Transition and Distribution of Dental Hygienists and Nurses in Japan

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Abstract

There has been an increasing shortage of dental hygienists in local medical institutions in the recent years. Several studies have investigated the regional distribution of dental hygienists; however, no studies have compared their distribution with those of nurses. In this report, we present the regional distribution of dental hygienists in the community-based medical care setting and draw comparisons with the distribution of nurses and training schools. The examination numbers for dental hygienists, dental technicians, nurses, public health nurses, midwives, and assistant nurses were analyzed.

We observed different trends of change in the number of workers by occupation over the last 20 years (1998–2018). The number of dental hygienists and nurses more than doubled during this period, whereas the number of public health nurses and midwives increased by approximately 1.5 times. There was a concomitant decrease in the number of assistant nurses and dental technicians during this period. The numbers of nurses and assistant nurses in a prefecture showed a strong correlation, with the enrolment capacity of local training facilities. This correlation was stronger than that observed between the number of dental hygienists/dental technicians and dental training school capacity. However, no corresponding significant correlation was observed for public health nurses and midwives. The ratio of the number of employees to the number of license holders showed an increase for dental hygienists; however, the corresponding ratio decreased for dental technicians.

Keywords :

social dentistry,
transition and distribution,
dental hygienists,
nurses, dental technicians

Introduction

The Dental and Oral Health Promotion Law, implemented in 2012, clearly states that it was the people's responsibility to strive to prevent dental diseases and to receive regular medical examinations and health guidance (1,2). In addition, in the revised Dental Hygiene Act, im-

plemented in 2015, the words "under the direct guidance of dentists" were changed to "under the guidance of dentists"; therefore, dental hygienists need to develop services independently, including health guidance for oral hygiene management and oral care. Furthermore, future community dental care must necessarily shift the focus of education for dental hygienists from conventional, complete medical care to community-based medical care that emphasizes comprehensive community care and multidisciplinary collaboration, in which collaboration with nurses

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and public health nurses is especially important (3-7).

In light of the rapid aging of society, an urgent challenge is to maintain a reliable supply of dental hygienists by enhancing the system of providing oral health services, focusing on oral hygiene management and care, including collaboration between nurses and dental hygienists (1,2). In recent years, however, securing dental hygienists has become difficult, and the shortage in local medical institutions has become particularly pronounced. So far, there have been various reports on dental hygienists' regional distribution (4,8), but none have presented a comparative examination of nurses' distribution. In this report, we present the regional distribution of dental hygienists for emphasizing community-based care and multidisciplinary collaboration, by comparing and analyzing these against the distribution of nurses and training schools.

Materials and Methods

The examination numbers for each prefecture compared with the national totals for dental hygienists, dental technicians, nurses, public health nurses, midwives, and assistant nurses in 1998, 2008, and 2018 (1,9,10), statistical data on nursing services in Japan 2018 (11) and statistical data on oral health in Japan 2018 (12,13) as well as admissions capacity of training facilities were calculated and examined. Some training facilities for dental hygienists, dental technicians, nurses, public health nurses, midwives, and assistant nurses may not be at full capacity when measured in terms of the available spaces and number of admitted students, while some may admit students beyond their available space. In the present study, we used the indicated number of available spaces to represent the number of students. We procured population estimates for each prefecture to calculate the number of healthcare employees per 100,000 people in each prefecture; additionally, these data were also used to calculate the number of training facilities per 100,000 people. This research analyzes data that has already been released, including statistical data from national statistics, and do not include contents that require ethical consideration.

The coefficients of variation (CVs) were determined using statistical analyses to compare variability. The Spearman correlation coefficient test was used to make comparisons between pairs of sub-groups with $p < 0.05$ taken to indicate statistical significance. Descriptive statistics

and statistical analyses were performed using the IBM SPSS statistical software v26.0 (IBM, Armonk, NY, USA).

Results

The total numbers of dental hygienists and dental technicians per 100,000 population in 1998, 2008, and 2018 were 48.5 and 28.9, in 1998, 75.5 and 27.7 in 2008, and 104.9 and 27.3 in 2018, respectively. Each value was calculated against an index of 100. The distributions (CVs) of dental hygienists and dental technicians were 30.7 and 26.0 in 1998, 24.5 and 27.2 in 2008, and 20.1 and 31.4 in 2018 (Table 1). The total national numbers for nurses, assistant nurses, public health nurses, and midwives per 100,000 population were 470.0, 309.4, 27.3, and 19.1 in 1998; 687.0, 293.7, 34.0, and 21.8 in 2008; and 963.8, 240.8, 41.9, and 29.2 in 2018, respectively. Each value was calculated against an index of 100. The distributions (CVs) for nurses, public health nurses, midwives, and assistant nurses were 20.5, 35.2, 27.1, and 22.5 in 1998; 19.2, 36.7, 24.7, and 18.2 in 2008; and 18.3, 41.5, 24.8, and 17.0 in 2018 (Table 2-1, Table 2-2).

