65.4	82	31.9
Jiangxi	281	7	2.5	274	97.5	0	0.0
Shandong	1,086	40	3.7	726	66.9	320	29.5
Henan	1,085	20	1.8	748	68.9	317	29.2
Hubei	524	13	2.5	381	72.7	130	24.8
Hunan	561	32	5.7	375	66.8	154	27.5
Guangdong	821	41	5.0	588	71.6	192	23.4
Guangxi	206	7	3.4	188	91.3	11	5.3
Hainan	38	1	2.6	34	89.5	3	7.9
Chongqing	411	21	5.1	264	64.2	126	30.7
Sichuan	545	18	3.3	493	90.5	34	6.2
Guizhou	340	10	2.9	259	76.2	71	20.9
Yunnan	374	9	2.4	281	75.1	84	22.5
Tibet	47	1	2.1	45	95.7	1	2.1
Shaanxi	624	24	3.8	402	64.4	198	31.7
Gansu	233	5	2.1	154	66.1	74	31.8
Qinghai	105	2	1.9	78	74.3	25	23.8
Ningxia	81	5	6.2	41	50.6	35	43.2
Xinjiang	216	4	1.9	170	78.7	42	19.4

of Chinese Stomatological Association (Approval no. 2014-003).

Statistical analysis

Descriptive analysis of resources for oral health was performed to compute the number and percentage of each item mentioned above, for each province nationally. The ratios regarding number of stomatological/dental workforce to population were calculated using the number of stomatological/dental workforce (including stomatologists/dentists, stomatological/dental nurses, and stomatological/dental technicians) divided by the number of population size reported in the latest National Census (the 6th National Census of China, 2010)⁴.

Results

There were totally 75,399 stomatological/dental departments nationally in all professional institutions in the mainland of China. Among them, 20.8% were set in hospitals, 73.0% were set in institutions of primary health care services, 2.9% were in professional institutions of public health, and the other 3.3% were in other health institutions, respectively (Table 1). Impressively, for the nature of public/private sectors, public sectors accounted for 30.2% nationally, while the other 69.8% were all private ones (Table 2).

In the mainland of China, there were 15,712 hospitals with stomatological/dental departments nationally, among which 552 (3.5%) were stomatological/dental specialised hospitals, 11,600 (73.8%) were stomatological/dental departments in general hospitals, and the other 3,560 (22.7%) were stomatological/dental departments in other hospitals (Table 3). According to the 2016 National Statistical Yearbook of China⁵, by the end of the year 2015, there were in total 17,430 general hospitals in the country, and 66.6% of these hospitals had established the stomatological/dental departments.

Table 4 showed that in total 55,030 stomatological/dental departments were set in institutions of primary health care services, among which 12.1% were community health care service centres/stations, 17.1% were township health care services, while the other 70.7% were stomatological/dental clinics. According to the 2016 National Statistical Yearbook of China⁵, by 2015 only 19.5% of the community health care service centres/stations had established stomatological/dental departments, whereas only 25.6% of the township health care services and 18.7% of the general clinics had stomatological/dental departments. Table 5 showed that in the country, a total of 2,169 professional institu-

tions of public health had stomatological/dental departments. Among these institutions, 35.0% were maternal and child health care services, 11.2% were institutions for prevention and control of oral diseases, while the other 53.8% were other institutions of public health.

Stomatological/dental personnel was also a focal point of the National Investigation of Resources for Oral Health in China. By the year 2015, the total number of stomatological/dental workforce in all professional institutions with stomatological/dental departments in the country was 314,347, among whom 171,587 (54.6%) were stomatologists/dentists, 118,822 (37.8%) were stomatological/dental nurses, and 23,938 (7.6%) were stomatological/dental technicians, respectively (Table 6). Based on the data of 6th National Census of China⁴, the ratio of number of stomatologists/dentists to population was 1:7,768 nationally, whereas that of stomatological/dental nurses to population was 1:11,217, and for stomatological/dental technicians the ratio was 1:55,678 (Table 7).

