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Original Article

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Association Between Dental Calculus and Hypertension Phenotypes in Highly Fit Adults: CHIEF Oral Health Study

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Background: Poor oral health evaluated by presence of dental calculus has been associated with hypertension (HTN) among middle- and old-aged adults. However, it is unclear for the association of HTN phenotypes with dental calculus in young adults.

Methods: This study examined the association between dental calculus and HTN in 5,345 military personnel, aged 19–45 years, without antihypertensive medications therapy in Taiwan from 2018 to 2021. Dental calculus was defined as presence of supragingival calculus in any teeth, except impacted teeth, and third molar. Combined HTN (CHTN) was diagnosed as systolic blood pressure (SBP) ≥130 mm Hg and diastolic blood pressure (DBP) ≥80 mm Hg. Isolated systolic and diastolic HTN were, respectively, defined as SBP ≥130 mm Hg only (ISHTN) and DBP ≥80 mm Hg only (IDHTN). Multiple logistic regression with adjustments for sex, age, toxic substance use, anthropometrics, lipid profiles, fasting glucose, and blood leukocyte counts were used to determine the association between dental calculus and HTN phenotypes in young adults.

Results: The prevalence of those with dental calculus, CHTN, ISHTN, and IDHTN was 20.8%, 10.8%, 10.2%, and 7.0%, respectively. The dental calculus was associated a greater possibility with CHTN [odds ratio (OR) and 95% confidence interval: 1.60 (1.31–1.95)]. However, the associations of dental calculus with ISHTN and IDHTN were null [OR: 1.05 (0.81–1.27) and 1.12 (0.86–1.46), respectively].

Conclusions: Our findings suggest that among young adults, poor oral health manifested by presence of dental calculus was associated with a greater possibility of CHTN, while not for ISHTN and IDHTN.

Keywords: blood pressure; dental calculus; hypertension; oral health; young adults.

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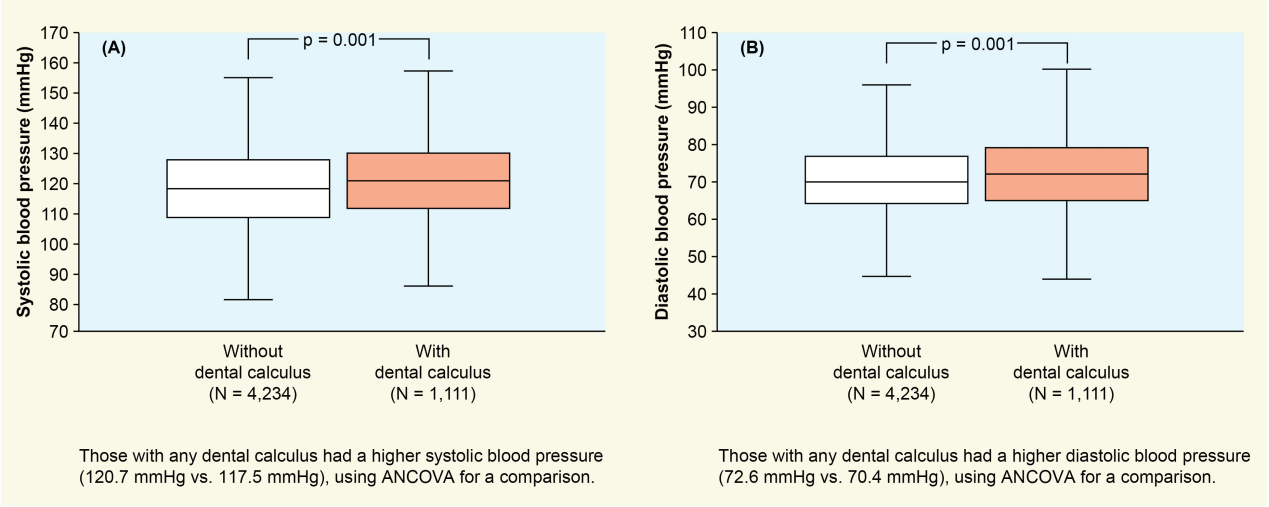
Graphical Abstract



Dental calculus, also known as tartar, represents mineralized oral biofilm and always covered by unmineralized viable bacterial plaque in human beings. Dental calculus may also amplify the effects of bacterial plaque by keeping the bacterial deposits in close contact with the tissue surface, thereby influencing both bacterial ecology and tissue response.[1] Experimental and epidemiologic studies have revealed that dental calculus is a potent contributor to periodontal disease.[2,3] In addition, periodontitis is not only caused by the presence of dental calculus due to poor oral hygiene, but also the depressed nutrition and immune status of the affected patients.[4–6]