The 2008 and 2018 indices were calculated with the number of employees in each of the six employment categories in 1998 set as 100. In 2018, the index was 216 for dental hygienists, 94 for dental technicians, 205 for nurses, 153 for midwives, 153 for public health nurses, and 78 for assistant nurses (Fig. 1).

The enrolment capacity of the training facilities per 100,000 population was calculated by prefecture, and the correlations of these figures with the number of employees are given. The correlation coefficient in 47 prefectures between the capacity for admission at training facilities for dental hygienists and dental hygienists per 100,000 population in 2018 was $r=0.35$ ($p<0.05$) and that between the capacity for admission at training facilities for dental technicians and dental technicians per 100,000 population was $r=0.37$ ($p<0.05$) (Fig. 2, Fig. 3). The correlation coefficient in 47 prefectures between the capacity for admission at training facilities for nurses and nurses per 100,000 population in 2018 was $r=0.63$ ($p<0.001$) and that between the capacity for admission at training facilities for assistant nurses and assistant nurses per 100,000 population in 2018 was $r=0.62$ ($p<0.001$) and that between the capacity for admission at training facilities for public health nurses and public health nurses per 100,000 population in 2018 was $r=0.03$ that between the capacity for admission

Table 1. The total numbers and distributions(CVs)of dental hygienists and dental technicians per 100,000 population in 1998, 2008 and 2018