Discussion

Main findings

Although the number of stomatological/dental specialised hospitals was much smaller than that of stomatological/dental departments in hospitals, they still play the backbone and leading roles in the ranks of professionals for prevention and control of oral diseases. As the professional teams for preventive stomatology/dentistry were always set in the large stomatological/dental specialised hospitals in China, their role became more crucial. The distribution of stomatological/dental departments in general hospitals were widespread and these institutions had strong and comprehensive capabilities of oral health care services, thus they were more accessible for people to seek for prevention and treatment of oral diseases than the specialised hospitals. According to the National Statistical Yearbook of China⁵, by the end of 2015, only 66.6% of general hospitals in the country had established the stomatological/dental departments, which meant that nearly one third of the general hospitals had no provision of stomatological/dental services, contributing to the inadequate accessibility of oral health care for the Chinese population.

Among all professional institutions with stomatological/dental departments in China, the institutions of primary health care services accounted for 73% and became the main body of oral health care services. Institutions of primary health care services included

Table 4 The number and distribution of stomatological/dental departments in institutions of primary health care services in each province of the mainland of China.

Provinces (municipalities/ autonomous regions)	Total	Community health care service centres/stations		Township health care services		Stomatological/ dental clinics	
		N	%	N	%	N	%
National	55,030	6,680	12.1	9,417	17.1	38,933	70.7
Beijing	1,562	440	28.2	93	6.0	1,029	65.9
Tianjin	477	89	18.7	81	17.0	307	64.4
Hebei	5,472	408	7.5	738	13.5	4,326	79.1
Shanxi	1,852	254	13.7	252	13.6	1,346	72.7
Inner Mongolia	1,408	207	14.7	267	19.0	934	66.3
Liaoning	2,745	92	3.4	113	4.1	2,540	92.5
Jilin	2,176	129	5.9	184	8.5	1,863	85.6
Heilongjiang	1,616	94	5.8	285	17.6	1,237	76.5
Shanghai	940	202	21.5	0	0.0	738	78.5
Jiangsu	2,281	294	12.9	456	20.0	1,531	67.1
Zhejiang	3,057	439	14.4	540	17.7	2,078	68.0
Anhui	1,165	136	11.7	372	31.9	657	56.4
Fujian	1,564	121	7.7	239	15.3	1,204	77.0
Jiangxi	1,363	45	3.3	161	11.8	1,157	84.9
Shandong	5,404	1,658	30.7	1,530	28.3	2,216	41.0
Henan	3,446	213	6.2	847	24.6	2,386	69.2
Hubei	2,223	198	8.9	606	27.3	1,419	63.8
Hunan	1,389	233	16.8	246	17.7	910	65.5
Guangdong	4,106	532	13.0	496	12.1	3,078	75.0
Guangxi	1,998	71	3.6	216	10.8	1,711	85.6
Hainan	503	33	6.6	57	11.3	413	82.1
Chongqing	1,025	154	15.0	236	23.0	635	62.0
Sichuan	2,203	67	3.0	636	28.9	1,500	68.1
Guizhou	511	45	8.8	113	22.1	353	69.1
Yunnan	931	52	5.6	148	15.9	731	78.5
Tibet	25	1	4.0	5	20.0	19	76.0
Shaanxi	1,492	177	11.9	233	15.6	1,082	72.5
Gansu	889	146	16.4	155	17.4	588	66.1
Qinghai	156	14	9.0	10	6.4	132	84.6
Ningxia	188	9	4.8	50	26.6	129	68.6
Xinjiang	863	127	14.7	52	6.0	684	79.3



Table 5 The number and distribution of stomatological/dental departments in professional institutions of public health in each province of the mainland of China.

