


## ORIGINAL ARTICLE

# Comparison of the risk of developing lumbar herniated intervertebral disc between dentists and other occupations: A nationwide population-based study in Taiwan

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## Funding information

Chi-Mei Medical Center, Grant/Award Number: 106CM-KMU-13; Kaohsiung Medical University Research Foundation, Grant/Award Number: KMU-Q105015

## Abstract

**Objectives:** Dentists may have a higher risk of developing lumbar herniated intervertebral disc (HIVD) due to prolonged sitting and improper postures during work. We conducted this study to delineate this issue, which is still unclear.

**Methods:** This nationwide population-based study was conducted using Taiwan National Health Insurance Research Database. We identified 10 734 dentists, 72 066 non-dentist health-care providers (HCPs), and an identical number of age- and gender-matched participants from the general population. The risk of developing lumbar HIVD among dentists, non-dentist HCPs, and general population was compared by tracing their medical histories between 2007 and 2011.

**Results:** The cumulative incidence rate of lumbar HIVD among dentists during the 5-year follow-up period was 1.40%. After adjusting for age, gender, and

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comorbidities, the risk of developing lumbar HIVD was found to be lower among dentists than that among the general population (adjusted odds ratio [AOR]: 0.80, 95% confidence interval [CI]: 0.64-1.00) and non-dentist HCPs (AOR: 0.81, 95% CI: 0.68-0.96).

**Conclusions:** Dentists in Taiwan have a lower risk of developing lumbar HIVD than that among other occupations. Although this result is different from the general cognition, it does not imply that the prevention of lumbar HIVD in dentists is not important. Further studies are warranted to better address this issue.

#### KEYWORDS

dentist, health-care provider, herniated intervertebral disc, lumbar

## 1 | INTRODUCTION

Herniated intervertebral disc of the lumbar spine (lumbar HIVD), which is one of the most serious causes of low back pain, indicates the displacement of cartilage, fluid, or bone of an intervertebral disc outside the borders of the disc space or its joints.<sup>1</sup> Lumbar HIVD has been reported to be the most common cause for performing lumbar spine surgery in working-age individuals.<sup>2</sup> It has been observed that patients develop a herniated disc at an average age of 41 years, with the diagnosis being slightly more common in men than in women.<sup>3</sup> An elevated body mass index (BMI) and being overweight (BMI: 25-30) and obese (BMI > 30) have been considered as the most important risk factors contributing to lumbar HIVD.<sup>4-6</sup> Being overweight also increases the risk for recurrent herniation after microdiscectomy.<sup>4-6</sup> Medical comorbidities such as diabetes and hyperlipidemia have also been reported as the risk factors for lumbar HIVD.<sup>7,8</sup>

Several studies have proposed that lumbar HIVD is associated with the occupation or work content. A statistically significant positive association has been observed between lumbar HIVD and forward bending as well as accumulated weight lifting or carrying.<sup>9</sup> Health-care providers (HCPs) have a high risk of developing lumbar HIVD because of their usual patient handling procedures such as lifting and moving patients.<sup>10-12</sup> Dentists have been reported to have a high risk of developing musculoskeletal disorders because of prolonged static and improper sitting postures and body movements that cause extra musculoskeletal loading.<sup>13,14</sup> The most prevalent musculoskeletal disorders among dentists, which also interfered with their daily activities, have been reported at the neck, lower back, and shoulder.<sup>14,15</sup> However, most of the previous studies have included all types of musculoskeletal disorders and did not focus on lumbar HIVD alone.<sup>14,15</sup> In addition, no study has yet compared the risk of developing lumbar HIVD between dentists and other occupations. Therefore, we conducted this nationwide population-based study to clarify this issue.