	1998				2008				2018			
	dental hygienis		prosthetist		dental hygienist		prosthetist		dental hygienist		prosthetist	
	Index		Index		Index		Index		Index		Index	
total	48.5	100.0	28.9	100.0	75.5	100.0	27.7	100.0	104.9	100.0	27.3	100.0
national												
Hokkaido	57.4	118.4	35.9	124.2	85.3	113.0	35.9	129.6	115.9	110.5	37.1	135.9
Aomori	27.9	57.5	44	152.2	50.2	66.5	41.8	150.9	73.3	69.9	42.2	154.6
Iwate	43.4	89.5	40.2	139.1	67.5	89.4	42	151.6	85	81.0	42.9	157.1
Miyagi	36.6	75.5	35.4	122.5	56.6	75.0	33.7	121.7	85.2	81.2	30.5	111.7
Akita	54	111.3	40.9	141.5	74.6	98.8	41	148.0	110.2	105.1	42.7	156.4
Yamagata	47.7	98.4	40.3	139.4	80.1	106.1	44.3	159.9	106.7	101.7	41.9	153.5
Fukushima	35.9	74.0	36.8	127.3	57.4	76.0	41.6	150.2	80.1	76.4	38.9	142.5
Ibaraki	32.8	67.6	21.5	74.4	57.3	75.9	20.7	74.7	83.5	79.6	21.7	79.5
Tochigi	45.6	94.0	28.6	99.0	66.7	88.3	26.5	95.7	93.9	89.5	24.9	91.2
Gunma	51.6	106.4	29.2	101.0	81.5	107.9	28.5	102.9	113.2	107.9	32.9	120.5
Saitama	33	68.0	16.2	56.1	56.6	75.0	16.4	59.2	85.8	81.8	15.5	56.8
Chiba	29.8	61.4	17.4	60.2	58.3	77.2	18	65.0	85.8	81.8	18.6	68.1
Tokyo	53.5	110.3	27.9	96.5	78.6	104.1	24.9	89.9	99.3	94.7	22.6	82.8
Kanagawa	48.3	99.6	20.2	69.9	67.5	89.4	19.5	70.4	94.2	89.8	18.8	68.9
Niigata	64.3	132.6	44.4	153.6	93.1	123.3	41.6	150.2	117.3	111.8	41.1	150.5
Toyama	56.6	116.7	44.9	155.4	82.1	108.7	40.9	147.7	107.4	102.4	39.7	145.4
Ishikawa	56.1	115.7	37	128.0	71.8	95.1	32.1	115.9	96.6	92.1	30.3	111.0
Fukui	47.1	97.1	32.3	111.8	69	91.4	33.9	122.4	94.8	90.4	34.9	127.8
Yamanashi	60.8	125.4	30.8	106.6	87	115.2	30.3	109.4	129.1	123.1	31.3	114.7
Nagano	64.9	133.8	32.1	111.1	95.8	126.9	31.2	112.6	124.9	119.1	31.8	116.5
Gifu	59.2	122.1	32.9	113.8	97.3	128.9	31.2	112.6	140.4	133.8	31.5	115.4
Shizuoka	39.9	82.3	30.3	104.8	66.2	87.7	28.2	101.8	99	94.4	26.7	97.8
Aichi	33	68.0	24.3	84.1	41.3	54.7	20	72.2	88.7	84.6	22.1	81.0
Mie	46.7	96.3	30.2	104.5	77.1	102.1	26.7	96.4	113.3	108.0	28.8	105.5
Shiga	48.7	100.4	20.7	71.6	74.5	98.7	29	104.7	98.2	93.6	26.6	97.4
Kyoto	13.7	28.2	14.8	51.2	61.4	81.3	22.1	79.8	93.6	89.2	21.5	78.8
Osaka	43	88.7	25.3	87.5	79.8	105.7	26.8	96.8	96.4	91.9	25.8	94.5
Hyogo	39	80.4	22.8	78.9	70.9	93.9	22.3	80.5	108.6	103.5	22.2	81.3
Nara	47.9	98.8	23.6	81.7	79.3	105.0	22.4	80.9	109	103.9	18.8	68.9
Wakayama	45.4	93.6	33.1	114.5	75.5	100.0	33.5	120.9	112.3	107.1	31.8	116.5
Tottori	90.6	186.8	48.5	167.8	118.7	157.2	46.6	168.2	148.8	141.8	46.6	170.7
Shimane	71.9	148.2	44.6	154.3	98.8	130.9	40.6	146.6	125.4	119.5	37.8	138.5
Okayama	77	158.8	32.3	111.8	111.4	147.5	28.9	104.3	156	148.7	30.3	111.0
Hiroshima	67.5	139.2	37.7	130.4	95.1	126.0	34.6	124.9	134.6	128.3	35.1	128.6
Yamaguchi	52.8	108.9	35.6	123.2	84.8	112.3	34.8	125.6	112.3	107.1	34.5	126.4
Tokushima	87.1	179.6	46.5	160.9	127.5	168.9	49.9	180.1	167.8	160.0	61.7	226.0
Kagawa	66.3	136.7	42.1	145.7	109.6	145.2	47.7	172.2	146.9	140.0	58.3	213.6
Ehime	48.8	100.6	37.9	131.1	87.3	115.6	37.6	135.7	118.4	112.9	39.3	144.0
Kochi	81.5	168.0	39.9	138.1	111.3	147.4	31	111.9	142.1	135.5	33.3	122.0
Fukuoka	64.3	132.6	32.8	113.5	93.9	124.4	26.6	96.0	124.8	119.0	28.7	105.1
Saga	72.1	148.7	36.5	126.3	115.2	152.6	34.3	123.8	147.6	140.7	30	109.9
Nagasaki	54.2	111.8	32.3	111.8	92.3	122.3	29.9	107.9	131.5	125.4	29.4	107.7
Kumamoto	62.7	129.3	32.5	112.5	105.2	139.3	36.3	131.0	140.5	133.9	30.1	110.3
Oita	79.8	164.5	45	155.7	107.4	142.3	49.1	177.3	131.4	125.3	52.8	193.4
Miyazaki	78.1	161.0	34.5	119.4	112.8	149.4	29.5	106.5	137.3	130.9	32.2	117.9
Kagoshima	55.4	114.2	33.2	114.9	80.7	106.9	27.1	97.8	116.8	111.3	27.5	100.7
Okinawa	45	92.8	20.7	71.6	56.6	75.0	18.6	67.1	89.6	85.4	15.9	58.2
CV	30.7		25.9		24.5		27.2		20.1		31.3	

Table 2-1. The total national numbers and distributions(CVs) for nurses and assistant nurses per 100,000 population in 1998, 2008 and 2018