Hypertension (HTN) affects 30%–45% of the general population worldwide[7] and is the most significant modifiable risk factor for cardiovascular disease (CVD) and mortality in the United States.[8] The HTN onset age <45 years old of young adults has been found with a higher risk of CVD and mortality events than the HTN onset age ≥45 years of middle- and old-aged adults.[9] Therefore, it is crucial to clarify the risk factors of HTN in young adults. Periodontal disease and HTN share common risk factors, e.g., older age, male sex, smoking, obesity, low education, and socioeconomic levels.[10] Current evidence revealed an association between periodontitis and high blood pressure (BP) in middle- and old-aged adults,[10–12] however the association was not confirmed in young adults.[5] A few studies also revealed that presence of dental calculus, representing poor oral hygiene status, was associated with a greater risk of HTN,[13] while there was no study for young adults. In this case, this study was aimed to investigate the association between dental calculus and HTN phenotypes in a population of young adults.

METHODS

Study population

The cardiorespiratory fitness and health in armed forces (CHIEF) oral health study[4–6,14] was a cross-sectional study from 2018 to 2020. The protocol has been approved by the Ethics Committee of the Mennonite Christian Hospital (No. 16-05-008), and written informed consent was obtained from each participant. Each participant underwent a checkup for dental calculus. Those with diabetes mellitus, active cancer, and pregnant or lactating women who had unhealthy gums were excluded. Those who had partial denture due to less than 16 teeth were excluded for a difficulty in frequently cleaning the oral cavity. In addition, those who received antihypertensive medications therapy were also excluded for reducing the correlation between dental calculus and BP levels.

Clinical and biological investigations

Each study participant's body height and weight and waist circumference (WC) were measured in the standing position. Body mass index (BMI) was defined as body weight (kg) divided by body height squared (m^2). All participants were asked not to smoke and use any caffeine after waking up in the morning, and had to take a rest for 15 minutes before measuring their BP. The BP of each participant was measured once by an automatic BP device (Parama-Tech, Fukuoka, Japan).[15] The mean arterial BP (MAP) was calculated as 2/3 × SBP + 1/3 × DBP. Overall HTN was defined as systolic BP (SBP) ≥130 mm Hg and/or diastolic BP (DBP) ≥80 mm Hg.[16] Combined HTN (CHTN) was defined as SBP ≥130 mm Hg and DBP ≥80 mm Hg. Isolated systolic HTN (ISHTN) was defined as only SBP ≥130 mm Hg with DBP <80 mm Hg and isolated diastolic HTN (IDHTN) was defined as only DBP ≥80 mm Hg with SBP <130 mm Hg.[16]

The blood sample was collected from each subject after a 12-hour overnight fast. Biochemical tests for fasting glucose (FPG), serum uric acid and lipid profiles, i.e., triglycerides, total cholesterol, low-density lipoprotein (LDL-C), and high-density lipoprotein (HDL-C) were performed by an auto analyzer (AU640, Olympus, Kobe, Japan). White blood cells (WBCs) count was measured by the XT-2000-I automated analyzer (Sysmex Corporation, Kobe, Japan).[4–6,14,17–19]

Metabolic risk factors of HTN

Several metabolic risk factors of arterial HTN have been identified.[20] According to the body weight classification for Taiwanese, overweight was defined as BMI: 24.0–27.4 kg/m^2, and obesity was defined as BMI: ≥27.5 kg/m^2.[21] Abdominal obesity was defined as WC ≥90 cm for men and ≥80 cm for women.[21] Dyslipidemia was defined if there was any condition fulfilled: (i) total cholesterol ≥200 mg/dl, (ii) HDL-C <40 mg/dl for men and <50 mg/dl for women, (iii) serum triglycerides ≥150 mg/dl. Dysglycemia was defined as FPG ≥100 mg/dl. Hyperuricemia was defined as ≥7.0 mg/dl for men and ≥6.0 mg/dl for women.

Oral hygiene assessment

After full mouth clinical examination, oral hygiene status was categorized into acceptable and poor based on the presence of visible supragingival calculus on any teeth or not. In addition, numbers of teeth with visible supragingival calculus were also counted. As participants were physically fit military young adults in this study, there was no 1 with supragingival calculus covering more than one-third of any teeth surface which was classified as low severity in previous studies.[21] The presence of dental calculus in the impacted teeth and third molars was not counted in this study.