## 2 | MATERIALS AND METHODS

### 2.1 | Data sources

This study was conducted based on the Taiwan National Health Insurance Research Database (NHIRD). Taiwan has a single-payer National Health Insurance program that includes approximately the entire Taiwan population.<sup>16</sup> The NHIRD containing registration files and original claims data for reimbursement is provided to the scientists in Taiwan for research purposes after de-identification.<sup>16</sup>

### 2.2 | Identification of dentists, non-dentist HCPs, and general population

An identical number of age- and gender-matched dentists and participants from the general population (non-HCPs) were identified from the NHIRD. In addition, an identical number of non-dentist HCPs and participants was identified from the general population after matching for age and gender. The non-dentist HCPs were included in this study because this population has a similar working environment and socioeconomic status to those of the dentists, which may help eliminate the potential confounders. The non-dentist HCPs included physicians, pharmacists, medical technicians, audiologists, consultant experts, clinical experts, dietitians, social workers, and language experts. Participants who had been diagnosed with lumbar HIVD (ICD-9-CM codes: 722.10, 722.52, 722.73, and 722.93) before 2007 were excluded. The criteria for diagnosing lumbar HIVD were based on the diagnosis on admission or ambulatory care for at least one time. Age subgroups were categorized as  $\leq 34$ , 35-59, and  $\geq 60$  years. Comorbidities were defined as diabetes (ICD-9-CM code 250), hypertension (ICD-9-CM code: 401-405), hyperlipidemia (ICD-9-CM code: 272), malignancy (ICD-9-CM code: 140-208), stroke (ICD-9-CM code: 436-438), coronary artery disease (CAD) (ICD-9-CM code: 410-414), chronic obstructive pulmonary disease (COPD) (ICD-9-CM code: 496), liver disease (ICD-9-CM code: 570-576), renal disease (ICD-9-CM code: 580-593),

and mental disorder (ICD-9-CM code: 290-319), which were identified as possible confounding factors for this study. The comorbidities included in this study were based on the diagnosis of these diseases on admission for at least one time or ambulatory care for at least three times. Residential areas were divided into north, center, south, and east. In total, 10 734 dentists, 72 066 non-dentist HCPs, and an identical number of age- and gender-matched participants from the general population were identified for this study.

### 2.3 | Comparison of the risk of developing lumbar HIVD

The risk of developing lumbar HIVD was compared between dentists and general population, between non-dentist HCPs and general population, and between dentists and non-dentist HCPs by following up their medical histories between 2007 and 2011. Stratified analyses for age and gender subgroups were also performed to assess whether age and gender were effect modifiers.

### 2.4 | Ethics statement

This study was strictly conducted according to the Declaration of Helsinki and approved by the Institutional Review Board at Chi-Mei Medical Center. As the NHIRD contains de-identified information, informed consents from the participants are waived, which does not affect the rights and welfare of the participants.

### 2.5 | Statistical analysis

We used an independent *t* test for continuous variables and a chi-square test for categorical variables in the comparison of demographic characteristics, comorbidities, and residential areas among dentists, non-dentist HCPs, and the general population. For comparing the risk of developing lumbar HIVD between dentists and general population and between non-dentist HCPs and general population, conditional logistic regression analysis was performed by adjusting for diabetes, hypertension, hyperlipidemia, malignancy, stroke, CAD,

**TABLE 1** Demographic characteristics and comorbidities of dentists, non-dentist HCPs, and general population

	Dentists (n = 10 734)	General population (n = 10 734)	<i>p</i> -value	Non-dentist HCPs (n = 72 066)	General population (n = 72 066)	<i>p</i> -value
Age (y)	43.72 ± 11.32	43.72 ± 11.32	>0.999	42.52 ± 12.16	42.52 ± 12.16	>0.999
Age (y)						
≤34	2873 (26.77)	2873 (26.77)	>0.999	22581 (31.33)	22581 (31.33)	>0.999
35-59	6972 (64.95)	6972 (64.95)		43394 (60.22)	43394 (60.22)	
≥60	889 (8.28)	889 (8.28)		6091 (8.45)	6091 (8.45)	
Gender						
Male	8117 (75.62)	8117 (75.62)		44524 (61.78)	44524 (61.78)	
Female	2617 (24.38)	2617 (24.38)	>0.999	27542 (38.22)	27542 (38.22)	>0.999
Comorbidity						
Diabetes	788 (7.34)	881 (8.21)	0.018	4311 (5.98)	4879 (6.77)	<0.001
Hypertension	1923 (17.92)	1754 (16.34)	0.002	11808 (16.38)	10269 (14.25)	<0.001
Hyperlipidemia	1546 (14.40)	1211 (11.28)	<0.001	9966 (13.83)	6840 (9.49)	<0.001
Malignancy	233 (2.17)	272 (2.53)	0.079	1859 (2.58)	1923 (2.67)	0.292
Stroke	204 (1.90)	319 (2.97)	<0.001	1363 (1.89)	1974 (2.74)	<0.001
CAD	562 (5.24)	466 (4.34)	0.002	3130 (4.34)	2978 (4.13)	0.047
COPD	469 (4.37)	613 (5.71)	<0.001	5010 (6.95)	4241 (5.88)	<0.001
Liver disease	1154 (10.75)	1040 (9.69)	0.010	7147 (9.92)	6314 (8.76)	<0.001
Renal disease	122 (1.14)	152 (1.42)	0.068	879 (1.22)	1088 (1.51)	<0.001
Mental disorder	894 (8.33)	1173 (10.93)	<0.001	8765(12.16)	7906 (10.97)	<0.001
Living area						
North	5735 (53.43)	5612 (52.28)	<0.001	34040 (47.23)	38391 (53.27)	<0.001
Center	2032 (18.93)	1901 (17.71)		14375 (19.95)	12615 (17.51)	
South	2801 (26.09)	3003 (27.98)		21971 (30.49)	19670 (27.29)	
East	166 (1.55)	218 (2.03)		1680 (2.33)	1390 (1.93)	

