



RELATIONSHIP OF GRIP AND PINCH STRENGTH TO BODY MASS INDEX AMONG DENTAL PROFESSIONALS - CROSS SECTIONAL STUDY

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ABSTRACT

Aim: To determine the relationship of grip and pinch strength to body mass index among dental professionals.

Methodology: In this cross sectional study total number of 150 dental professionals, aged 22 to 40 years, who fulfilled selection criteria, were recruited through Purposive sampling. Participant's height, weight, body mass index, grip strength, lateral pinch strength, Pad to Pad pinch strength and Tip to Tip pinch strength were then assessed. All measurements were taken by using standardized procedures. The data collected was analyzed by using Pearson's correlation test.

Results: The inferential statistics had shown that there was a significant positive correlation between body mass index and grip strength with correlation coefficient (r) value of 0.233 (p = 0.004), body mass index and lateral pinch strength with of r value 0.259 (p value = 0.01), body mass index and pad to pad pinch strength with r value of 0.209 (p value = 0.05), body mass index and tip to tip pinch strength with r value of 0.169 (p value = 0.05).

Conclusion: The study shows that there is a significant weak positive correlation between body mass index and Grip strength, body mass index and lateral pinch strength, body mass index and pad to pad pinch strength & body mass index and tip to tip pinch strength.

Key Words: Body Mass Index, Grip strength, Lateral pinch strength, Pad to Pad pinch strength, Tip to Tip pinch strength

INTRODUCTION

Grip and pinch strength of dental professionals have been focused in numerous studies worldwide. The prevalence of work-related upper extremity Musculo-Skeletal Disorders are increased among dentists and dental hygienists than other professionals.¹ As the work area of dentists is narrow, dental treatment is performed in a very inflexible work posture,² so they are more prone for Musculo-Skeletal Disorders even from early stage of their career.³ One of the factors associated with the high prevalence of upper extremity Musculo-Skeletal Disorders among dental practitioners is the repeated high pinch force applied during periodontal scaling⁴. Over-use and extreme range of motion of certain muscle groups and joints are caused by repeated identical or similar motions, which are performed over a period of time can eventually lead to muscular fatigue which in turn affects the grip and pinch strength.⁵

Hand strength evaluation has been identified as an important factor in predicting Musculo-Skeletal Disorders, the grip strength and pinch strength are considered to be an objective outcome measures.⁶ Grip and pinch are measures of the hand muscles strength^{7, 8} Pinch grip strength has been used as indices of strength in hand therapy assessments.⁹ The grip strength and pinch strength was reported to be higher in dominant hand.¹⁰

Body mass in adults can be classified using body mass index, which is a simple index of weight-for-height, With the increase in body mass index grading, the health risk may be differ among different population.^{11, 12} Research has shown that individuals fall into overweight or obese categories has higher chances of experiencing health problems.¹³ body mass index is one of the key factors in the development of musculoskeletal dysfunction, that may vary among different professionals.

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Singh A, Prohit B reported that Obesity was observed in third-year (22.4%), final-year (16.3%) students, interns (20.4%) and faculty members (40.8%).¹⁴Ibegbu Augustine Oseloka et.al stated that body mass index have positive correlation with grip strength among Nigerian students.¹⁵T Kamarul, TS Ahmad stated that grip strength was positively correlated with hand dominance, gender, occupation, height, and weight, but not with body mass index.¹⁶Also, Angelica Soares et.al concluded that there was no association between grip strength and body mass index in general population.¹⁷

Disparity exists in the literature over the relationship between hand grip strength and body mass index in different professionals, some researchers claiming a positive relationship between grip strength and body mass index in all age groups, while other researchers found no relationship¹⁸⁻²¹. Especially in dental profession there are lacks of studies in finding the relationship between body mass index with grip and pinch strength. Hence, this study aims to find the correlation between grip and pinch strength with body mass index among dental professionals.