	1998				2008				2018			
	nurse		assistant nurse		nurse		assistant nurse		nurse		assistant nurse	
	Index		Index		Index		Index		Index		Index	
total national	470.0	100.0	309.4	100.0	687.0	100.0	293.7	100.0	963.8	100.0	240.8	100.0
Hokkaido	560.0	119.1	437.9	141.5	849.1	123.6	408.6	139.1	1219.4	126.5	315.9	131.2
Aomori	524.0	111.5	393.2	127.1	768.8	111.9	449.3	153.0	1033.1	107.2	387.5	160.9
Iwate	631.4	134.3	295.1	95.4	853.6	124.3	261.7	89.1	1098.9	114.0	235.7	97.9
Miyagi	418.0	88.9	300.8	97.2	624.6	90.9	309.4	105.3	867.3	90.0	239.4	99.4
Akita	550.1	117.0	320.5	103.6	813.7	118.4	332.4	113.2	1153.0	119.6	320.7	133.2
Yamagata	540.1	114.9	278.3	89.9	787.1	114.6	289.7	98.6	1076.2	111.7	253.6	105.3
Fukushima	447.8	95.3	408.0	131.9	657.1	95.6	425.3	144.8	920.7	95.5	357.0	148.3
Ibaraki	328.8	70.0	265.0	85.6	525.0	76.4	291.6	99.3	765.5	79.4	246.6	102.4
Tochigi	376.0	80.0	327.0	105.7	600.4	87.4	346.3	117.9	846.8	87.9	301.3	125.1
Gunma	391.5	83.3	378.2	122.2	665.1	96.8	403.7	137.5	974.5	101.1	381.6	158.5
Saitama	272.1	57.9	220.5	71.3	445.0	64.8	215.6	73.4	693.6	72.0	190.5	79.1
Chiba	319.2	67.9	198.6	64.2	479.8	69.8	191.8	65.3	722.7	75.0	155.5	64.6
Tokyo	475.6	101.2	172.1	55.6	606.8	88.3	131.1	44.6	792.3	82.2	90.9	37.7
Kanagawa	376.0	80.0	147.4	47.6	515.8	75.1	124.9	42.5	738.4	76.6	93.3	38.7
Niigata	477.8	101.7	312.5	101.0	708.4	103.1	303.5	103.3	1010.8	104.9	249.7	103.7
Toyama	590.1	125.6	337.4	109.0	853.8	124.3	343.8	117.1	1211.1	125.7	298.3	123.9
Ishikawa	644.7	137.2	374.2	120.9	927.1	134.9	322.9	109.9	1278.7	132.7	262.6	109.1
Fukui	520.2	110.7	416.5	134.6	806.0	117.3	416.4	141.8	1161.8	120.5	365.6	151.8
Yamanashi	462.1	98.3	252.8	81.7	687.3	100.0	267.5	91.1	1006.5	104.4	254.3	105.6
Nagano	504.3	107.3	238.5	77.1	785.2	114.3	257.8	87.8	1083.3	112.4	233.9	97.1
Gifu	384.6	81.8	307.5	99.4	588.7	85.7	298.4	101.6	848.8	88.1	276.8	115.0
Shizuoka	440.5	93.7	198.2	64.1	619.7	90.2	201.9	68.7	900.1	93.4	173.7	72.1
Aichi	401.3	85.4	258.6	83.6	576.8	84.0	222.9	75.9	814.5	84.5	179.0	74.3
Mie	415.3	88.4	309.9	100.2	636.0	92.6	313.0	106.6	945.3	98.1	270.2	112.2
Shiga	491.8	104.6	167.3	54.1	748.5	109.0	162.1	55.2	999.0	103.7	120.9	50.2
Kyoto	510.7	108.7	265.7	85.9	787.9	114.7	251.6	85.7	1089.8	113.1	191.7	79.6
Osaka	443.7	94.4	268.1	86.7	661.9	96.3	252.7	86.0	942.0	97.7	176.9	73.5
Hyogo	456.8	97.2	272.6	88.1	680.7	99.1	245.0	83.4	996.7	103.4	192.6	80.0
Nara	408.3	86.9	235.9	76.2	646.0	94.0	221.3	75.3	964.7	100.1	154.1	64.0
Wakayama	429.6	91.4	436.9	141.2	745.5	108.5	421.4	143.5	1154.5	119.8	334.5	138.9
Tottori	620.7	132.1	373.3	120.7	892.9	130.0	415.8	141.6	1282.1	133.0	393.4	163.4
Shimane	618.9	131.7	447.9	144.8	918.2	133.7	463.6	157.8	1289.6	133.8	426.8	177.2
Okayama	644.7	137.2	360.5	116.5	912.2	132.8	310.2	105.6	1239.4	128.6	237.6	98.7
Hiroshima	510.1	108.5	468.0	151.3	779.6	113.5	461.8	157.2	1102.1	114.3	396.2	164.5
Yamaguchi	582.6	124.0	496.8	160.6	891.2	129.7	502.5	171.1	1263.6	131.1	482.5	200.4
Tokushima	660.6	140.6	530.0	171.3	899.2	130.9	544.8	185.5	1235.2	128.2	488.6	202.9
Kagawa	649.1	138.1	388.6	125.6	872.3	127.0	429.6	146.3	1195.5	124.0	415.9	172.7
Ehime	617.8	131.4	503.0	162.6	902.6	131.4	451.2	153.6	1245.5	129.2	398.6	165.5
Kochi	665.3	141.6	622.2	201.1	1031.8	150.2	584.0	198.8	1511.0	156.8	485.8	201.7
Fukuoka	617.0	131.3	454.2	146.8	880.7	128.2	419.4	142.8	1189.2	123.4	342.5	142.2
Saga	622.4	132.4	556.6	179.9	931.7	135.6	548.7	186.8	1335.4	138.6	553.0	229.7
Nagasaki	602.0	128.1	553.4	178.9	961.5	140.0	595.1	202.6	1319.2	136.9	519.5	215.7
Kumamoto	675.0	143.6	572.4	185.0	962.0	140.0	575.0	195.8	1309.7	135.9	556.4	231.1
Oita	592.7	126.1	496.3	160.4	888.8	129.4	506.2	172.4	1276.2	132.4	485.0	201.4
Miyazaki	598.3	127.3	592.6	191.5	938.9	136.7	617.1	210.1	1298.1	134.7	571.4	237.3
Kagoshima	609.7	129.7	652.4	210.9	959.6	139.7	641.7	218.5	1394.3	144.7	550.2	228.5
Okinawa	501.5	106.7	342.6	110.7	758.6	110.4	360.9	122.9	1060.6	110.0	259.4	107.7
CV	20.5		35.2		19.2		36.7		18.3		41.5	