Provinces (municipalities/ autonomous regions)	Total	Maternal and child health care services		Institutions for prevention and control of oral diseases		Other institutions of public health	
		N	%	N	%	N	%
National	2,169	760	35.0	243	11.2	1,166	53.8
Beijing	646	15	2.3	23	3.6	608	94.1
Tianjin	36	13	36.1	6	16.7	17	47.2
Hebei	62	61	98.4	1	1.6	0	0.0
Shanxi	37	9	24.3	9	24.3	19	51.4
Inner Mongolia	44	29	65.9	9	20.5	6	13.6
Liaoning	63	13	20.6	40	63.5	10	15.9
Jilin	52	11	21.2	2	3.8	39	75.0
Heilongjiang	49	19	38.8	22	44.9	8	16.3
Shanghai	34	1	2.9	15	44.1	18	52.9
Jiangsu	45	21	46.7	8	17.8	16	35.6
Zhejiang	88	33	37.5	5	5.7	50	56.8
Anhui	48	10	20.8	4	8.3	34	70.8
Fujian	44	22	50.0	2	4.5	20	45.5
Jiangxi	21	16	76.2	5	23.8	0	0.0
Shandong	16	16	100.0	0	0.0	0	0.0
Henan	96	58	60.4	12	12.5	26	27.1
Hubei	49	43	87.8	0	0.0	6	12.2
Hunan	29	18	62.1	1	3.4	10	34.5
Guangdong	104	42	40.4	9	8.7	53	51.0
Guangxi	33	32	97.0	0	0.0	1	3.0
Hainan	5	0	0.0	4	80.0	1	20.0
Chongqing	141	10	7.1	1	0.7	130	92.2
Sichuan	190	181	95.3	3	1.6	6	3.2
Guizhou	15	14	93.3	1	6.7	0	0.0
Yunnan	14	13	92.9	0	0.0	1	7.1
Tibet	0	0	-	0	-	0	-
Shaanxi	118	25	21.2	53	44.9	40	33.9
Gansu	66	22	33.3	7	10.6	37	56.1
Qinghai	3	3	100.0	0	0.0	0	0.0
Ningxia	5	4	80.0	1	20.0	0	0.0
Xinjiang	16	6	37.5	0	0.0	10	62.5

Table 6 The number and distribution of stomatological/dental workforce in all professional institutions with stomatological/dental departments in each province of the mainland of China.

Provinces (municipalities/ autonomous regions)	Total	Stomatologists dentists		Stomatological/ dental nurses		Stomatological/ dental technicians	
		N	%	N	%	N	%
National	314,347	171,587	54.6	118,822	37.8	23,938	7.6
Beijing	15,143	8,260	54.5	6,328	41.8	555	3.7
Tianjin	11,675	6,311	54.1	4,939	42.3	425	3.6
Hebei	27,676	15,678	56.6	11,745	42.4	253	0.9
Shanxi	8,401	4,811	57.3	2,797	33.3	793	9.4
Inner Mongolia	6,855	3,499	51.0	2,585	37.8	771	11.2
Liaoning	11,132	7,088	63.7	3,038	27.3	1,006	9.0
Jilin	13,348	6,955	52.1	5,354	40.1	1,039	7.8
Heilongjiang	14,351	9,083	63.3	3,028	21.1	2,240	15.6
Shanghai	6,763	4,256	62.9	2,472	36.6	35	0.5
Jiangsu	6,962	3,937	56.5	2,444	35.2	581	8.3
Zhejiang	14,843	10,951	73.8	3,409	23.0	483	3.2
Anhui	6,389	3,635	56.9	2,257	35.3	497	7.8
Fujian	9,309	5,801	62.3	3,025	32.5	483	5.2
Jiangxi	3,628	3,173	87.5	254	7.0	201	5.5
Shandong	32,777	11,898	36.3	17,179	52.4	3,700	11.3
Henan	19,945	10,778	54.0	6,779	34.0	2,388	12.0
Hubei	8,309	5,742	69.1	2,431	29.3	136	1.6
Hunan	6,847	3,476	50.8	2,721	39.7	650	9.5
Guangdong	22,314	12,486	56.0	8,423	37.7	1,405	6.3
Guangxi	6,125	3,821	62.4	1,806	29.5	498	8.1
Hainan	1,814	1,117	61.6	563	31.0	134	7.4
Chongqing	4,385	2,479	56.5	1,587	36.2	319	7.3
Sichuan	12,536	7,548	60.2	4,764	38.0	224	1.8
Guizhou	12,751	5,770	45.3	6,075	47.6	906	7.1
Yunnan	2,612	1,544	59.1	880	33.7	188	7.2
Tibet	225	171	76.0	49	21.8	5	2.2
Shaanxi	10,434	5,358	51.4	3,491	33.4	1,585	15.2
Gansu	11,071	2,311	20.9	6,893	62.2	1,867	16.9
Qinghai	614	313	51.0	151	24.6	150	24.4
Ningxia	1,115	780	70.0	274	24.5	61	5.5
Xinjiang	3,998	2,557	64.0	1,081	27.0	360	9.0