Data are number (%) or mean ± SD.

CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; HCP, health-care provider.

COPD, liver disease, renal disease, and mental disorder. The risk of developing lumbar HIVD was compared between dentists and non-dentist HCPs using unconditional logistic regression analysis by adjusting for age, gender, diabetes, hypertension, hyperlipidemia, malignancy, stroke, CAD, COPD, liver disease, renal disease, and mental disorder. SAS 9.4 for Windows (SAS Institute, Cary, NC, USA) was used for all analyses, and the significance level was set at 0.05 (two tails).

### 3 | RESULTS

We identified a total of 10 734 dentists and 10 734 age- and gender-matched participants from the general population for the comparisons (Table 1). The mean age ( $\pm$ SD) of the dentists was  $43.72 \pm 11.32$  years. In terms of age subgroups, 26.77% of them were aged  $\leq 34$  years, 64.95% were aged 35–59 years, and 8.28% were aged  $\geq 60$  years. The majority of dentists were men (75.62%). Dentists had a significantly increased proportion of comorbidities of hypertension (17.92% vs 16.34%), hyperlipidemia (14.40% vs 11.28%), CAD (5.24% vs 4.34%), and liver

disease (10.75% vs 9.69%) but a decreased proportion of comorbidities of diabetes (7.34% vs 8.21%), stroke (1.90% vs 2.97%), COPD (4.37% vs 5.71%), and mental disorder (8.33% vs 10.93%) than that among the general population. Regarding the comparison of residential areas, more number of dentists was living in the northern and central areas than that among the general population. We also identified 72 066 non-dentist HCPs and identical numbers of age- and gender-matched participants from the general population for the comparisons (Table 1). The mean age ( $\pm$ SD) of these individuals was  $42.52 \pm 12.16$  years. Regarding age subgroups, 31.33% of them were aged  $\leq 34$  years, 60.22% were aged 35–59 years, and 8.45% were aged  $\geq 60$  years. There was a predominance of male non-dentist HCPs (61.78%). Non-dentists HCPs had an increased proportion of comorbidities of hypertension (16.38% vs 14.25%), hyperlipidemia (13.83% vs 9.49%), CAD (4.34% vs 4.13%), COPD (6.95% vs 5.88%), liver disease (9.92% vs 8.76%), and mental disorder (12.16% vs 10.97%), but a decreased proportion of comorbidities of diabetes (5.98% vs 6.77%), stroke (1.89% vs 2.74%), and renal disease (1.22% vs 1.51%) than that among the general population. Regarding the comparison of

**TABLE 2** Comparison of the risk of developing lumbar HIVD between dentists and general population by conditional logistic regression analysis