Table 2-2. The total national numbers and distributions(CVs)for public health nurses and midwives per 100,000 population in 1998, 2008 and 2018

	1998				2008				2018			
	public health nurse		midwives		public health nurse		midwives		public health nurse		midwives	
	Index		Index		Index		Index		Index		Index	
total national	27.3	100.0	19.1	100.0	34.0	100.0	21.8	100.0	41.9	100.0	29.2	100.0
Hokkaido	38.2	139.9	22.2	116.2	49.2	144.7	27.0	123.9	59.3	141.5	31.6	108.2
Aomori	34.9	127.8	24.0	125.7	43.2	127.1	21.5	98.6	54.2	129.4	26.7	91.4
Iwate	43.4	159.0	27.6	144.5	46.0	135.3	23.9	109.6	60.0	143.2	32.3	110.6
Miyagi	32.9	120.5	25.5	133.5	37.6	110.6	26.8	122.9	47.5	113.4	31.4	107.5
Akita	44.1	161.5	23.9	125.1	46.3	136.2	26.6	122.0	59.6	142.2	32.8	112.3
Yamagata	37.5	137.4	22.9	119.9	46.3	136.2	26.2	120.2	57.2	136.5	32.2	110.3
Fukushima	33.8	123.8	21.1	110.5	41.8	122.9	20.0	91.7	56.9	135.8	27.5	94.2
Ibaraki	26.1	95.6	12.3	64.4	31.9	93.8	16.8	77.1	40.1	95.7	25.7	88.0
Tochigi	26.5	97.1	15.7	82.2	35.5	104.4	18.1	83.0	49.0	116.9	27.6	94.5
Gunma	31.9	116.8	15.5	81.2	42.7	125.6	18.6	85.3	51.2	122.2	26.3	90.1
Saitama	15.1	55.3	11.5	60.2	22.7	66.8	16.2	74.3	30.3	72.3	23.1	79.1
Chiba	20.9	76.6	13.4	70.2	28.5	83.8	16.2	74.3	33.3	79.5	23.9	81.8
Tokyo	20.9	76.6	21.0	109.9	23.9	70.3	22.8	104.6	28.4	67.8	29.6	101.4
Kanagawa	15.9	58.2	16.8	88.0	20.5	60.3	19.0	87.2	23.5	56.1	25.5	87.3
Niigata	36.2	132.6	31.4	164.4	42.7	125.6	30.9	141.7	54.3	129.6	34.0	116.4
Toyama	37.8	138.5	29.6	155.0	48.9	143.8	32.0	146.8	59.1	141.1	41.0	140.4
Ishikawa	32.3	118.3	20.2	105.8	40.8	120.0	26.5	121.6	49.7	118.6	30.5	104.5
Fukui	37.2	136.3	19.3	101.0	56.4	165.9	23.9	109.6	61.6	147.0	32.0	109.6
Yamanashi	52.6	192.7	18.0	94.2	60.5	177.9	20.2	92.7	76.5	182.6	31.9	109.2
Nagano	46.0	168.5	23.9	125.1	58.5	172.1	28.9	132.6	77.2	184.2	42.5	145.5
Gifu	29.5	108.1	21.3	111.5	42.2	124.1	22.4	102.8	49.5	118.1	31.6	108.2
Shizuoka	24.5	89.7	18.9	99.0	35.7	105.0	18.6	85.3	47.0	112.2	27.3	93.5