community health care service centres/stations, township health care services, and stomatological/dental clinics. Although these stomatological/dental departments could only do some basic work, but they played the most important role for the extensive coverage of oral health care in the country, which constituted the fundament of the national network for treatment, prevention and control of oral diseases. However, according to National Statistical Yearbook of China⁵, by 2015 only 19.5% of the community health care service centres/stations had established stomatological/dental departments, whereas only 25.6% of the township health care services and 18.7% of the general clinics had stomatological/dental departments. Obviously, in the primary health care settings, there was still a large deficiency of oral health care services in the country, which might also lead to the difficulty of oral health attendance for the Chinese people.

From the public/private nature, the public sectors accounted for 30.2%, whereas the private ones accounted for 69.8%. With the support and guidance of policies and the rapid influx of social capitals, the number of private institutions for oral health care would exhibit a rapidly growing trend, so more attentions should be paid to the function of these private sectors in treatment, prevention and control of oral diseases.

There is a total of 75,399 stomatological/dental departments nationally in all professional institutions in the mainland of China (including stomatological/dental specialised hospitals), however the stomatological/dental departments in the professional institutions of public health only accounted for 2.9%, among which stomatological/dental departments in maternal and child health care services made up for 35.0%. Compared to this proportion, that of stomatological/dental departments set in the institutions for prevention and control of oral diseases seemed much lower and relatively insufficient. According to the preliminary results of the 4th National Oral Health Survey of China announced by the National Health Commission, caries prevalence in primary teeth became more serious than a decade ago, and the prevention and control of dental caries was recommended to be started at a lower age than ever before, thus the stomatological/dental departments both in the maternal and child health care services and institutions for prevention and control of oral diseases would be much essential to achieve this goal nationally.

An important indicator for measurement of the sufficiency of human resources for oral health in a country/region was the ratio of number of stomatological/dental workforce to population. The WHO suggested a standard of 1:5,000, which could be risen up to 1:2,000 in

developed countries. In our country, the ratio of stomatologists/dentists to population was close to 1:8,000, which was still far from sufficient according to the WHO criteria. Besides the above, the distribution of human resources for oral health in China was extremely uneven. For instance, in some provinces and municipalities at a higher level of economic development, such as Beijing and Tianjin, the ratio of stomatologists/dentists to population had already reached the WHO criteria, and some areas (e.g. the urban area) in these places had even exceeded the standard of developed countries. However, in some other underdeveloped areas, this ratio remained much lower than the WHO criteria, and the stomatological/dental workforce were seriously insufficient. This inequality of distribution of human resources for oral health would be a major problem to be solved in the following few decades.

Policy suggestions

In order to improve the oral health indicators for the great strategic goal of “Healthy China 2030”, and to maintain the oral and systemic health and meet the ever-increasing demands of the Chinese people on oral health care services, some suggestions for the policies on future oral health work could be put forward based on the main findings of the National Investigation of Resources for Oral Health in China.

Some measures were suggested to be applied to promote the work of oral health care. Improvement of the prevention and control system of oral diseases, emphasis on the leading role of the government in the prevention and control of oral diseases, construction of a network for prevention and control of oral diseases at all levels, and the establishment of the national and regional stomatological/dental centres as a basis, were all beneficial to comprehensively promote the management on the whole life cycle with regards to oral health. Setting up national and provincial prevention and control centres for oral diseases, and collaboration among stomatological/dental specialised hospitals, stomatological/dental departments in general hospitals and institutions for prevention and control of oral diseases, were both helpful to provide technical guidance and professional training for stomatological/dental personnel on treatment, prevention and control of oral diseases, so as to provide standardised oral health education, accurate diagnosis, and corresponding treatment and preventive measures for the population.

Strengthening the network for prevention and control of oral diseases at all levels, especially for the primary oral health care services, would be very important for

Table 7 The ratios of number of stomatological/dental workforce to population in each province of the mainland of China.

