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re: Musculoskeletal pain and its relation to individual and work-related factors: A cross-sectional study among Turkish office workers

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This is the abstract:
Purpose

Office workers are commonly exposed to work-related musculoskeletal pain. This study investigated the individual and work-related risk factors linked to musculoskeletal pain and pain-related disability among Turkish office workers.

Materials and Methods

One-hundred-fifty office workers were included. Data was collected using the online survey with a combination of the Standardized Scandinavian Musculoskeletal Questionnaire, Oswestry Disability Index (ODI), Neck Disability Index (NDI), Disabilities of the Arm, Shoulder, and Hand questionnaire short form (Q-DASH). The participants were divided into four subgroups: no pain (n=26), low back pain (n=37), neck pain (n=49) and upper extremity pain (n=38).

Results

There were differences between subgroups in terms of condition that feet touch the floor and condition that keyboard, mouse, and wrist are in the straight line (p=0.01 and p=0.02, respectively). The working year was correlated with the ODI score (rho=0.80, p=0.04). There was also significant correlation between the NDI score and working hours (rho=0.41, p=0.003), while Q-DASH was correlated with body mass index and working years (rho=0.40, p=0.01, and rho=0.32, p=0.04, respectively).

Conclusion

The disability-related pain was found associated with various modifiable risk factors such as physical inactivity, body mass index, working hours, working years, and workplace ergonomics in the office workers.

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Musculoskeletal pain and its relation to individual and work-related factors: A cross-sectional study among Turkish office workers

--Manuscript Draft--

Full Title:	Musculoskeletal pain and its relation to individual and work-related factors: A cross-sectional study among Turkish office workers
Manuscript Number:	JOSE-2020-0211
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Keywords:	low back; musculoskeletal disorders; neck pain; upper extremity; working conditions
Manuscript Classifications:	Ergonomics; Occupational safety and health; Other; Risk assessment
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Musculoskeletal pain and its relation to individual and work-related factors: A cross-sectional study among Turkish office workers

No financial support or other benefits from commercial sources have been provided for this study.

With regard to the work, no conflict of interest exists.

Ethical approval for this study was obtained from the Non-Interventional Clinical Research Ethics Committee of ……University (Approval number: ……..).

This study has been registered on ClinicalTrials.gov with the registration number NCTXXXXX

ABSTRACT

Purpose: Office workers are commonly exposed to work-related musculoskeletal pain. This study investigated the individual and work-related risk factors linked to musculoskeletal pain and pain-related disability among Turkish office workers.

Materials and Methods: One-hundred-fifty office workers were included. Data was collected using the online survey with a combination of the Standardized Scandinavian Musculoskeletal Questionnaire, Oswestry Disability Index(ODI), Neck Disability Index(NDI), Disabilities of the Arm, Shoulder, and Hand questionnaire short form(Q-DASH). The participants were divided into four subgroups: no pain (n=26), low back pain (n=37), neck pain (n=49) and upper extremity pain (n=38).

Results: There were differences between subgroups in terms of condition that feet touch the floor and condition that keyboard, mouse, and wrist are in the straight line (p=0.01 and p=0.02, respectively). The working year was correlated with the ODI score (rho=0.80, p=0.04). There was also significant correlation between the NDI score and working hours (rho=0.41, p=0.003), while Q-DASH was correlated with body mass index and working years (rho=0.40, p=0.01, and rho=0.32, p=0.04, respectively).

Conclusions: The disability-related pain was found associated with various modifiable risk factors such as physical inactivity, body mass index, working hours, working years, and workplace ergonomics in the office workers.

Keywords: low back; musculoskeletal disorders; neck pain; upper extremity; working conditions

1. Introduction

Office work, mainly involving computer use, meetings, presentations, reading, and telephone calls, can be characterized as a sedentary work [1]. Office work may require prolonged static work posture, working in awkward positions, or performing repetitive manual tasks typically involves activities such as reading, writing, and typing [2,3]. Current literature showed that office workers had been spent on average three-quarters of their working hours sitting, moreover, workplace sitting is one of the significant contributors to total daily sitting time in office workers [4]. Because of adverse effects of physical inactivity, computer work and excessive sitting have been perceived as an emerging occupational safety and health issue, and also identified as a considerable risk factor for musculoskeletal disorders [5,6].

Musculoskeletal symptoms such as low back pain and neck pain or upper extremity pain are commonly reported in office workers [2,3,7]. There has been some attention in the literature regarding the relationship between physical factors in the workplace, and the physical condition of the individual (e.g., flexibility, strength, posture, level of physical activity), and the development of musculoskeletal pain [1-3,7]. For example, the prolonged sitting posture and the inappropriate placement of computer devices have been closely linked with the rising prevalence and incidence of musculoskeletal pain in office workers [2,7,8]. Although office workers are often exposed to musculoskeletal pain, which might be considered a significant work-related health problem for this group, the most effective treatment is not yet described [7]. Therefore, prevention is regarded as the best strategy to eliminate the adverse consequences of musculoskeletal pain related to work [9].