Aichi	20.2	74.0	16.4	85.9	27.1	79.7	21.0	96.3	36.2	86.4	29.7	101.7
Mie	23.4	85.7	11.8	61.8	33.4	98.2	15.9	72.9	40.9	97.6	24.8	84.9
Shiga	36.9	135.2	19.7	103.1	44.2	130.0	23.9	109.6	50.6	120.8	35.1	120.2
Kyoto	29.0	106.2	22.7	118.8	35.2	103.5	28.4	130.3	45.8	109.3	34.6	118.5
Osaka	16.6	60.8	20.0	104.7	20.5	60.3	24.1	110.6	25.9	61.8	30.7	105.1
Hyogo	21.8	79.9	18.2	95.3	25.0	73.5	19.2	88.1	32.1	76.6	28.2	96.6
Nara	26.7	97.8	18.3	95.8	32.7	96.2	21.0	96.3	41.0	97.9	27.5	94.2
Wakayama	30.6	112.1	19.2	100.5	43.4	127.6	23.5	107.8	52.9	126.3	30.7	105.1
Tottori	40.3	147.6	27.6	144.5	49.2	144.7	29.1	133.5	59.3	141.5	42.7	146.2
Shimane	54.0	197.8	28.1	147.1	59.3	174.4	30.6	140.4	79.3	189.3	47.9	164.0
Okayama	37.0	135.5	17.5	91.6	46.9	137.9	22.2	101.8	53.6	127.9	28.4	97.3
Hiroshima	33.0	120.9	19.1	100.0	35.2	103.5	17.5	80.3	46.1	110.0	24.1	82.5
Yamaguchi	39.0	142.9	22.6	118.3	50.7	149.1	26.0	119.3	55.5	132.5	30.9	105.8
Tokushima	37.7	138.1	26.4	138.2	45.7	134.4	24.7	113.3	55.8	133.2	37.0	126.7
Kagawa	38.7	141.8	18.4	96.3	50.2	147.6	24.6	112.8	58.5	139.6	32.7	112.0
Ehime	34.1	124.9	18.0	94.2	44.8	131.8	19.5	89.4	51.9	123.9	24.8	84.9
Kochi	47.5	174.0	16.9	88.5	54.7	160.9	21.6	99.1	73.9	176.4	27.1	92.8
Fukuoka	23.0	84.2	19.8	103.7	29.9	87.9	21.2	97.2	35.8	85.4	28.4	97.3
Saga	39.3	144.0	14.9	78.0	53.2	156.5	20.2	92.7	60.2	143.7	28.9	99.0
Nagasaki	33.8	123.8	17.5	91.6	44.6	131.2	24.2	111.0	56.2	134.1	33.0	113.0
Kumamoto	34.0	124.5	17.9	93.7	44.4	130.6	18.5	84.9	56.5	134.8	26.6	91.1
Oita	38.4	140.7	20.1	105.2	46.8	137.6	21.0	96.3	58.7	140.1	29.3	100.3
Miyazaki	33.3	122.0	16.8	88.0	45.7	134.4	21.4	98.2	62.3	148.7	29.7	101.7
Kagoshima	35.1	128.6	22.0	115.2	45.6	134.1	27.4	125.7	58.3	139.1	38.8	132.9
Okinawa	32.2	117.9	20.6	107.9	36.9	108.5	22.8	104.6	53.0	126.5	30.9	105.8
CV	27.1		22.5		24.7		18.2		24.8		17.0

Fig. 1. The 2008 and 2018 indices calculated with the number of employees in each of the six employment categories in 1998 set as 100.