Statistical analysis

The baseline demographic and clinical characteristics were expressed as mean ± SD for continuous data, and numbers (percentages) for categorical data. Differences between groups with and without dental calculus were performed utilizing 1-way ANOVA and chi-square test for continuous and categorical variables, respectively. Analysis of covariance (ANCOVA) was used to examine if there existed a difference in the mean of SBP, DBP, and MAP between those with and those without dental calculus, and among the groups classified by numbers of teeth with dental calculus. Multiple linear regression analysis was used to separately determine β value and 95% confidence interval (CI) of presence of dental calculus (with vs. without) and numbers of teeth with dental calculus with SBP and DBP. The adjusted covariates were age, sex, BMI, WC, lipid profiles, FPG, serum uric acid, WBC, betel nut chewing, smoking, and alcohol intake status. In addition, multiple logistic regression analysis was used to separately estimate the odds ratio (OR) and 95% CI for the association of presence of dental calculus (with vs. without) and numbers of teeth with dental calculus with overall HTN, CHTN, ISHTN, and IDHTN. The logistic model was adjusted for age, sex, body weight categories, abdominal obesity, dyslipidemia status, dysglycemia status, hyperuricemia, systemic inflammation defined as WBC ≥7.50 10^3/μl, alcohol intake, betel nut chewing, and cigarette smoking. This study used the SPSS software (IBM Corp. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.) for statistical analyses.

RESULTS

A total of 5,405 military personnel were recruited in present study. Those with diabetes mellitus (*N* = 12), pregnant or lactating female (*N* = 8), active cancer (*N* = 1), less than 16 teeth (*N* = 15), and antihypertensive medications therapy (*N* = 24) were excluded. Finally, 5,345 individuals (4,774 men and 571 women), aged 29.5 years on average, and 28.0% of them were with HTN for final analysis.

Clinical characteristics are shown in Table 1. The prevalence of participants with dental calculus, CHTN, ISHTN, and IDHTN was 20.8% (*N* = 1,111), 10.8% (*N* = 576), 10.2% (*N* = 546), and 7.0% (*N* = 374), respectively. Those with any HTN phenotypes [*N* = 1,496 (28.0%)] had a greater prevalence of male sex, betel nut chewing, and a greater level of age, SBP, DBP, BMI, WC, total cholesterol, LDL-C, serum triglycerides, FPG, serum uric acid, blood WBC, and lower HDL-C. In addition, those with any HTN phenotypes had a higher prevalence of dental calculus presence (25.4%).

Figures 1 and 2 reveal the ANCOVA results. As compared with participants without dental calculus, those with any dental calculus had a higher SBP (120.7 vs. 117.5 mm Hg), DBP (72.6 vs. 70.4 mm Hg), and MAP (104.7 vs. 101.6 mm Hg). There were no statistically differences in the SBP, DBP, and MAP levels between those with 1 tooth or 2 affected teeth and those free of dental calculus. By contrast, those who had 3 or more than 3 teeth with dental calculus had a greater SBP (126.4 and 134.6 mm Hg), DBP (76.4 and 82.0 mm Hg), and mean blood pressure level (109.7 and 117.1 mm Hg).

Presence of any dental calculus was positively correlated with SBP (β = 1.66, 95% CI: 0.54–2.48), DBP (β = 1.31, 95% CI: 0.67–1.95), and MAP levels (β = 1.61, 95% CI: 0.90–2.33) (Table 2). If numbers of teeth with dental calculus were treated as a categorical variable, there was a positive correlation with SBP (β = 1.83, 95% CI: 1.52–2.14), DBP (β = 1.26, 95% CI: 1.02–1.50), and MAP (β = 1.67, 95% CI: 1.40–1.94).

Participants with any dental calculus had a greater possibility of overall HTN (OR = 1.26, 95% CI: 1.08–1.46) and CHTN (OR = 1.60, 95% CI: 1.31–1.95), whereas the associations were null for ISHTN and IDHTN. There was a dose-dependent association of numbers of teeth with any dental calculus with overall HTN and CHTN. As compared with those without dental calculus, the possibility of overall HTN increased gradually in those with 1, 2, 3, and ≥4 affected teeth (OR: 1.13, 1.18, 1.30, and 1.55, respectively), and the trend for CHTN was also present (OR: 1.41, 1.43, 1.71, and 1.99, respectively). On the contrary, the trend for ISHTN and IDHTN was not present (Table 3).