Identifying the associated risk factors, especially those that can be modified, is the first and the most important step in prevention. The evidence reporting the contribution of physical factors related to an individual's occupation, psychosocial factors, organizational factors, and

individual factors to musculoskeletal pain among office workers has been increasing day by day [10]. Musculoskeletal pain in different regions of the body are linked with various risk factors; for example, the risk factors for neck pain do not have to be the same as those for low back pain or upper extremity pain [2,7,8]. In addition, risk factors related to wrist pain might be different from factors that cause shoulder pain, so risk factors for musculoskeletal pain region should be defined separately for each part of the body. On the other hand, most studies investigating the individual and work-related risk factors, which lead to musculoskeletal pain, have been conducted in European countries and North America. Because of the difference in health, economic, and social systems, their results are not generalizable to other countries. Therefore, the present study aimed to investigate the individual and work-related risk factors linked to musculoskeletal pain and pain-related disability among Turkish office workers.

2. Materials and methods

2.1.Study Design

The present study was a cross-sectional design study and was conducted from November 2019 to December 2019. The rights of subjects were protected. Also, they were asked to sign an informed consent form that had been approved by the Human Research Ethics Committee of …… University (Approval number:……). This study has been registered on ClinicalTrials.gov with the registration number …..

2.2.Participants

One hundred-fifty participants, who were office workers in Turkey, were included in the present study. The participants consisted of employees who work in an office, for example carrying out clerical or administrative work for an organization. Inclusion criteria were determined as aged between 18 and 55 years, men or women, an office worker who occupy in the current office at least six months, able to understand and read Turkish as a language. Participants excluded from

the study if they had a diagnosis of musculoskeletal disease, spine curvature disorders such as scoliosis, kyphosis, kyphoscoliosis, undergone surgery affecting the musculoskeletal system within the last 1-month, or been pregnant.

"Sample Size Calculators" is an online sample size calculation web service that was used to calculate the sample size (https://www.sample-size.net/). The calculations were based on an alpha level of 0.05, a β level of 20%, the expected correlation coefficient of 0.40 to 0.69 (moderate correlation), and the desired power of 80% [11]. These parameters generate a necessary sample size of at least 14 to 47 participants for each group. Thus, a total of 200 participants were invited to the study.

2.3.Study Protocol

Data collection was carried out using the online survey. The online survey link was delivered via corporate e-mail to office workers. The questionnaire created through Google forms was delivered to the participants via the link. The link had been active within a month for the data collection process. The participants were informed about the fact that the study was carried out for scientific purposes, and the information was not shared with third parties. Before they started the questionnaire, they were asked whether they were willing to participate. All participants answered "yes" to the question, "Do you agree to participate in the survey?". Thus, all participants have provided voluntary consent to participate.

2.4.Outcome measures

The socio-demographic characteristics (age, sex, body mass index (BMI)) and health status (presence of chronic disease, medication, and history of injury) were questioned. In addition, information was collected about working hours in a day and working days in a week in the current job, and the total working years. Exercise habits (yes or no) and the number of daily steps per day tracked by smartphone applications were assessed. Participants were asked to

answer the question by taking account of their number of daily steps in the last week [12]. Under 5000 steps per day was considered as inactive, 5000 to 7499 steps per day considered as low active, 7500 to 9999 steps per day was considered as somewhat active, and 10000 steps per day considered active [13]. In addition, it was questioned whether the working environments of the participants were appropriate for the visual arrangement through visuals containing necessary arrangements that must be in the proper office ergonomics (Appendix).

The Standardized Scandinavian Musculoskeletal Questionnaire (NMQ) was used to assess musculoskeletal complaints. NMQ is a questionnaire that evaluates waist, neck, shoulder, and general musculoskeletal complaints with standardized questions. Pain and discomfort was questioned in the last 12 months and the last seven days, the mapping of the body in specific nine regions (feet-ankles, knees, thighs, hips, ankles, hands, wrist, elbows, back, shoulders, neck) and whether this situation interferes with the usual work [14,15]. At the end of the NMQ, the participants were encountered by the question of “Do you have any pain related to the musculoskeletal system? and Which region is the most painful?". Surveys of participants who do not feel any pain due to the musculoskeletal system were completed. Participants with musculoskeletal pain were referred to the assessment questionnaire appropriate for the localization of the region where they feel the most pain. According to the pain region, the participants were divided into four subgroups, such as no pain, low back pain, neck pain, and upper extremity pain.

The Oswestry Disability Index (ODI) was used to determine the degree of disability in individuals with low back pain. ODI consists of a total of 10 items measuring the severity of pain, personal care, lifting, walking, sitting, standing, social life, sleep, travel, and pain. Each item is rated between 0-5. As the total score increases, the level of disability increases. The maximum score is 50 points; it is evaluated as severe between 31-50 points, moderate between 11-30 points, and mild between 1-10 points. The total score obtained from the patient can be

converted to the percentage system and calculated as a percentage [16,17]. Also, the optimal cut-off value of the ODI was estimated to be 12 on low back pain with disability [18].

Participants with neck pain were evaluated with the Neck Disability Index (NDI). The Neck Disability Index is based on the Oswestry Disability Index and consists of 10 topics. Pain sensitivity includes personal care, weightlifting, reading, headaches, concentration, work/work, driving, sleep, and social activities. Each question has six response options that measure the severity of pain or limitation. Scoring is done between 0-5, and the total score is calculated between 0-50 points. According to the total score, there is no limitation between 0-4 points; Slight limitation of 5-14; Moderate limitation of 15-24; Serious limitations between 25-34; 34 and above are classified as totally restricted [19,20]. In addition, the optimal cut-off value of the NDI was estimated to be 15 on neck pain with disability [21].

The Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire short form (Quick DASH, Q-DASH) was used for participants with wrist, shoulder, or arm pain. Q-DASH is a regional outcome measure developed for upper extremity musculoskeletal disorders. It should include 11 questions; at least 10 of 11 questions should be answered to calculate the score of the scale reported to be used instead of DASH. Each question is scored on a 5-point scale, and a final score ranging from 0 (no disability) to 100 (severe disability) is calculated [22,23]. Also, the cut off value of the Q-DASH was determined, in which a score of less than 15 is interpreted as "no problem," a score of 16-40 represents “problem, but working," and a score of greater than 40 represents “unable to work” [24]

2.5.Statistical analysis

The data were analysed using the statistical package for the social sciences (SPSS version 22.0) software. The results have been reported as descriptive statistics. The Kolmogorov–Smirnov test was used to test for normal distribution of data before the statistical analysis. Demographic

variables were compared between the groups using a Kruskal-Wallis H test for continuous variables and a chi-square test for categorical data. Intercorrelations between parameters were computed through Spearman correlation analysis. Correlation coefficient (rho) was interpreted as: 0.00-0.10 negligible correlation; 0.10-0.39 weak correlation; 0.40-0.69 moderate correlation 0.70-0.89 strong correlation; and 0.90-1.00 very strong correlation [11].

3. Results

Two hundred participants were screened for possible for inclusion. Thirteen office workers declined to participate in the study and thirty-seven participants were excluded due to various reasons (diagnosis of musculoskeletal disease, pregnancy, undergone surgery affecting the musculoskeletal system within the last 1-month, etc.). One-hundred-fifty participants (mean age, 31.95±8.45 years; 80 female; mean BMI, 24.35±4.13 kg/m2) were included in the study.

Participants have been working 8.95± 3.99 hours in a day, 5.27±0.84 days a week at an office, and had been occupied in this position for at least a year. A total of 17.3% participants stated that they do not have any pain, twenty women and seventeen men participated of which 24.7% had low back pain, twenty-seven women and twenty-two men participated of which 32.7% had neck pain, twenty-five women and thirteen men participated of which 25.3% had upper extremity pain. The characteristics of the participants, according to the musculoskeletal pain region, are presented in Table 1. Participants with upper extremity pain had significantly lower age than participants with low back pain and participants with neck pain ($p=0.03$ and $p=0.002$, respectively). No differences were found between four subgroups in terms of sex, BMI, working hours, working days, and working years ($p>0.05$). There is no difference in regular exercise habits between subgroups, but the number of daily steps was statistically significantly different between subgroups ($p=0.03$). Forty percent of the participants were inactive, 26% of the participants were low active, 7.3% of the participants were somewhat active, and 10% of

participants were active. However, approximately 17% of them had no idea about their daily steps per day (Table 1).

Table 2 demonstrates the differences between "yes" and "no" responders in terms of proper workplace ergonomics according to the musculoskeletal pain region. There is a difference between subgroups in terms of the position that participants' feet touch the floor comfortably, and position that keyboard, mouse position, and wrists of participants are in the straight line ($p=0.01$ and $p=0.02$, respectively). Approximately 50% of participants in each subgroup consisted of painful participants stated that the contact of feet with the ground is not appropriate with the shown image ($p=0.01$). It was observed that keyboard, mouse usage position and wrist straight alignment of participants was improper in 39.5% of participants with upper extremity pain, 27% of participants with low back pain, and 18.4% of participants with neck pain (Table 2).

The mean ODI score was 44.05±10.20 points in participants with low back pain, the mean NDI score was 21.10±12.44 points in participants with neck back pain, and the mean Q-DASH score was 28.94±19.53 points in participants with upper extremity pain. Spearman's correlation analysis showed that the working year was significantly correlated with the mean ODI score ($rho=0.80$, $p=0.04$). There was also a significant correlation between the mean NDI score and working hours ($rho=0.41$, $p=0.003$), while Q-DASH was significantly correlated with age and working years ($rho=0.40$, $p=0.01$, and $rho=0.32$, $p=0.04$, respectively) (Table 3).

4. Discussion

The present study found that a 12-months prevalence of musculoskeletal pain, especially in the neck, upper extremity, and low back, is high among Turkish office workers. Also, approximately 78% of participants did not have a regular exercise habit, while 66% of those were inactive or less active. It was observed that there was a difference between participants in

terms of proper workplace ergonomics according to the presence of musculoskeletal pain. Almost half the participants with low back, neck, and upper extremity pain were indicated that feet do not touch the floor, while 39.5% of those with upper extremity pain stated that the keyboard, mouse, and wrist are not a straight line. The disability-related pain was found associated with various factors such as BMI, working hours, and years among the participants with musculoskeletal pain.

Recent studies indicated that musculoskeletal pain, which was associated with several work-related factors, are commonly reported in low back and neck region among office workers [24-27]. Consistent with previous findings, our findings showed that neck pain was the most prevalent musculoskeletal complaints, and the second one is upper extremity pain in office workers [2,7,8,28]. Moreover, Hanna et al. pointed out that there was a significant association between both upper and lower back pain and vigorous physical activity, with the latter being protective of back pain in sedentary type workers [29]. Another study emphasized that physical inactivity in leisure time is found to be related to higher prevalence rates of symptoms in especially workers with sedentary tasks such as professional groups similar to the occupation profile in our study [30]. The physical capacity was also found to be related with the presence of neck and low back symptoms in office workers in a recent study [31]. Therefore, it should not be underestimated that higher levels of activity are associated with suffering less pain and more pain inhibition