MATERIALS AND METHODS

This study was conducted among dental professionals aged 22 to 40 years with a sample size of 150. Purposive sampling method was used. The participants who fulfilled the selection criteria were included in the study. Prior to the participation, the study was explained and written informed consent was obtained from each of them. Ethical clearance was obtained from University ethics committee. The inclusion criteria: healthy dental professionals who are practicing at least for 1 year, males and females between 22 to 40 years of age with full functional range of motions of upper limb and neck. Exclusion criteria were participants with MSD, a history of recent surgery, any neurological disorder and any systemic illness.

A standardized weighing machine was used to measure the weight of each Participant. The height was measured by using a stadiometer. Body Mass Index was calculated for each participant by using the formula $\text{Body Mass Index} = \frac{\text{Weight(Kg)}}{\text{Height(m)}^2}$

METHODS

Grip strength was measured by using a Jamar Dynamometer (figure 1), lateral pinch (figure 2), pad to pad (figure 3) and tip to tip (figure 4) pinch strengths were measured by using a pinch gauge. The standardized functional positions were used.²²⁻²⁵ Participants were asked to Grip/pinch with his/her dominant hand; other end of the pinch gauge was hold by the investigator. Explanation was given to squeeze the dy-

namometer and press the pinch gauge. Then, they were allowed to familiarize themselves with the instrument by a sub-maximal practice trial. Finally, they were asked to squeeze/pinch the handle of dynamometer/pinch gauge as strong as possible and measurement was taken (in Kg). The same was repeated for 3 times, allowing a 10 seconds rest between the measurements.²³ Average of 3 measurements was calculated and documented.

STATISTICAL ANALYSIS

The collected data was analyzed using SPSS version 22. Descriptive Statistics was produced for Age, Gender, Hand dominance, body mass index, grip strength, lateral pinch, and pad to pad and tip to tip pinch strength distribution. The Pearson's Correlation test was used to check the relationship between body mass index and grip strength, lateral pinch, pad to pad and tip to tip, $P < 0.05$ is considered to be significant.

RESULTS

Results show there is a significant positive correlation between body mass index and grip strength with correlation coefficient (r) equal to 0.233 ($p = 0.004$) (refer Table 3 and graph 1). There is a significant positive correlation between body mass index and lateral pinch strength with $r = 0.259$ ($p = 0.01$) (refer Table 4 and graph 2). There is a significant positive correlation between the body mass index and pad to pad pinch strength with $r = 0.209$ ($p = 0.05$) (Table 5 and graph 3). There is a significant positive correlation between the body mass index and tip to tip pinch strength with $r = 0.169$ ($p = 0.05$) (refer Table 6 and graph 4)

DISCUSSION

Descriptive statistics shows that participants between 23 to 40 years old (male - 47.33%, female- 52.77%) were participated in the study. Both right and left dominance were included in the study, while comparing the percentage of right and left dominance, it is observed that 93.33 are right dominant individuals.

The inferential statistical value in correlating body mass index with grip strength shows that there was a significant positive correlation but it was weak (r value = 0.233). Similar findings were observed in a study "systematic exploring the relationship between hand grip strength and body mass index in healthy general population" by Kun-Hsi Liao.²⁶ Ibegbu Augustine Oseloka also concluded that there is a positive correlation between hand grip strength and body mass index in Nigerian college students.¹⁶

When correlating body mass index with lateral pinch strength, pad to pad pinch strength, and tip to tip pinch strength, the results showed that there were significant positive correlations but it was weak (r value = 0.259, 0.29, 0.169 respectively). Study results agree with the findings of Tsuyoshi Tajika et al, which showed that there was significant weak positive correlation of body mass index with lateral pinch and tip to tip pinch strengths but pad to pad pinch strength was not significant.²⁷ Ehsanollah Habibi et al who conducted a study on hand grip and pinch strength concluded that there was a significant positive relationship between body mass index and pinch strength.²⁸