Variable	Number (%)	OR (95% CI)	AOR (95% CI) <sup>a</sup>	<i>p</i> -value <sup>b</sup>
Dentists (n = 10 734)	150 (1.40)	0.81 (0.66–1.01)	0.80 (0.64–1.00)	0.049
General population (n = 10 734)	184 (1.71)	1.00	1.00	
Age subgroup				
$\leq 34$ y				
Dentists (n = 2873)	26 (0.90)	0.87 (0.51–1.47)	0.83 (0.49–1.40)	0.481
General population (n = 2873)	30 (1.04)	1.00	1.00	
35–59 y				
Dentists (n = 6972)	104 (1.49)	0.79 (0.61–1.02)	0.77 (0.60–1.01)	0.056
General population (n = 6972)	132 (1.89)	1.00	1.00	
$\geq 60$ y				
Dentists (n = 889)	20 (2.25)	0.91 (0.49–1.68)	0.95 (0.49–1.81)	0.866
General population (n = 889)	22 (2.47)	1.00	1.00	
Gender subgroup				
Male				
Dentists (n = 8117)	120 (1.48)	0.86 (0.67–1.09)	0.83 (0.65–1.07)	0.150
General population (n = 8117)	140 (1.72)	1.00	1.00	
Female				
Dentists (n = 2617)	30 (1.15)	0.68 (0.43–1.08)	0.71 (0.44–1.15)	0.165
General population (n = 2617)	44 (1.68)	1.00	1.00	

AOR, adjusted odds ratio; CI, confidence interval; HCP, health-care provider; HIVD, herniated intervertebral disc; OR, odds ratio.

<sup>a</sup>Adjusted for diabetes, hypertension, hyperlipidemia, malignancy, stroke, coronary artery disease, chronic obstructive pulmonary disease, liver disease, renal disease, and mental disorder.

<sup>b</sup>For AOR.

residential areas, a lesser number of non-dentists HCPs were living in the northern area than that among the general population.

During the study period between 2007 and 2011, the cumulative incidence rates of lumbar HIVD among the dentists and the general population were found to be 1.40% and 1.71%, respectively (Table 2). Dentists were found to have a lower risk of developing lumbar HIVD than did the general population after adjusting for diabetes, hypertension, hyperlipidemia, malignancy, stroke, CAD, COPD, liver disease, renal disease, and mental disorder (adjusted odds ratio [AOR]: 0.80, 95% confidence interval [CI]: 0.64-1.00,  $p$ : 0.049). Stratified analyses showed that dentists in the age subgroup of 35-59 years had a trend of lower risk of developing lumbar HIVD than that among the general population (AOR: 0.77, 95% CI: 0.60-1.01,  $p$ : 0.056).

Non-dentist HCPs did not have a higher risk of developing lumbar HIVD than that among the general population (AOR: 1.07, 95% CI: 0.98-1.16,  $p$ : 0.121) (Table 3). Stratified analyses showed that non-dentist HCPs in the age subgroup of  $\leq 34$  years had a significantly higher risk of developing lumbar HIVD than that among the general population (AOR: 1.33, 95% CI: 1.11-1.59,  $p$ : 0.003).

The risk of developing lumbar HIVD was found to be significantly lower among dentists than that among the non-dentist HCPs (AOR: 0.81, 95% CI: 0.68-0.96,  $p$ : 0.015) (Table 4). Stratified analyses revealed that male dentists had a lower risk than that among male non-dentist HCPs (AOR: 0.81, 95% CI: 0.67-0.99,  $p$ : 0.038).

## 4 | DISCUSSION

This study identified a cumulative incidence rate of 1.40% of lumbar HIVD among dentists during the 5 years of follow-up. Dentists were found to have a lower risk of developing lumbar HIVD than that among the non-dentist HCPs and the general population. Stratified analyses revealed that this lower risk among dentists compared with that among non-dentist HCPs was detected only in the male population and that only the non-dentist HCPs in the age subgroup of  $\leq 34$  years had a higher risk of developing lumbar HIVD than did the general population.

To our knowledge, this is the first study to report the incidence rate of lumbar HIVD among the dentists. Previous studies have reported that 47.6%-65.7% of dentists

**TABLE 3** Comparison of the risk of developing lumbar HIVD between non-dentist HCPs and general population by conditional logistic regression analysis