Prolonged sitting, static posture, and uncomfortable back support were all found to be associated with low back pain, shoulder pain, and upper back pain [5,25,29]. Besides, it has been proposed that mouse position, chair position, prolonged inactivity, monitor placement, and lack of ergonomic knowledge are one of the factors leading to neck pain [2,8,26,32]. Beyond the statistical significance, our findings demonstrated that office workers with musculoskeletal pain had worse workplace ergonomics than office workers without pain in

terms of average eye-screen distance, presence of foot support, the comfort of the foot, and non-ergonomic chair. Gathered information from shown workplace ergonomic images showed that keyboard, mouse, and wrist straight alignment was highly improper, especially in the office workers with upper extremity pain compared to those without pain. Similarly, office workers who have low back pain, upper extremity, or neck pain have mostly reported that their feet do not touch the floor while sitting in our study. Office ergonomic training might reduce musculoskeletal disorders in office workers; thus, the importance of ergonomic knowledge in office workers should be underlined once more [33].

In this study, office workers with neck pain or low back pain had moderate to severe limitations in terms of the NDI and ODI [18,21]. It has been found that disability-related neck pain is getting worse with the increase in working hours, and disability-related low back pain is getting worse with the increase in working years in our study. Ergonomic conditions and workplace physical exposures such as repetitive work, improper work postures, and awkward computer workstation setup were found to be associated with the incidence of musculoskeletal pain in office workers [2,8,29]. A recent study concluded that Turkish office workers who have been at their desks for long periods in the improper positions of computer usage and sitting positions have an adverse effect on musculoskeletal pain in the lower back, upper back, shoulder, neck, arm and foot [27]. These findings are in line with our results, which indicated that office workers with musculoskeletal pain have mostly been working in the improper office ergonomics. Additionally, it was observed that the disability scores according to pain region increase as the working year or working hours increased. Therefore, working in a non-ergonomic place can be considered as a risk factor causing musculoskeletal pain and pain related disability. Furthermore, office workers with upper extremity pain could be categorized as office workers who continued working despite the upper extremity problems according to their mean Q-DASH score [24]. In the literature it was demonstrated that the predictors of upper

277 extremity symptoms consist of ergonomic conditions such as an uncomfortable sitting posture,
278 nonadjustable desk usage and work related conditions such as working on a computer for more
279 than five hours, less breaks during working period [34]. Our results showed that keyboard,
280 mouse usage position and wrist straight alignment of participants was improper in
281 approximately forty percent of participants with upper extremity pain. It was also found that
282 the upper extremity pain is getting worse with the BMI increase. It can be interpreted as it
283 becomes challenging to maintain proper posture and to reach the objects on the table as the
284 body becomes disproportionate. Therefore, both ergonomic factors related to work and
285 individual factors that contribute to upper extremity pain should be considered in office worker.

286 This study has some limitations that should be highlighted. First, the cross-sectional design of
287 the study resulted in the identification of several associations between variables, although it was
288 not possible to determine the causal relationships. Second, the data collection was performed
289 using participants' self-reporting due to resource constraints; therefore, the accuracy of the
290 collected data may be compromised. Self-reported data gathered by questionnaires are always
291 prone to certain types of biases, such as recall bias and/or responder bias. Third, the study
292 population was limited to office workers, so the results could not be generalized to other
293 workers.

294

295 **5. Conclusion**

296 This cross-sectional study revealed that musculoskeletal pain is linked to various individual and
297 work-related factors in Turkish office workers. The individual factors leading to
298 musculoskeletal pain consisted of physical inactivity and a high BMI. The results suggested
299 that inadequate workplace ergonomics, specifically the average eye-screen distance, foot
300 support, the comfort of the foot areas under the desk, feet touch the floor, chair height, arm, and
301 backrest, line between keyboard, mouse, and wrist are linked to improper working postures.

Therefore, these work-related factors were contributing to musculoskeletal pain in office workers. Besides, working with improper posture for a long working time and continuing this for many years led to an increase in disability-related musculoskeletal pain in office workers. This study suggests that sedentary type office workers need eliminating the individual and work-related risk factors, which are mostly modifiable risk factors, to promote their musculoskeletal health.

Disclosure Statement

The authors declare that there are no possible conflicts of interest. The authors would like to thank all participants.

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Table 1. Characteristics of the study population according to the musculoskeletal pain region.

Parameters		Pain Region according to the NMQ				p
	Total	No pain	Low back pain	Neck pain	Upper extremity pain	
	(n=150)	(n=26)	(n=37)	(n=49)	(n=38)	
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	
Age, (year)*	31.95±8.45	30.30±5.86	32.54±8.16	34.75±10.54	28.89±5.87	***0.01***
Sex, n (%)**						
Female	80 (53.3)	8 (30.7)	20 (54.0)	27 (55.1)	25 (65.7)	0.06
Male	70 (46.7)	18 (69.3)	17 (46.0)	22 (44.9)	13 (34.3)	
BMI (kg/m^2)*	24.35±4.13	25.48 ± 4.19	24.22 ± 3.89	23.05 ± 4.34	24.87 ± 3.82	0.06
Smoking habits, n (%)**						
Never smoker	60 (40)	15 (57.7)	18 (48.6)	17 (34.7)	16 (42.1)	0.30
Former smoker	24 (16)	1 (3.8)	5 (13.5)	12 (24.5)	6 (15.8)	
Current smoker	66 (44)	10 (38.5)	14 (37.8)	20 (40.8)	16 (42.1)	
Working hours*	8.95±3.99	8.73±1.47	8.24±1.11	8.71±1.93	9.26±5.48	0.29
Working days*	5.27±0.84	5.38±0.50	5.27±0.45	5.20± 1.00	5.29±1.06	0.76
Working years*	9.31±8.69	9.27±7.04	8.76±7.17	11.94±11.60	6.47±5.34	0.06
Exercise Habits, n (%)**						
Yes	34 (22.7)	18 (69.2)	4 (10.8)	13 (26.5)	8 (21.1)	0.21
No	116 (77.3)	8 (30.8)	33 (89.2)	36 (73.5)	30 (78.9)	
Number of steps per day, n (%)**						
< 5000 steps	60 (40)	9 (34.6)	17 (45.9)	18 (36.7)	16 (42.1)	
5000 - 7499 steps	39 (26)	10 (38.5)	6 (16.2)	12 (24.5)	11 (28.9)	***0.03***
7500 - 9999 steps	11 (7.3)	0(0)	6 (16.2)	2 (4.1)	3 (7.9)	
>10000 steps	15 (10)	1 (3.8)	0(0)	10 (20.4)	4 (10.5)	
Have no idea	25 (16.7)	6 (23.1)	8 (21.6)	7 (14.3)	4 (10.5)	