The positive correlation between body mass index with grip strength and pinch strength observed in this study may have occurred due to the reason that the subjects involved in the study were young adults and falls more in normal and overweight category (64.67% and 21.33%). The existence of greater percentage of lean body mass in normal and overweight individuals compared to the underweight and obese (7.3% and 6.67%) individuals may be influenced to perform handgrip and pinch in a better way. This is agreed by the study done by Duangporn Thong-Ngam et al. stated that subjects with normal body mass index had significantly higher hand grip strength than overweight and obese group.²⁹ The result of Smrithi shetty et al. revealed that the Body Mass Index of underweight category has less grip strength compared to normal and overweight category among young adults.³⁰

It is a known fact that dental professionals use more of hand grip and pinch activities with different stressful positions that may keep stress on the musculoskeletal system which in turn leads to repeated fatigue of small hand muscles resulting in less hand grip and pinch strength,³¹ this may be a reason for weak correlation. However, further studies comparing dental professionals with general population is needed.

LIMITATION

Though we planned to include the participants from 22 to 40 years old, except very few many above 30 years were unwilling to participate in the study.

CONCLUSION

The study shows that there is a significantly weak positive correlation of body mass index with grip strength and pinch strength. So body mass index may be considered as an influential variable in determining the grip strength and pinch strength, which is an essential component of dental clinical performance.

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REFERENCES

1. Milerad E, Ekenvall L. Symptoms of the neck and upper extremities in dentists. *Scandinavian journal of work environment & health*. 1990 Apr 1;129-34.
2. Bramson JB, Smith S, Romagnoli G. Evaluating dental office ergonomic risk factors and hazards. *The Journal of the American Dental Association*. 1998 Feb 28; 129(2):174-83.
3. Yi J, Hu X, Yan B, Zheng W, Li Y, Zhao Z. High and specialty-related musculoskeletal disorders afflict dental professionals even since early training years. *Journal of Applied Oral Science*. 2013 Aug; 21(4):376-82.
4. Villanueva A, Dong H, Rempel D. A biomechanical analysis of applied pinch force during periodontal scaling. *Journal of biomechanics*. 2007 Dec 31; 40(9):1910-5.
5. An introduction to ergonomics: Risk Factors, msds, Approaches and Interventions. American dental association. 2004
6. Angst F, Drerup S, Werle S, Herren DB, Simmen BR, Goldhahn J. Prediction of grip and key pinch strength in 978 healthy subjects. *BMC musculoskeletal disorders*. 2010 May 19;11(1):94.
7. John Brookfield (1995). *Mastery of Hand Strength*.
8. John Brookfield (2002). *The Grip Master's Manual*.
9. Nayak US, Queiroga JM. Pinch grip, power grip and wrist twisting strengths of healthy older adults. *Gerontechnology*. 2004 Jan 4;3(2): 77-88.
10. Incel NA, Ceceli E, Durukan PB, Erdem HR, Yorgancioglu ZR. Grip strength: effect of hand dominance. *Singapore medical journal*. 2002 May; 43(5):234-7.
11. World Health Organization. BMI classification. Global database on body mass index. available from http://apps.who.int/bmi/index.jsp?introPage=intro_3.html [homepage on the Internet] c2016 [updated 2016 January 17, 12.30a.m]
12. Body Mass Index: Considerations for Practitioners. Department of health and human service center for disease control and prevention. CDC; [homepage on the Internet] updated 2015; available from :<http://www.cdc.gov/healthyweight/assessing/bmi>
13. National Heart foundation in association with the faculty of Public Health and department of Health, 2007. *Lightening the load. Tackling overweight and obesity. a toolkit for developing local strategies to tackle overweight and obesity in children and adults*. [Online] London: department of Health. Available at: http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/Publications Policy and Guidance/dH_073936 [accessed May 2009].
14. Singh A, Purohit B. Evaluation of Global Physical activity Questionnaire (GPAQ) among healthy and obese health professionals in central India. *Baltic Journal of Health and Physical Activity*. 2011 Jan 1; 3(1):34-43.
15. Oseloka IA, Bello BM, Oliver HW. Association of Handgrip Strength with Body Mass Index among Nigerian Students. *IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS)*. 2014; PP 01-07