DISCUSSION

The present study revealed an association between presence of dental calculus and BP in military young adults who received regular physical training in their bases. Our results also demonstrated a 26% increased prevalence of HTN for dental calculus with adjustments for the traditional confounding factors, e.g., older age, male, obesity, and systemic inflammation. In addition, there was a dose-dependent association between numbers of teeth with dental calculus and the BP level as well as the possibility of overall HTN and CHTN. However, there were no associations of dental calculus presence with ISHTN and IDHTN.

Several studies have revealed the association between poor oral hygiene and (overall) HTN.[13,22,23] The French National Healthcare System Survey showed that individuals with poor oral hygiene had a higher possibility of HTN in the general population.[21] Notably, in those younger than 65 years, the possibility (OR) of dental calculus for HTN defined as SBP ≥140 mm Hg was 1.18 (95% CI: 1.07–1.29), which was close to the present study (OR: 1.26). The association was also observed in the general population of Chinese that frequent tooth brushing (≥twice daily) was associated with a 45% reduction in HTN events.[22] Kim *et al.* further revealed that community-based oral hygiene services might promote HTN control by preventing dental calculus production and gum bleeding in those with HTN.[13] Our findings were in line with previous study results that poor oral hygiene evaluated by supragingival dental calculus was associated with a higher possibility of HTN in young adults. Moreover, we demonstrated that the BP levels and the possibility of HTN were dose dependently associated with numbers of affected teeth, reinforcing the link between poor oral hygiene and HTN, particularly for CHTN. The association varied according to the HTN phenotype may be reasoned in part by that many risk factors of dental calculus, such as older age, male sex, greater body weight, and higher inflammation level were associated with a greater risk of CHTN, while fewer contributing factors of dental calculus presented an association with ISHTN and IDHTN in young adults in our study and the previous studies.[24] Moreover, in a previous study[25] and a

Table 1. Baseline demographic and clinical characteristics (*N* = 5,345)

	Those without hypertension (N = 3,849)	Those with hypertension (N = 1,496)	P value
Presence of any dental calculus	731 (19.0)	380 (25.4)	<0.001
Systolic blood pressure, mm Hg	112.51 ± 10.06	132.76 ± 9.11	<0.001
Diastolic blood pressure, mm Hg	66.76 ± 7.06	81.46 ± 9.65	<0.001
Mean blood pressure, mm Hg	97.00 ± 9.59	115.66 ± 7.25	<0.001
Pulse pressure, mm Hg	45.64 ± 9.00	51.29 ± 12.31	<0.001
Combined hypertension	0	576 (38.5)	
Isolated systolic hypertension	0	546 (36.5)	
Isolated diastolic hypertension	0	374 (25.0)	
Heart rate, beat per minute	72.20 ± 11.33	75.85 ± 11.80	<0.001
Age, y	28.80 ± 5.80	30.92 ± 5.73	<0.001
Sex, male (%)	3,330 (86.5)	1,444 (96.5)	<0.001
Alcohol drinking, active (%)	1,328 (34.5)	555 (37.1)	0.08
Betel nut chewing, active (%)	321 (08.3)	194 (13.0)	<0.001
Cigarette smoking, active (%)	1,218 (31.6)	442 (29.5)	0.12
Body mass index, kg/m^2	24.28 ± 3.18	26.42 ± 3.34	<0.001
Waist circumference, cm	81.45 ± 8.78	87.05 ± 9.01	<0.001
Blood test			
Total cholesterol, mg/dl	172.53 ± 33.02	183.35 ± 36.00	<0.001
Low-density lipoprotein, mg/dl	103.68 ± 29.28	111.99 ± 31.14	<0.001
High-density lipoprotein, mg/dl	49.42 ± 10.46	47.45 ± 10.15	<0.001
Triglyceride, mg/dl	104.82 ± 81.74	143.61 ± 129.83	<0.001
Fasting plasma glucose, mg/dl	92.42 ± 12.87	94.75 ± 15.62	<0.001
Serum uric acid, mg/dl	6.37 ± 1.37	6.95 ± 1.44	<0.001
White blood cells, 10^3/μl	6.69 ± 1.66	7.10 ± 1.79	<0.001

Continuous variables are expressed as mean ± SD, and categorical variables as *N* (%).