Group 1: No pain; Group 2: Low back pain; Group 3: Neck pain; Group 4: Upper extremity pain.

Abbreviations: n, number; NMQ, the Standardized Scandinavian Musculoskeletal Questionnaire; SD, standard deviation.

*_Kruskal–Wallis H test_; significance level set at <0.05.

**Chi-square test; significance level set at <0.05.

Table 2. The differences between "yes" and "no" responders in terms of proper workplace ergonomics according to the musculoskeletal pain region.

Workplace Ergonomics	No pain (n=26)	Low back pain (n= 37)	Neck pain (n=49)	Upper extremity pain (n= 38)	p*
	n (%)	n (%)	n (%)	n (%)	
Average eye-screen distance					
Yes	20 (76.9)	30 (81.1)	32 (65.3)	23 (60.5)	0.18
No	6 (23.1)	7 (18.9)	17 (34.7)	15 (39.5)	
Table width					
Yes	25 (96.2)	33 (89.2)	42(85.7)	28 (73.7)	0.07
No	1 (3.8)	4 (10.8)	7 (14.3)	10 (26.3)	
The comfort of the foot areas under the desk					0.80
Yes	19 (73.1)	26 (70.3)	35 (71.4)	24 (63.2)	
No	7 (26.9)	11 (29.7)	14 (28.6)	14 (36.8)	
Feet touch the floor					
Yes	22 (84.6)	19 (51.4)	24 (49.0)	17 (44.7)	***0.01***
No	4 (26.8)	18 (48.6)	25 (51.0)	21 (55.3)	
Foot support					
Yes	18 (69.2)	21 (56.8)	28 (57.1)	23 (60.5)	0.74
No	8 (30.8)	16 (43.2)	21 (42.9)	15 (39.5)	
The chair moves back and forth 360°					
Yes	22 (84.6)	29 (78.4)	37 (75.5)	25 (65.8)	0.34
No	4 (15.4)	8 (21.6)	12 (24.5)	13 (34.2)	
Keyboard and mouse level at the same level					0.29
Yes	22 (84.6)	29 (78.4)	39 (79.6)	25 (65.8)	
No	4 (15.4)	8 (21.6)	10 (20.4)	13 (34.2)	
Keyboard, mouse, and wrist are straight line					***0.02***
Yes	24 (92.3)	27 (73)	40 (81.6)	23 (60.5)	
No	2 (7.7)	10 (27)	9 (18.4)	15 (39.5)	

*Chi-square test; significance level set at <0.05.

Table 3. The relation between the level of disability and age, the body mass index, working hours, working days, and working hours according to the musculoskeletal pain region.

Variables	Low back pain ODI (n= 37)	Neck pain NDI (n=49)	Upper extremity pain Q-DASH (n= 38)
	rho(p)	rho(p)	rho(p)
Age	0.02(0.88)	-0.09(0.84)	0.07(0.64)
BMI	-0.01(0.97)	-0.02(0.84)	***0.40(0.01)***[*]
Working hours	-0.05(0.74)	***0.41(0.003)***[**]	0.08(0.61)
Working days	-0.16(0.33)	0.26(0.06)	-0.16(0.33)
Working years	***0.80(0.04)***[*]	-0.22(0.12)	***0.32(0.04)***[*]

Abbreviations: BMI, Body mass index; NDI, Neck disability index; ODI, Oswestry disability index; Q-DASH, The disabilities of the arm, shoulder and hand questionnaire short form.

[*]Spearman correlation test, correlation is significant at the $p<0.05$ level. (2-tailed).

[**]Spearman correlation test, correlation is significant at the $p<0.01$ level. (2-tailed).

Table 1. Characteristics of the study population according to the musculoskeletal pain region.