16. Kamarul T, Ahmad TS, Loh WY. Normal hand grip strength in the adult Malaysian population. *Journal of Orthopaedic Surgery*. 2006; 14(2):172-71.
17. Nascimento AS, Pinto IR, Abreu MM, Almeida SP, Fernandes B, Tomás M. Association between grip strength, anthropometric data and functional capacity. 2 health ipleiria.congresso internacional de saúde do ipleiria.
18. Madaan V, Chaudhari A. Prevalence and Risk Factor associated with Musculoskeletal Pain among Students of MGM Dental College: A cross sectional survey. *Journal of Contemporary Dentistry*. 2012 May; 2(2):22-7.
19. Apovian CM, Frey CM, Wood GC, Rogers JZ, Still CD, Jensen GL. Body mass index and physical function in older women. *Obesity Research*. 2002 Aug 1; 10(8): 740-7.
20. Koley S, Kaur N, Sandhu JS. A study on hand grip strength in female labourers of Jalandhar, Punjab, India. *J. Life Sci*. 2009; 1(1):57-62.
21. Sucharita S, Bharathi AV, Vaz MA. Effect of age and nutritional status on heart rate responses to cough and maximum handgrip. *Indian journal of physiology and pharmacology*. 2004 Jan 24; 48(1):106-10.
22. Sirajudeen MS, Shah UN, Pillai PS, Mohasin N, Shantaram M. Correlation between grip strength and physical factors in men. *International Journal of Health and Rehabilitation Sciences (IJHRS)*. 2012; 1(2):58-63.
23. Hand Grip Strength protocol. Tufts university nutrition collaborative. Center for drug abuse and AIDS research. TNC-CDAAR.1986; Revised 09/03
24. Shin H, Moon SW, Kim GS, Park JD, Kim JH, Jung MJ, Yoon CH, Lee ES, Oh MK. Reliability of the pinch strength with digitalized pinch dynamometer. *Annals of rehabilitation medicine*. 2012 Jun 1; 36(3):394-9.
25. Jansen CW, Simper VK, Stuart HG, Pinkerton HM. Measurement of maximum voluntary pinch strength:: Effects of forearm position and outcome score. *Journal of Hand Therapy*. 2003 Dec 31; 16(4):326-36.
26. Liao KH. Systematic exploring the relationship between hand-grip strength and body mass index (BMI). InThe 11th Asia Pacific Engineering and Management Systems Conference. Taiwan 2010.
27. Tajika T, Kobayashi T, Yamamoto A, Shitara H, Ichinose T, Shimoyama D, Okura C, Kanazawa S, Nagai A, Takagishi K. Relationship Between Grip, Pinch Strengths and Anthropometric Variables, Types of Pitch Throwing Among Japanese High School Baseball Pitchers. *Asian journal of sports medicine*. 2015 Mar; 6(1).
28. Habibi E, Kazemi M, Dehghan H, Mahaki B, Hassanzadeh A. Hand grip and pinch strength: Effects of workload, hand dominance, age, and body mass index. *Pak J Med Sci*. 2013; Vol. 29 No. 1
29. Thong-Ngam D. Body mass index and percentage of body fat determined physical performance in healthy personnel. *Asian Biomedicine (Research Reviews and News)*. 2012 Apr 2; 6(02):313.
30. Thong-Ngam D. Body mass index and percentage of body fat determined physical performance in healthy personnel. *Asian Biomedicine (Research Reviews and News)*. 2012 Apr 2; 6(02):313.
31. Abbas SU. Pinch Force and Work related Musculoskeletal Disorders in Dental Professionals. UCHC Graduate School Masters Theses. 2004 Jun 1:12

Table 1: Descriptive statistics: Gender and hand dominance distribution.