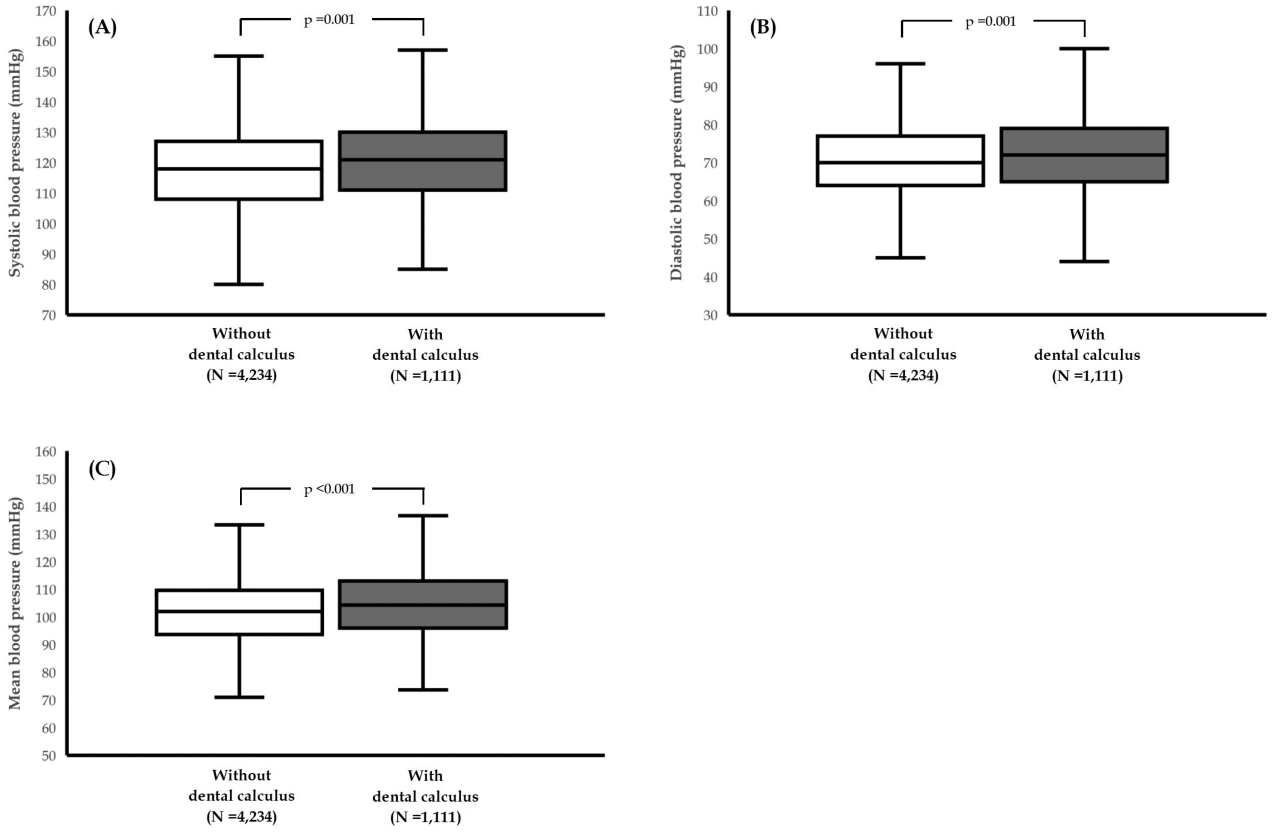


Figure 1. The results of ANCOVA that as compared with those without dental calculus, (**a**) those with any dental calculus had a higher systolic blood pressure (120.7 vs. 117.5 mm Hg), (**b**) higher diastolic blood pressure (72.6 vs. 70.4 mm Hg), and (**c**) higher mean blood pressure level (104.7 vs. 101.6 mm Hg). Abbreviation: ANCOVA, analysis of covariance.