Provinces (municipalities/ autonomous regions)	Population	Stomatologists/ dentists		Stomatological/ dental nurses		Stomatological dental technicians	
		N	Ratio ^a	N	Ratio ^a	N	Ratio ^a
National	1,332,810,869	171,587	1:7,768	118,822	1:11,217	23,938	1:55,678
Beijing	19,612,368	8,260	1:2,374	6,328	1:3,099	555	1:35,338
Tianjin	12,938,693	6,311	1:2,050	4,939	1:2,620	425	1:30,444
Hebei	71,854,210	15,678	1:4,583	11,745	1:6,118	253	1:284,009
Shanxi	35,712,101	4,811	1:7,423	2,797	1:12,768	793	1:45,034
Inner Mongolia	24,706,291	3,499	1:7,061	2,585	1:9,558	771	1:32,044
Liaoning	43,746,323	7,088	1:6,172	3,038	1:14,400	1,006	1:43,485
Jilin	27,452,815	6,955	1:3,947	5,354	1:5,128	1,039	1:26,422
Heilongjiang	38,313,991	9,083	1:4,218	3,028	1:12,653	2,240	1:17,104
Shanghai	23,019,196	4,256	1:5,409	2,472	1:9,312	35	1:657,691
Jiangsu	78,660,941	3,937	1:19,980	2,444	1:32,185	581	1:135,389
Zhejiang	54,426,891	10,951	1:4,970	3,409	1:15,966	483	1:112,685
Anhui	59,500,468	3,635	1:16,369	2,257	1:26,363	497	1:119,719
Fujian	36,894,217	5,801	1:6,360	3,025	1:12,196	483	1:76,386
Jiangxi	44,567,797	3,173	1:14,046	254	1:175,464	201	1:221,730
Shandong	9,5792,719	11,898	1:8,051	17,179	1:5,576	3,700	1:25,890
Henan	94,029,939	10,778	1:8,724	6,779	1:13,871	2,388	1:39,376
Hubei	57,237,727	5,742	1:9,968	2,431	1:23,545	136	1:420,866
Hunan	65,700,762	3,476	1:18,901	2,721	1:24,146	650	1:101,078
Guangdong	104,320,459	12,486	1:8,355	8,423	1:12,385	1,405	1:74,249
Guangxi	46,023,761	3,821	1:12,045	1,806	1:25,484	498	1:92,417
Hainan	8,671,485	1,117	1:7,763	563	1:15,402	134	1:64,713
Chongqing	28,846,170	2,479	1:11,636	1,587	1:18,177	319	1:90,427
Sichuan	80,417,528	7,548	1:10,654	4,764	1:16,880	224	1:359,007
Guizhou	34,748,556	5,770	1:6,022	6,075	1:5,720	906	1:38,354
Yunnan	45,966,766	1,544	1:29,771	880	1:52,235	188	1:244,504
Tibet	3,002,165	171	1:17,557	49	1:61,269	5	1:600,433
Shaanxi	37,327,379	5,358	1:6,967	3,491	1:10,692	1,585	1:23,550
Gansu	25,575,263	2,311	1:11,067	6,893	1:3,710	1,867	1:13,699
Qinghai	5,626,723	313	1:17,977	151	1:37,263	150	1:37,511
Ningxia	6,301,350	780	1:8,079	274	1:22,998	61	1:103,301
Xinjiang	21,815,815	2,557	1:8,532	1,081	1:20,181	360	1:60,599

^a Ratio, the number of stomatological/dental workforce divided by the number of population.



the better availability and accessibility of oral health care. It was suggested to raise the position of departments of preventive stomatology/dentistry in stomatological/dental specialised hospitals, and to establish or improve stomatological/dental departments in general hospitals, institutions of primary health care services and maternal and child health care services. Besides, it would also be essential to accelerate the construction of primary network for prevention and control of oral diseases and to train personnel for primary oral health care services, so as to meet the ever-growing needs and demands for oral health care in the Chinese population.

Enhancing the capabilities of prevention and control of oral diseases in institutions of primary health care services, including community health care service centres/stations, township health care services, and stomatological/dental clinics, would be better to give full play to the roles of institutions of private sectors and co-ordinate social resources, leading the innovation and development of oral health care services. It was also recommended to emphasise on the advantage of starting prevention of oral disease at an early age, and to promote appropriate techniques for treatment, prevention and control of oral diseases.