Parameters		Pain Region according to the NMQ				p
	Total	No pain	Low back pain	Neck pain	Upper extremity pain	
	(n=150)	(n=26)	(n=37)	(n=49)	(n=38)	
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	
Age, (year)*	31.95±8.45	30.30±5.86	32.54±8.16	34.75±10.54	28.89±5.87	***0.01***
Sex, n (%)**						0.06
Female	80 (53.3)	8 (30.7)	20 (54.0)	27 (55.1)	25 (65.7)	
Male	70 (46.7)	18 (69.3)	17 (46.0)	22 (44.9)	13 (34.3)	
BMI (kg/m^2)*	24.35±4.13	25.48 ± 4.19	24.22 ± 3.89	23.05 ± 4.34	24.87 ± 3.82	0.06
Smoking habits, n (%)**						0.30
Never smoker	60 (40)	15 (57.7)	18 (48.6)	17 (34.7)	16 (42.1)	
Former smoker	24 (16)	1 (3.8)	5 (13.5)	12 (24.5)	6 (15.8)	
Current smoker	66 (44)	10 (38.5)	14 (37.8)	20 (40.8)	16 (42.1)	
Working hours*	8.95±3.99	8.73±1.47	8.24±1.11	8.71±1.93	9.26±5.48	0.29
Working days*	5.27±0.84	5.38±0.50	5.27±0.45	5.20± 1.00	5.29±1.06	0.76
Working years*	9.31±8.69	9.27±7.04	8.76±7.17	11.94±11.60	6.47±5.34	0.06
Exercise Habits, n (%)**						0.21
Yes	34 (22.7)	18 (69.2)	4 (10.8)	13 (26.5)	8 (21.1)	
No	116 (77.3)	8 (30.8)	33 (89.2)	36 (73.5)	30 (78.9)	
Number of steps per day, n (%)**						***0.03***
< 5000 steps	60 (40)	9 (34.6)	17 (45.9)	18 (36.7)	16 (42.1)	
5000 - 7499 steps	39 (26)	10 (38.5)	6 (16.2)	12 (24.5)	11 (28.9)	
7500 - 9999 steps	11 (7.3)	0(0)	6 (16.2)	2 (4.1)	3 (7.9)	
>10000 steps	15 (10)	1 (3.8)	0(0)	10 (20.4)	4 (10.5)	
Have no idea	25 (16.7)	6 (23.1)	8 (21.6)	7 (14.3)	4 (10.5)	

Group 1: No pain; Group 2: Low back pain; Group 3: Neck pain; Group 4: Upper extremity pain.

Abbreviations: n, number; NMQ, the Standardized Scandinavian Musculoskeletal Questionnaire; SD, standard deviation.

*_Kruskal–Wallis H test_; significance level set at <0.05.

**Chi-square test; significance level set at <0.05.

Table 2. The differences between "yes" and "no" responders in terms of proper workplace ergonomics according to the musculoskeletal pain region.

Workplace Ergonomics	No pain (n=26)	Low back pain (n= 37)	Neck pain (n=49)	Upper extremity pain (n= 38)	p*
	n (%)	n (%)	n (%)	n (%)	
Average eye-screen distance					
Yes	20 (76.9)	30 (81.1)	32 (65.3)	23 (60.5)	0.18
No	6 (23.1)	7 (18.9)	17 (34.7)	15 (39.5)	
Table width					
Yes	25 (96.2)	33 (89.2)	42(85.7)	28 (73.7)	0.07
No	1 (3.8)	4 (10.8)	7 (14.3)	10 (26.3)	
The comfort of the foot areas under the desk					0.80
Yes	19 (73.1)	26 (70.3)	35 (71.4)	24 (63.2)	
No	7 (26.9)	11 (29.7)	14 (28.6)	14 (36.8)	
Feet touch the floor					
Yes	22 (84.6)	19 (51.4)	24 (49.0)	17 (44.7)	***0.01***
No	4 (26.8)	18 (48.6)	25 (51.0)	21 (55.3)	
Foot support					
Yes	18 (69.2)	21 (56.8)	28 (57.1)	23 (60.5)	0.74
No	8 (30.8)	16 (43.2)	21 (42.9)	15 (39.5)	
The chair moves back and forth 360°					
Yes	22 (84.6)	29 (78.4)	37 (75.5)	25 (65.8)	0.34
No	4 (15.4)	8 (21.6)	12 (24.5)	13 (34.2)	
Keyboard and mouse level at the same level					0.29
Yes	22 (84.6)	29 (78.4)	39 (79.6)	25 (65.8)	
No	4 (15.4)	8 (21.6)	10 (20.4)	13 (34.2)	
Keyboard, mouse, and wrist are straight line					***0.02***
Yes	24 (92.3)	27 (73)	40 (81.6)	23 (60.5)	
No	2 (7.7)	10 (27)	9 (18.4)	15 (39.5)	

*Chi-square test; significance level set at <0.05.

Table 3. The relation between the level of disability and age, the body mass index, working hours, working days and working hours according to the musculoskeletal pain region.

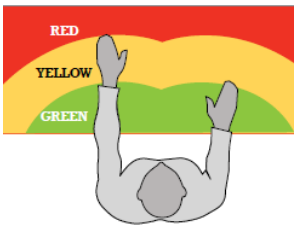
Variables	Low back pain ODI (n= 37)	Neck pain NDI (n=49)	Upper extremity pain Q-DASH (n= 38)
	rho(p)	rho(p)	rho(p)
Age	0.02(0.88)	-0.09(0.84)	0.07(0.64)
BMI	-0.01(0.97)	-0.02(0.84)	***0.40(0.01)****
Working hours	-0.05(0.74)	***0.41(0.003)****	0.08(0.61)
Working days	-0.16(0.33)	0.26(0.06)	-0.16(0.33)
Working years	***0.80(0.04)****	-0.22(0.12)	***0.32(0.04)****

Abbreviations: BMI, Body mass index; NDI, Neck disability index; ODI, Oswestry disability index; Q-DASH, The disabilities of the arm, shoulder and hand questionnaire short form.