Fig. 2. The correlation coefficient in 47 prefectures between the capacity for admission at training facilities for dental hygienists and dental hygienists per 100,000 population in 2018

at training facilities for midwives and midwives per 100,000 population in 2018 was $r=0.18$ (Fig. 4, Fig. 5, Fig. 6, Fig. 7).

The number of employed dental hygienists and dental technicians (number of license holders) in 1998, 2008, and 2018 (Fig. 8) was given. In 2018, the number of employed dental hygienists and dental technicians (number of license holders) was 132,629 (282,988) and 34,468 (120,157), respectively. In 1998, 2008, and 2018, the ratios of the number of employees to the number of license holders were 38.9%, 43.4%, and 46.9% for dental hygienists and 42.7%, 32.6%, and 28.7% for dental technicians, respectively (Fig. 9).

Discussion

Universities have begun offering dental hygiene courses, which is a great step forward for the specialists in the field; moreover, the requirements of dental hygiene professors will likely be different at universities than that of

Fig. 3. The correlation coefficient in 47 prefectures between the capacity for admission at training facilities for dental technicians and dental technicians per 100,000 population in 2018

Fig. 4. The correlation coefficient in 47 prefectures between the capacity for admission at training facilities for nurses and nurses per 100,000 population in 2018

their current level at vocational schools (1,2). The tasks of dental hygienists may vary depending on their place of employment. However, there is a widely recognized tendency toward increasing workload and diversification, wherein new tasks are added. Furthermore, the amount of collaborative work undertaken by professionals belonging to different categories is increasing, and planning, coordination, and evaluation skills are being sought-along with practical expertise-in fields such as administration, hospital care, dentistry services for disabled patients, and nursing home care services (1,2).

In recent years, it has been difficult to ensure sufficient staffing of dental hygienists, with significant shortages, particularly in dental clinics (1,14). While this situation

Fig. 5. The correlation coefficient in 47 prefectures between the capacity for admission at training facilities for assistant nurses and assistant nurses per 100,000 population in 2018

Fig. 6. The correlation coefficient in 47 prefectures between the capacity for admission at training facilities for public health nurses and public health nurses per 100,000 population in 2018

Fig. 7. The correlation coefficient in 47 prefectures between the capacity for admission at training facilities for midwives and midwives per 100,000 population in 2018

Fig. 8. The number of employed dental hygienists and dental technicians (number of license holders) in 1998, 2008, and 2018

Fig. 9. The ratios of the number of employees to the number of license holders for dental hygienists and for dental technicians in 1998, 2008 and 2018

was thought to exist throughout Japan, reported on geographical distribution indicate that the number of dental hygienists per 100,000 people was higher in West Japan than in East Japan (1,4,14). There was a concentration of dental assistants in East Japan, but this was not the case for dental technicians. The same geographical distribution was not found for dental clinics, which employ large numbers of dental hygienists. Existing research on the trends in numbers of dental hygienists and dental technicians per dental clinic from 1975 through 2015 showed that in recent years (4,14), the number of dental hygienists is increasing, while the number of dental technicians is on the decline. Furthermore, reports on the distribution of the number of dental hygienists and technicians per 100,000 people by municipality suggested that there were high numbers of dental hygienists in the Chugoku and Kyushu regions while there were more dental technicians in the Tohoku, Hokuriku, Chugoku, and Kyushu regions (1,14). With regard to the factors in the concentration of dental

hygienists in West Japan, a positive correlation was founded between the number of dental hygienists viewed by prefecture and the number of dental hygienists trained; that was, because there were more graduates from dental hygienist training facilities in West Japan, the number of dental hygienists hired by dental clinics was higher as well(1,4,14).