Variable	Number (%)	OR (95% CI)	AOR (95% CI) <sup>a</sup>	$p$ -value <sup>b</sup>
Non-dentist HCPs (n = 72 066)	1267 (1.76)	1.11 (1.02-1.20)	1.07 (0.98-1.16)	0.121
General population (n = 72 066)	1147 (1.59)	1.00	1.00	
Age subgroup				
$\leq 34$ y				
Non-dentist HCPs (n = 22 581)	294 (1.30)	1.35 (1.13-1.61)	1.33 (1.11-1.59)	0.003
General population (n = 22 581)	219 (0.97)	1.00	1.00	
35-59 y				
Non-dentist HCPs (n = 43 394)	809 (1.86)	1.07 (0.97-1.19)	1.02 (0.93-1.13)	0.653
General population (n = 43 394)	755 (1.74)	1.00	1.00	
$\geq 60$ y				
Non-dentist HCPs (n = 6091)	164 (2.69)	0.95 (0.77-1.17)	0.94 (0.75-1.17)	0.570
General population (n = 6091)	173 (2.84)	1.00	1.00	
Gender subgroup				
Male				
Non-dentist HCPs (n = 44 524)	846 (1.90)	1.13 (1.03-1.25)	1.07 (0.97-1.19)	0.171
General population (n = 44 524)	748 (1.68)	1.00	1.00	
Female				
Non-dentist HCPs (n = 27 542)	421 (1.53)	1.06 (0.92-1.21)	1.05 (0.91-1.20)	0.533
General population (n = 27 542)	399 (1.45)	1.00	1.00	

AOR, adjusted odds ratio; CI, confidence interval; HCP, health-care provider; HIVD, herniated intervertebral disc; OR, odds ratio.

<sup>a</sup>Adjusted for diabetes, hypertension, hyperlipidemia, malignancy, stroke, coronary artery disease, chronic obstructive pulmonary disease, liver disease, renal disease, and mental disorder.

<sup>b</sup>For AOR.

**TABLE 4** Comparison of the risk of developing lumbar HIVD between dentists and non-dentist HCPs by unconditional logistic regression analysis

Variable	Number (%)	OR (95% CI)	AOR (95% CI) <sup>a</sup>	<i>p</i> -value <sup>b</sup>
Dentists (n = 10 734)	150 (1.40)	0.79 (0.67-0.94)	0.81 (0.68-0.96)	0.015
Non-dentist HCPs (n = 72 066)	1147 (1.59)	1.00	1.00	
Age subgroup				
≤34 y				
Dentists (n = 2873)	26 (0.90)	0.69 (0.46-1.04)	0.70 (0.47-1.05)	0.081
Non-dentist HCPs (n = 22 581)	219 (0.97)	1.00	1.00	
35-59 y				
Dentists (n = 6972)	104 (1.49)	0.80 (0.65-0.98)	0.83 (0.67-1.02)	0.077
Non-dentist HCPs (n = 43,394)	755 (1.74)	1.00	1.00	
≥60 y				
Dentists (n = 889)	20 (2.25)	0.83 (0.52-1.33)	0.89 (0.56-1.43)	0.639
Non-dentist HCPs (n = 6091)	173 (2.84)	1.00	1.00	
Gender subgroup				
Male				
Dentists (n = 8117)	120 (1.48)	0.78 (0.64-0.94)	0.81 (0.67-0.99)	0.038
Non-dentist HCPs (n = 44 524)	748(1.68)	1.00	1.00	
Female				
Dentists (n = 2617)	30 (1.15)	0.75 (0.52-1.09)	0.80 (0.55-1.16)	0.234
Non-dentist HCPs (n = 27 542)	399 (1.45)	1.00	1.00	

AOR, adjusted odds ratio; CI, confidence interval; HCP, health-care provider; HIVD, herniated intervertebral disc; OR, odds ratio.

<sup>a</sup>Adjusted for age, gender, diabetes, hypertension, hyperlipidemia, malignancy, stroke, coronary artery disease, chronic obstructive pulmonary disease, liver disease, renal disease, and mental disorder.

<sup>b</sup>For AOR.

complained of low back pain, which was defined based on self-reports of the dentists.<sup>13,17,18</sup> Lumbar HIVD described in this study was diagnosed by the treating physicians, which is more reliable and specific than the previous definitions. The major risk factor and the mechanism responsible for developing a lumbar HIVD among the dentists is the prolonged static posture (PSP).<sup>13</sup> PSP may contribute to the following subsequent progressions: muscle fatigue, muscle imbalance, muscle ischemia or necrosis, pain, protective muscle contraction, and then, joint hypomobility, nerve compression, and HIVD.<sup>13</sup>