*Spearman correlation test, correlation is significant at the $p<0.05$ level. (2-tailed).

**Spearman correlation test, correlation is significant at the $p<0.01$ level. (2-tailed).

Appendix: Proper Workplace Ergonomics*

Average eye-screen distance The position of the monitor should be at least 20 inches (51 cm) from the eye level—about an arm's length distance.	
Table width The width of the table should be such that it can easily reach the items on the table. - Frequently used objects should be located up close in the "green" zone. - Objects that are used less often can be placed in the midrange area, the "yellow" zone. - Seldom used objects can be placed in the "red" zone.	
The comfort of the foot areas under the desk There should be enough space where the feet can be easily extended under the table and the body can be easily moved. **Feet touch the floor** The feet should be flat on the ground, the knee should be at an angle of 90 degrees, the part supporting the waist should be in the chair, the back should be upright, the shoulders should be comfortable, the elbows should be at an angle of 90 degrees and the wrist should be kept in the neutral position. **Foot support** Feet should be on the ground. If this is not possible, foot support should be used.	
The chair moves back and forth 360° The chair should be able to go back and forth, turn 360 degrees, adjustable in height, support the waist, and support the back.	
Keyboard and mouse level at the same level The keyboard and mouse must be at the same height for proper hand-mouse placement. **Keyboard, mouse, and wrist are straight line** While using the keyboard and mouse, the wrist should be kept in a straight line.	

**Office ergonomics: Self-assessment worksheet (https://ehs.oregonstate.edu/ergonomics-office-setting).*

Reviewer Recommendation and Comments for Manuscript Number JOSE-2020-0211

Musculoskeletal pain and its relation to individual and work-related factors: A cross-sectional study among Turkish office workers

Original Submission
Iwan Muhamad Ramdan, Ph.D Reviewer 2

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Recommendation: Accept subject to minor revision

Overall Manuscript Rating (1 - 100):

Custom Review Question(s):	**Response**
As a thank you and to acknowledge the contribution of our reviewers, the journal may publish a list of the names of those who have reviewed at the end of the year. This will not be linked to any specific paper and will only be done if the list of reviewers is long enough to protect the anonymity of the review process for individual papers. If you would prefer for your name **not to be included** in a published list of reviewers, please indicate this below.	Include my name
If anyone else was involved in writing this report, for example a student or a colleague, and they agree to be recognised for this work please provide their name and email address in the free text box below.	-
Would you be willing to review a revision of this manuscript?	Yes
Is there a financial or other conflict of interest between your work and that of the authors?	No
Scientific Value (scale 1-5)	3 - Further work required
Practical Value (scale 1-5)	3 - Further work required
Review of Literature (scale 1-5)	3 - Not up-to-date
Statistical Analysis (scale 1-5)	5 - Very good/good
Methodology (scale 1-4)	3 - Clarification required
Style and Organization (scale 1-7)	4 - Some revision required
General Evaluation (scale 1-4)	2 - Not acceptable without major revision

Reviewer Comments to Author

Your research results are quite interesting and will be useful for the prevention of occupational diseases (MSDs) especially office workers who use computers. However, there are still many improvements and additional references (especially in the discussion) so that your research article becomes better.

Reviewer Confidential Comments to Editor:

Title:
Research subjects, research data and discussion of this article are limited to office workers who work using computers, the title of the article should be made more specific, for example ...: A cross-sectional study among Turkish office workers who work using computers.

Abstract
Line 39: Scandinavian or Nordic Musculoskeletal Questionnaire? Please check again in accordance with the reference that your citation.
Line 52 (keywords): please add "work with computer"

Study design:
Line 96-99: This section is more appropriate if transferred to the study protocol section, equipped with the approval number and ethical clearance approval using what standards?

Participants:
Line 105: Did the researcher ensure that the respondents in this study did not have other work activities outside their office that could affect their current musculoskeletal complaints?
Line 110: Did the researcher ensure that the respondents in this study did not have other work activities outside their office that could affect their current musculoskeletal complaints?

Outcome measures:
Line 128: Please explain, BMI is calculated by the respondent or calculated by researchers?What formula was used to calculate it?
Line 136: Please check again, NMQ in Dawson et al's research stands for The Nordic Musculoskeletal Questionnaire.
Line 138: Please explain, whether waist, neck, shoulder, and
general musculoskeletal complaints are a summary or simplification of 9 body parts (neck, shoulder, upper back, elbow, wrist/hand, low back, hip/thigh, knee, and ankle/foot).
Line 157: Please adding "were futher evaluated"
Line 174: Please explain, why researchers use these four measuring instruments, what are the advantages compared to other measuring tools

Discussion
Line 223: Please clarify the meaning of this sentence. What is the meaning of "a 12-months"?. Based on the standards applicable in the country/location of the study, is the prevalence of musculoskeletal disorders found to be classified as high, medium or low?
Line 245: You should compare the results of your research with the results of previous studies that are specific to workers who use computers.
Line 255: Where do researchers get this data?whether in this study respondents were asked to send pictures or photographs of their work

stations?. if yes, please include in the material and methods section.
Line 269: Your research findings are very interesting. Based on the pictures listed in the appendix, the worker has used a computer and its equipment is quite ergonomic. Seat height, monitor screen distance, etc. can be adjusted according to the user's comfort. However, musculoskeletal disorders still occur. This still requires a more detailed discussion.
Line 285: Your research found that the age of workers and the number of steps per day was significantly related to pain region according to the NMQ. Please discuss these findings, what are the implications, how to reduce pain complaints due to these two variables based on the results of similar studies, etc.
Line 293: Please include the researcher's suggestion for further similar studies so that the limitations of this research can be minimized