With regard to the distribution of hospital nurses by region, the reports showed significantly higher numbers outside the Kanto region(3). The distribution of nurses by prefecture in relation to the population sizes has been reported to be lower in the Kanto and Tokai regions and higher in the San'in and Shikoku regions(1,3). Other reports showed a significant difference even when adjusted for socioeconomic characteristics such as population density and income level in the secondary medical area and for factors relating to nurse supply and demand; regions apparently have independent relations with hospital nurse supply and demand(1,3). Presently, policies are being enacted toward ensuring that nursing personnel staffing includes enhanced support for returning to work, work environment improvements to increase retention and to prevent employee resignations, and expanded training to new staff(1,15). It has been shown that the number of working nurses in each prefecture was related to the number of entrants to nursing schools and training facilities, and it has been reported that increasing the number of trained nurses, a supply factor, was related to the increase in the number of hospital nurses(1,3,15).

According to the Cabinet Office Gender Equality Bureau "White Paper on Gender Equality 2013" and "Background of Labour Force Participation Rate of Women (M-shaped Curve)," based on data from the Ministry of Internal Affairs and Communications' Labor Force Survey, in recent years, the trough of the M-curve was growing shallower in comparison to the peaks(16). The white paper also noted characteristics by generation: "When examining the labour force participation rate of women by cohort(generation), younger cohorts have higher peaks and a shallower bottom at older ages." It also emphasized the usefulness of analysis by generation(16). The trends reported in the numbers of working dental hygienists viewed by generational cohort match the Cabinet Office paper regarding the M-shaped curve as noted in the White Paper(15). In addition, other reports on the employment status of dental hygienists have confirmed a na-

tionwide decrease in employed workers in their 20s and 30s and an increase in those in their 40s(4,14). However, with regard to dental technicians, both men and women may be more likely to leave their jobs as they grow older. These results indicated that within the dental profession, employment continuity was a particular problem with regard to the profession of the dental technician(1,4,14).

This study analyzed the geographical distribution of dental hygienists and nurses and the correlation between the two. The importance of cross-professional collaboration between dental hygienists and nurses through oral care, in particular, has been increasing in recent years. Clinical settings commonly involve interventions in everyday oral care by ward nurses and specialist oral care by dental professionals(17–19). It is important that nurses gain basic knowledge of techniques of oral care while also acquiring the ability to make judgments to be able to request that senior dental professionals handle patients with difficult issues in oral care(18,19). Past reports showed that several nurses tending to inpatients requiring specialist oral care from dentists and dental hygienists found improvements in their patients'oral hygiene status by assigning a full-time dental hygienist for oral care interventions early in the acute stage(18,19). It has been evidenced that dental professionals generally lack the knowledge and experience in pathologies for disease and general care, and their combined insufficient understanding of nursing care presents obstacles to care. Therefore, team-based medical care, making the most of both specializations, is considered necessary. It is important to achieve cross-professional collaboration between dental hygienists and nurses in medical settings across all regions, as well as employing and training sufficient personnel, preventing early resignations, and providing support for returning to work.

In this study, a small coefficient of variation(CV) was found for the distribution of dental hygienists by prefecture between 1998 and 2018, and the CV was almost equal for the distribution of nurses, which remained practically unchanged. Dental hygienists have tended to develop a less locally uneven distribution than before. However, there has been a tendency for the locally uneven distribution of dental technicians to increase. The uneven local distribution of nurses, public health nurses, and midwives has either remained constant or decreased, and an

increasing trend has been observed for locally uneven distribution among assistant nurses. The numbers for nurses and assistant nurses by prefecture highly correlated with the enrolment capacity of local training facilities. This correlation was found to be higher than that between dental hygienists and dental technicians and training school capacity in the dental field. On the contrary, no significant correlations were found for public health nurses and midwives. In contrast with universities that train physicians and dentists, which usually function near enrolment capacity, the number of training facilities increases or decreases each year, most facilities do not achieve full enrollment capacity, and a large number of people leave or change work, all of which leads to differences in correlation. Differences were observed in the number of workers by occupation over the last 20 years: The number of dental hygienists and nurses more than doubled; the number of public health nurses and midwives increased about 1.5 times; and the number of assistant nurses and dental technicians decreased. This study showed that the ratios of the number of employees to the number of license holders in 1998, 2008, and 2018 were 38.9%, 43.4%, and 46.9% for dental hygienists and 42.7%, 32.6%, and 28.7% for dental technicians, respectively. Thus, the percentage of employment has been increasing for dental hygienists but decreasing for dental technicians. Measures are currently in place to control early retirement and support those who wish to return to work. Future studies should compare job profiles in the dental and medical fields and analyze factors that contribute to job transition, attrition, and return to work. Measures to deal with these factors should also be assessed.

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Conflict of Interest

There are no conflicts of interest to declare.

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