Variable (n=150)		Frequency (%)
Gender	Male	71 (47.33)
	Female	79 (52.67)
Hand Dominance	Right	145 (93.33)
	Left	5 (6.67)

Table 2: Descriptive statistics of Age, Body Mass Index, Grip Strength, Lateral Pinch, Pad to Pad and Tip to Tip pinch strength.

Variables (n=150)	Minimum	Maximum	Mean	Standard Deviation	
Age (Year)	23	40	26.05	2.95	
Body Mass Index Score	16.40	34.72	23.3	3.79	
Grip Strength (Kg)	6.60	49.30	25.08	7.47	
Pinch Strength (Kg)	Lateral Pinch	2.80	13.50	5.99	1.96
	Pad to Pad	2.00	11.80	4.42	1.59
	Tip to Tip	0.60	6.50	2.77	1.17

Table 3: Inferential statistics of correlation between Body Mass Index and Grip Strength

Variable (n=15U)	Mean (Standard Deviation)	Correlation coefficient "r"	p value
Body Mass Index	23.33(3.79)	0.233	0.004
Grip Strength	25.07(7.47)		

Table 4: Inferential statistics of correlation between Body Mass Index and Lateral Pinch strength

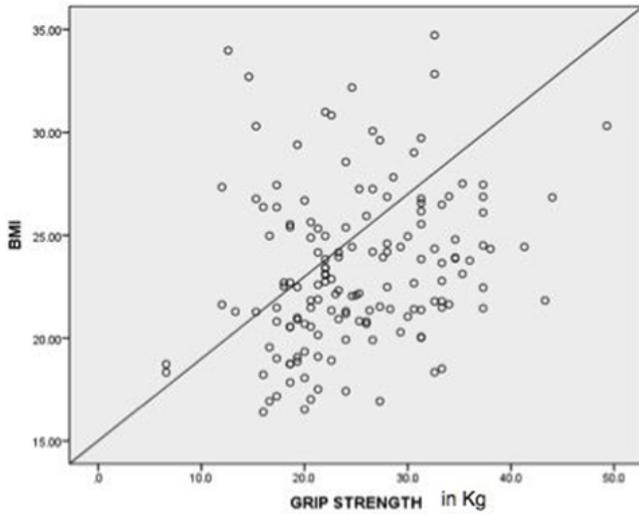
Variable (n=15U)	Mean (SD)	Correlation coefficient "r"	p value
Body Mass Index	23.33 (3.79)	0.259	0.01
Lateral Pinch strength	5.99 (1.96)		

Table 5: Inferential statistics of correlation between Body Mass Index and Pad to Pad pinch strength

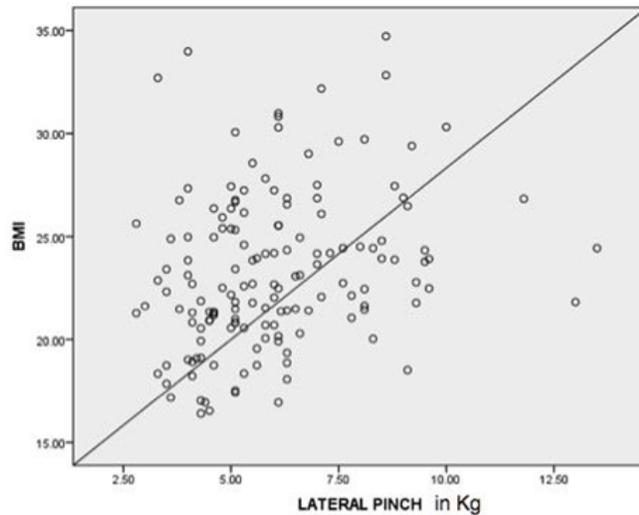
Variable (n=150)	Mean (Standard deviation)	Correlation coefficient "r"	p Value
Body Mass Index	23.33 (3.79)	0.209	0.05
Pad to Pad pinch strength	4.42 (1.59)		