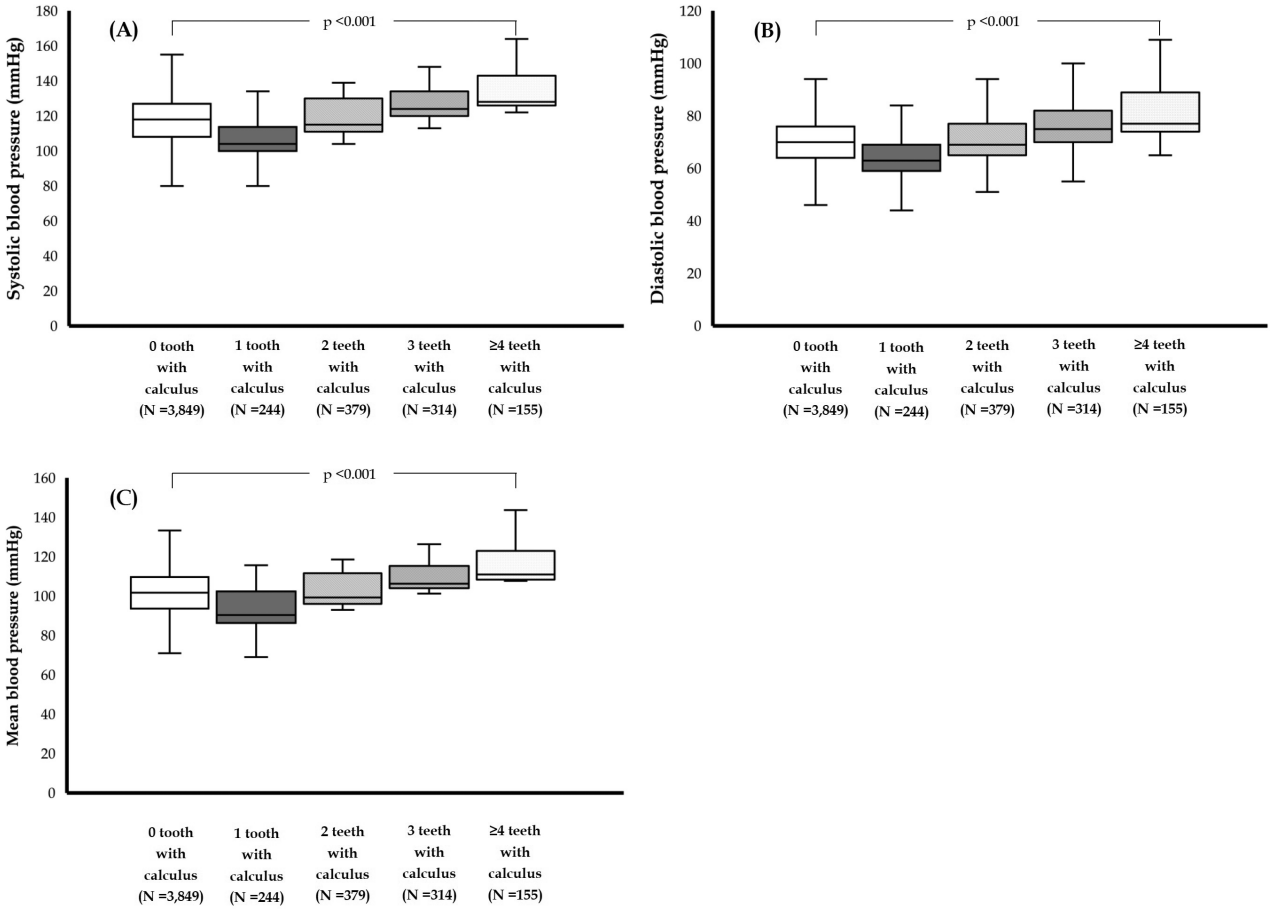


Figure 2. The results of ANCOVA (**a**–**c**) that those who had 1 tooth or 2 teeth with dental calculus had a similar level of SBP, DBP, and MAP compared with those without dental calculus. By contrast, (a) those who had 3 or more than 3 teeth with dental calculus had a greater SBP (126.4 and 134.6 mm Hg), (b) a greater DBP (76.4 and 82.0 mm Hg), and (c) a greater MBP (109.7 and 117.1 mm Hg). Abbreviations: ANCOVA, analysis of covariance; DBP, diastolic blood pressure; MAP, mean arterial pressure; MBP, mean blood pressure; SBP, systolic blood pressure.

Table 2. Multivariable liner regression analysis model for the correlation between dental calculus and blood pressure