The lower risk among dentists in this study is different from the general cognition, which may be due to the fact that non-dentist HCPs and general population may have more risk factors for developing a lumbar HIVD than those among the dentists. In addition, dentists may have more health-seeking behavior, self-treatment,<sup>19,20</sup> and medical knowledge than that among the general population, which may decrease the risk of developing lumbar HIVD. In addition, some of the non-dentist HCPs, such as physicians in surgical departments, may have more working hours and other risk factors for developing lumbar HIVD than those among the dentists.<sup>21</sup> A study

in Taiwan reported that the average weekly work time among attending physicians at an academic center was 65.6 hours.<sup>21</sup> Recent studies have also shown that physicians have a higher risk of developing lumbar and cervical HIVD than that among the general population in Taiwan, which could also be attributed to the long working hours.<sup>22,23</sup>

Dentists, like physicians, may have more knowledge than the general population, which could help them reduce the risk of developing a lumbar HIVD. There are no studies regarding the comparison of diseases between dentists and general population. However, several studies have reported that physicians are at a decreased risk of developing certain diseases compared with the general population, including acute myocardial infarction, peptic ulcer disease, urolithiasis, and stroke due to their better medical knowledge.<sup>24-27</sup>

Although this study reports a novel finding using a nationwide population-based design, some limitations still exist. First, there was no detailed information regarding the occupational exposure, including the working hours per week, the years of entering the workforce, and the physical activity while working, private lifestyle,

nutrition, and BMI, which may be confounding factors for this study. However, we had adjusted for hypertension, diabetes, and hyperlipidemia, which could be the surrogates for private lifestyle, nutrition, and BMI. Second, dentists may treat themselves based on their medical knowledge, rather than seeking medical advice; therefore, using the claims data in this study might have underestimated the risk in dentists. Third, the follow-up period of 5 years may not be long enough to evaluate the effect of occupational exposure. A longer follow-up may be needed for a better evaluation. Fourth, due to the differences in occupational workload, race, culture, and medical resources, the results of this study may not be generalized to other nations.

## 5 | CONCLUSION

This is the first study comparing the risk of developing lumbar HIVD among dentists, non-dentist HCPs, and general population. In contrast to the general cognition, dentists were found to have a lower risk of developing lumbar HIVD than that among the general population and non-dentist HCPs. Additional risk factors in the general population and non-dentist HCPs when compared with the dentists may play the role. Despite this finding, it does not imply that dentists need not pay attention to their risk factors responsible for developing lumbar HIVD. These results could provide an important reference for the responsible authorities for policy making and promoting occupational health for all the HCPs. However, further studies regarding the detailed occupational exposure, with a longer follow-up period, and in other nations are warranted.

## ACKNOWLEDGMENTS

This study was supported by a Grant from Kaohsiung Medical University Research Foundation (KMU-Q105015) and 106CM-KMU-13 from Chi-Mei Medical Center. We thank the National Health Insurance Administration, Ministry of Health and Welfare (managed by the National Health Research Institutes—Registered number NHIRD-102-024 and NHIRD-100-057), for access to the Taiwan NHIRD. The conclusions in this study do not represent those of the National Health Insurance Administration, Ministry of Health and Welfare, or National Health Research Institutes.

## DISCLOSURE

*Approval of the research protocol:* This study was strictly conducted according to the Declaration of Helsinki and approved by the Institutional Review Board at Chi-Mei Medical Center. *Informed consent:* As the NHIRD contains de-identified information, informed consents from the participants are

waived, which does not affect the rights and welfare of the participants. *Registry and the registration no. of the study/trial:* N/A. *Animal studies:* N/A. *Data sharing and data accessibility:* N/A.

## CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

## AUTHORS' CONTRIBUTIONS

W.T.H., C.C. Hsu, C.C. Huang, and S.F.W. designed the study and wrote the manuscript. S.F.W. performed the data analysis and wrote the manuscript. H.J.L., S.B.S., and J.J.W. provided clinical experience and wrote the manuscript. C.C. Huang and S.F.W. supervised the whole study. All authors read and approved the final manuscript.

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**How to cite this article:** Huang W-T, Weng S-F, Hsu C-C, et al. Comparison of the risk of developing lumbar herniated intervertebral disc between dentists and other occupations: A nationwide population-based study in Taiwan. *J Occup Health.* 2019;61:227–234. <https://doi.org/10.1002/1348-9585.12036>