Table 6: Inferential statistics of correlation between Body Mass Index and Tip To tip pinch strength

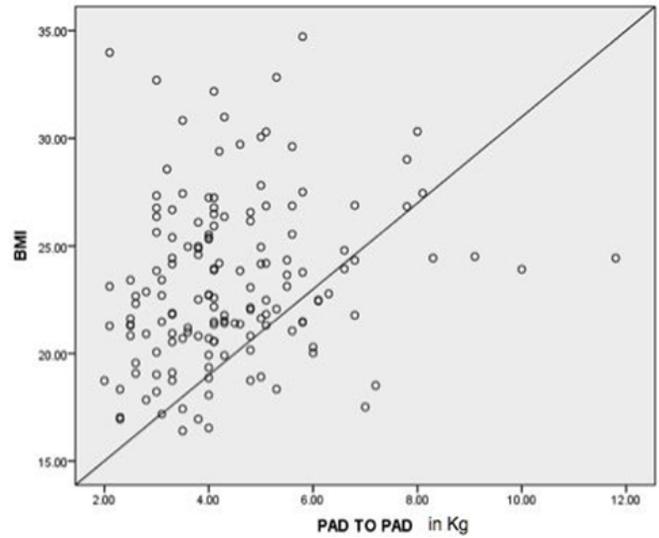
Variable (n=150)	Mean (Standard deviation)	Correlation coefficient "r"	p Value
Body Mass Index	23.33 (3.79)	0.169	0.05
Tip to Tip pinch strength	2.77 (1.17)		



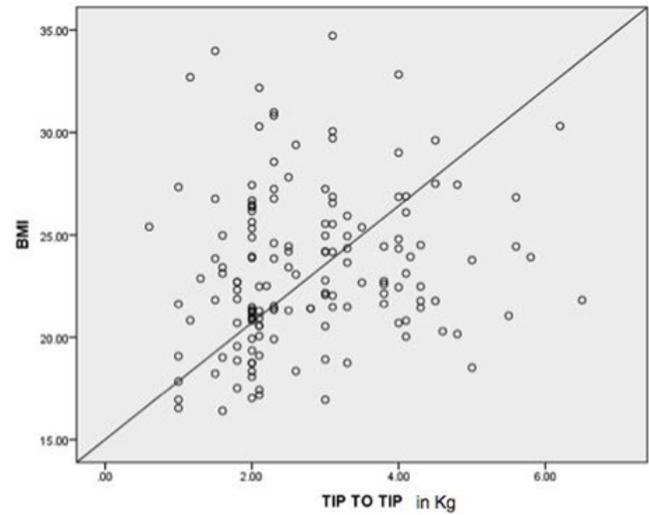
Graph 1: Scatter plot of correlation between body mass index and grip strength



Graph 2: Scatter plot of correlation between body mass index and lateral pinch strength



Graph 3: Scatter plot of correlation between body mass index and pad to pad pinch strength



Graph 4: Scatter plot of correlation between body mass index and tip to tip pinch strength

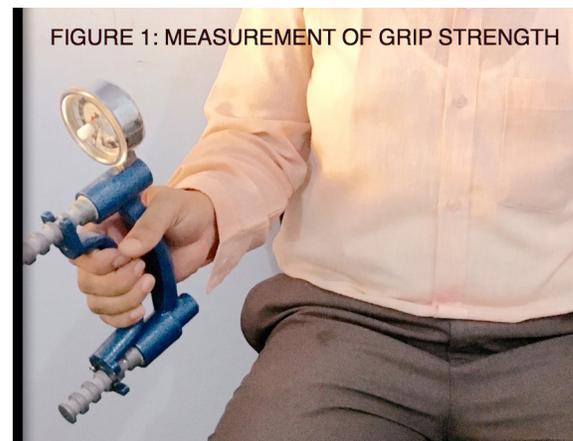


FIGURE 1: MEASUREMENT OF GRIP STRENGTH