	Systolic BP			Diastolic BP			Mean BP		
	β	95% CI	*P* value	*β*	95% CI	*P* value	*β*	95% CI	*P* value
Numbers of teeth with calculus	1.83	1.52, 2.14	<0.001	1.26	1.02, 1.50	<0.001	1.67	1.40, 1.94	<0.001
Presence of any dental calculus	1.66	0.84, 2.48	<0.001	1.31	0.67, 1.95	<0.001	1.61	0.90, 2.33	<0.001
Age	0.07	0.01, 0.13	0.03	0.35	0.31, 0.40	<0.001	0.16	0.11, 0.21	<0.001
Male sex	8.09	6.86, 9.32	<0.001	3.16	2.20, 4.11	<0.001	6.30	5.23, 7.37	<0.001
Body mass index	0.83	0.65, 1.00	<0.001	0.38	0.24, 0.51	<0.001	0.67	0.51, 0.82	<0.001
Waist circumference	0.12	0.06, 0.19	<0.001	0.04	−0.01, 0.09	0.13	0.09	0.03, 0.15	0.002
Total cholesterol	−0.07	−0.10, −0.03	0.001	−0.03	−0.06, −0.01	0.03	−0.06	−0.09, −0.02	0.001
Low-density lipoprotein	0.06	0.02, 0.10	0.002	0.04	0.01, 0.07	0.007	0.06	0.02, 0.09	0.001
High-density lipoprotein	0.16	0.11, 0.22	<0.001	0.11	0.07, 0.15	<0.001	0.14	0.10, 0.19	<0.001
Triglycerides	0.02	0.01, 0.02	<0.001	0.01	0.01, 0.02	<0.001	0.02	0.01, 0.02	<0.001
Fasting glucose	0.02	−0.00, 0.05	0.10	0.01	−0.01, 0.03	0.28	0.02	−0.01, 0.04	0.12
Serum uric acid	0.20	−0.07, 0.47	0.15	0.33	0.12, 0.54	0.002	0.31	0.07, 0.54	0.01
WBC counts	0.53	0.33, 0.73	<0.001	0.45	0.29, 0.60	<0.001	0.49	0.32, 0.66	<0.001

Data are presented as *β* value and 95% confidence intervals (CIs) with additional adjustments for alcohol drinking, betel nut chewing, and cigarette smoking. Data for the covariates were adjusted for numbers of teeth with calculus. Abbreviations: BP, blood pressure; WBC, white blood cell counts.

meta-analysis[26] performed for young adults, the relative risk for incident events of CVD in stage 1 CHTN was, respectively, estimated 1.67 and 1.92, which was significantly higher than 1.36 in stage 1 ISHTN and 1.32 in stage 1 IDHTN. These evidence might suggest the critical role of dental calculus specifically for CHTN and as a potential target to prevent subsequent CVD events.

There were no associations of localized periodontitis with SBP and DBP in young adults in our prior study.[5] Some studies showed that the initiation of periodontal disease in young adults is closely related to plaque accumulation, while calculus accumulation is more prevalent in chronic periodontitis found in older adults.[27,28] However, distinguishing between the effects of

Table 3. Multivariable logistic regression analysis model for the association of dental calculus and hypertension phenotypes

	Overall hypertension			Combined hypertension			Isolated systolic hypertension			Isolated diastolic hypertension		
	OR	95% CI	*P* value	OR	95% CI	*P* value	OR	95% CI	*P* value	OR	95% CI	*P* value
Presence of any dental calculus	1.26	1.08, 1.46	0.003	1.60	1.31, 1.95	<0.001	1.05	0.81, 1.27	0.90	1.12	0.86, 1.46	0.38
0 tooth with calculus	1.00			1.00			1.00			1.00		
1 tooth with calculus	1.13	0.83, 1.54	0.44	1.41	1.02, 1.94	0.03	1.03	0.65, 1.64	0.89	1.01	0.57, 1.79	0.97
2 teeth with calculus	1.18	0.93, 1.50	0.17	1.43	0.93, 2.20	0.10	1.08	0.75, 1.53	0.68	1.03	0.67, 1.57	0.90
3 teeth with calculus	1.30	1.02, 1.67	0.03	1.71	2.56, 2.34	0.001	1.00	0.63, 1.39	0.74	1.19	0.77, 1.83	0.43
≥4 teeth with calculus	1.55	1.10, 2.19	0.01	1.99	1.32, 2.99	0.001	1.09	0.64, 1.87	0.74	1.39	0.77, 2.52	0.27
Age ≥30 y	1.37	1.20, 1.56	<0.001	1.94	1.58, 2.38	<0.001	0.82	0.67, 0.99	0.04	1.82	1.43, 2.31	<0.001
Male sex	2.96	2.18, 4.01	<0.001	2.37	1.44, 3.89	0.001	9.07	4.24, 19.41	<0.001	1.52	0.99, 2.33	0.06
Overweight (24.0–27.4 kg/m^2)	1.74	1.48, 2.04	<0.001	2.23	1.71, 2.90	<0.001	1.56	1.23, 1.98	<0.001	1.40	1.07, 1.84	0.01
Obesity (≥27.5 kg/m^2)	2.41	1.94, 3.00	<0.001	3.26	2.35, 4.51	<0.001	2.31	1.68, 3.19	<0.001	1.38	0.94, 2.04	0.10
Abdominal obesity	1.33	1.11, 1.59	0.002	1.22	0.96, 1.56	0.10	1.37	1.05, 1.78	0.02	1.24	0.91, 1.70	0.17
Total cholesterol ≥200 mg/dl	1.12	0.96, 1.31	0.14	1.26	1.03, 1.55	0.02	0.96	0.76, 1.22	0.74	1.18	0.91, 1.52	0.21
Low high-density lipoprotein	0.84	0.71, 0.99	0.04	0.74	0.58, 0.93	0.01	1.05	0.83, 1.33	0.67	0.76	0.56, 1.03	0.07
Triglycerides ≥150 mg/dl	1.37	1.16, 1.61	<0.001	1.37	1.10, 1.70	0.004	1.24	0.98, 1.58	0.07	1.30	0.98, 1.73	0.07
Fasting glucose ≥100 mg/dl	1.23	1.05, 1.45	0.01	1.16	0.93, 1.45	0.17	1.40	1.12, 1.76	0.003	0.97	0.72, 1.30	0.81
Hyperuricemia	1.27	1.11, 1.45	<0.001	1.15	0.95, 1.39	0.14	1.23	1.01, 1.49	0.03	1.43	1.13, 1.79	0.002
WBC ≥7.50 10^3/μl	1.23	1.07, 1.41	0.004	1.42	1.17, 1.72	<0.001	1.15	0.94, 1.42	0.17	1.09	0.85, 1.39	0.50