For stomatological/dental workforce, professional education and training of high-quality personnel for stomatology/dentistry, and optimisation of the structure of stomatological/dental professionals, were needed to be improved to meet the needs of oral health care in the large Chinese population. To that end, encouraging policies were also recommended to reasonably guide the graduates of stomatological/dental schools of universities and colleges to devote their career to some underdeveloped areas, so as to promote the equilibrium development of stomatology/dentistry and provide high-quality oral health care services for people in different regions of the country.

Conclusion

The National Investigation of Resources for Oral Health in China exhibited the current status and distribution of resources of oral health in the country, and insufficiency of stomatological/dental workforce and institutions and inequalities of their distribution were found nationally. This could provide some policy suggestions for the health authorities in China to promote oral health in the Chinese population in the future.

Conflicts of interest

The authors reported no conflicts of interests related to this study.

Author contributions

Drs Xiang Yu SUN and Chao YUAN participated in the study design, performed the research, and drafted the manuscript; Dr Xiao Zhe WANG contributed to the epidemiological data collection and analyses, and critically revised the manuscript; Drs Xing WANG, Xi Ping Feng, Bao Jun TAI, De Uu HU, Huan Cai Lin, Bo WANG, Yan SI, Chun Xiao WANG, Wen Sheng RONG, Wei Jian WANG, Xue Nan LIU, and Shu Guo ZHENG trained the investigators, designed and supervised the survey; Drs Xue Nan LIU and Shu Guo ZHENG conceived and supervised the study, provided valuable guidance in study design and editorial review, and critically revised the manuscript.

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Supplementary Table 1 Terms and definitions.

Term	Definition
Professional institutions (for medical treatment and health care)	The institutions who obtained the official practising licenses from the departments of health and family planning or obtained the registered certificate for legal entities from the departments of civil affairs, the industrial/commercial administrative departments, or the administrative departments of institutional management, and provided services of health care, disease control and health supervision, or undertook medical research and training of medical professionals. Professional institutions include hospitals, institutions of primary health care services, professional institutions of public health, and other health institutions.
Institutions (hospitals) of public sectors	The institutions (hospitals) economically owned by the state or collectivities.
Institutions (hospitals) of private sectors	The institutions (hospitals) not economically owned by the state or collectivities, but funded by the following forms: joint venture, share-holding partnership, private ownership, or Hong Kong/Macao/Taiwan and overseas investment.
Hospitals	Including general hospitals, hospitals of traditional Chinese medicine, hospitals of combined traditional Chinese and western medicine, ethnomedical hospitals, and all kinds of specialised hospitals/nursing homes, but excluding specialised institutions of disease prevention and control, maternal and child health care services, and sanatoriums.
Institutions of primary health care services	Including community health service centres/stations, street/township/village health care services, and outpatient services/clinics/infirmaries.
Professional institutions of public health	Including centres for disease prevention and control, and specialised institutions of disease prevention and control, institutions of health education, maternal and child health care services, first-aid centres/stations, agencies of blood supply, institutions of health supervision, and agencies of family planning services.
Other health institutions	Including sanatoriums, clinical centres for laboratory examinations, institutions of health and medical research/training/examinations, exchange centres for health and medical personnel, and statistical information centres for health and medicine.
Health workforce (human resources for health)	Health staff (working in hospitals, institutions of primary health care, professional institutions of public health and other health institutions), rural doctors/hygienists, and other technical/administrative/assistant personnel. Only the on-duty staffs who received salary paid at the end of the year (including all types of permanent staffs and those with long-term contracts), and those who were rehired for more than half a year, were included in the statistics of this investigation. However, temporary workers, retirees, former staffs, the personnel who had left the institution but with retained labour relationships, and the staffs rehired within half a year, were all excluded.
Stomatologists/dentists	Those who had the official practising certificates and provided stomatological/dental treatment and oral health care services, including both registered stomatologists/dentists and assistant stomatologists/dentists.
Stomatological/dental nurses	Those who had the registered nursing certificates and were engaging in stomatological/dental nursing works actually, with exclusion of those working in administrative positions.
Stomatological/dental technicians	Technicians who were responsible for the production and processing of dentures.