Data are presented as odds ratio (OR) and 95% confidence intervals (CIs), separately for presence of any dental calculus and numbers of teeth with calculus, with adjustments for the covariates and alcohol drinking, betel nut chewing, and cigarette smoking. Data for the covariates (age, sex, body weight category, abdominal obesity, lipid profiles, fasting glucose, hyperuricemia, and WBC status) were adjusted for numbers of teeth with calculus. Abbreviation: WBC, white blood cell counts.

calculus and plaques on the periodontium is difficult, since calculus is always covered with a nonmineralized plaque layer.[29] Dental calculus might not contribute directly to inflammation, but it provides a fixed nidus for the continued accumulation of bacterial plaque and its retention in proximity to the periodontium. Dental calculus further cause oral microbiome dysbiosis, and trigger proinflammatory cytokines, which could generate systemic inflammation and impairment of the vasodilatation of the endothelium, and ultimately result in an increase of BP.[5,6,30–32] In addition, presence of dental calculus is more possibly to reflect the poor oral hygiene status compared with presence of periodontitis which is also affected by the nutrition status, i.e., a U-shaped relationship with BMI,[4] thus resulting in no association for BP in our previous study.[5]

Some limitations of the present study were presented. First, owing to the cross-sectional design, this study cannot infer a temporal association of the exposures and outcomes. Second, biofilm calcification has been reported to develop in as quickly as 4–8 hours, and up to 50% would be mineralized within 2 days, and 60%–90% were mineralized in 12 days.[33] Therefore, it is very difficult to detect the proportions of calculus deposition, which might affect the results. Finally, the BP of each participant was measured once by an automatic device in the present study where the accuracy might be merely modest. On the contrary, there were some strengths in the present study. Firstly, the selection bias was minimized due to only 1.2% participants with other comorbidities excluded from analysis. For instance, those with any type diabetes mellitus could not join military, and the prevalence of new-onset diabetes (n = 12) in the study was low, possibly due to that most participants (n = 5,141) were physically active and younger than 40 years. In addition, since the lifestyle and the environment of military personnel were unified, many unmeasured bias could be reduced accordingly.

In conclusion, the study findings suggested that poor oral hygiene manifested by presence of supragingival calculus was associated with a higher possibility of overall HTN and CHTN, but not with ISHTN and IDHTN in young adults in Taiwan. Our outcomes strengthen the evidence in support of a relationship between poor oral hygiene and higher BP, particularly in young adults. Based on the present study finding, poor oral hygiene is suggested as a potential risk factor for high/uncontrolled BP, and effective oral care should be regarded as an adjunct lifestyle measure for the management of HTN.

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DISCLOSURE

The authors declared no conflict of interest.

DATA AVAILABILITY

As the study materials were obtained from the military personnel in Taiwan, the data were confidential and not allowed to be opened in public. If there are any needs for clarification, the readers can contact the corresponding author for sharing the data.

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