Conclusions
Line 296: Please add how the number of MSDs occurred
Line 298: The conclusion of the relationship between the age of workers and the number of steps per day should be written here

Table 1: Please add the Kolmogorov-Smirnov test results

Attachments:

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Subject: JOSE-2020-0435: request to review a manuscript for the International Journal of Occupational Safety and Ergonomics
Date: 16 October 2020 20.05
To: Iwan Muhamad Ramdan iwanmuhamadramdan@gmail.com

Ref. JOSE-2020-0435

Dear Dr Muhamad Ramdan,

re: Hand functionality in dentists: The effect of anthropometric dimensions and specialty

We have received a manuscript for publication in the International Journal of Occupational Safety and Ergonomics (JOSE). I would be very grateful if you could consider reviewing it for us. I would need a brief report outlining the article's merits, potential amendments to improve its quality or reasons why you may feel it is not worthy of publication in JOSE. If you feel able to support JOSE in this way, could you submit your report within 30 days? Please submit your comments online at https://www.editorialmanager.com/ijose/, where you will find space for confidential comments for the editor, comments for the author and a report form.

This is the abstract:
Background: The aim of this study was to investigate the relationship between dentists' hand functionality (handgrip, tip-to-tip, key, and palmar strengths) with dental specialty (maxillofacial surgery, endodontics, pediatric dentistry), socio-demographic factors, and six hand-forearm anthropometric dimensions.
Methods: A cross-sectional study was designed in which 720 certified dentists (330 males and 390 females) voluntarily participated in the study. A tape meter (± 0.1cm), and a digital Caliper (± 0.1 mm) were used to measure anthropometric dimensions. Jamar hydraulic dynamometer and pinch gauge were used to measure Handgrip Strength (HGS) as well as tip-to-tip, key, and palmar pinches.
Results: Hand strengths decreased with age and clinical experience, and were always greater in male than female dentists. Maxillofacial surgeons of 35-39 years attained the highest values of handgrip and key pinch strengths, while 30-34 years endodontists attained the peak values of tip-to-tip pinch strength. Among measured hand dimensions, forearm circumference was significantly greater in maxillofacial surgeons compared with endodontists and pediatric dentists.
Conclusion: Hand functionality is specialty-related among dentists because distinct dental specialties expose practitioners to different task demands. Like any other manual workers, dentists need more ergonomic and usable hand tools tailored not only to the intended application but also to the anthropometry of users.

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International Journal of Occupational Safety and Ergonomics (JOSE)

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Subject: JOSE-2020-0435
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To: Iwan Muhamad Ramdan iwanmuhamadramdan@gmail.com

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re: Hand functionality in dentists: The effect of anthropometric dimensions and specialty

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Managing Editor
International Journal of Occupational Safety and Ergonomics (JOSE)

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Subject: JOSE-2020-0435: Thank you
Date: 31 October 2020 05.41
To: Iwan Muhamad Ramdan iwanmuhamadramdan@gmail.com

Ref. JOSE-2020-0435

Dear Dr Muhamad Ramdan,

re: Hand functionality in dentists: The effect of anthropometric dimensions and specialty

Thank you for reviewing this manuscript for the International Journal of Occupational Safety and Ergonomics (JOSE).

As a special thank you, please find below a link to a voucher for a 30% discount on Taylor & Francis books:

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International Journal of Occupational Safety and Ergonomics (JOSE)

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JOSE-2020-0435
"Hand functionality in dentists: The effect of anthropometric dimensions and specialty"
Original Submission

Iwan Muhamad Ramdan, Ph.D (Reviewer 2)

Reviewer Recommendation Term:	Accept subject to substantial revision
Overall Reviewer Manuscript Rating:	78

Custom Review Question(s):	Response
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If anyone else was involved in writing this report, for example a student or a colleague, and they agree to be recognised for this work please provide their name and email address in the free text box below.	-
Would you be willing to review a revision of this manuscript?	Yes
Is there a financial or other conflict of interest between your work and that of the authors?	No
Scientific Value (scale 1-5)	4 - Merits attention
Practical Value (scale 1-5)	4 - Merits attention
Review of Literature (scale 1-5)	3 - Not up-to-date
Statistical Analysis (scale 1-5)	5 - Very good/good
Methodology (scale 1-4)	4 - Suitable
Style and Organization (scale 1-7)	4 - Some revision required
General Evaluation (scale 1-4)	3 - Acceptable with revision

Comments to Editor:

This article is valuable enough to be published in JOSE, after corrected in the background section, results, discussion and references update

Comments to Author:

Background
1. The author has not clearly stated the main problem of the research, whether the problem is significant and has led to losses for dentists, patients, and the general public?
2. The study was conducted on dentists, but the authors listed CTS problems in dental nurses. This is less relevant, the authors should list the various musculoskeletal disorders experienced by dentists as a result of their work (especially due to work posture and work tools that are not ergonomic).
3. The final objectives to be achieved from this research are not yet clearly written. Towards the creation of more ergonomic dentist work instruments for 3 different dental specialists? or for some other purpose?

Material and Methods: Very good

Results: At the bottom of table 4, please include the results of the data distribution normality test

Discussion:
1. In order for this article to be more interesting and easy for readers to understand, it is best if the authors explain in more detail the variables studied
2. The authors has not explained the implications of each of the research findings
3. Limitations of the study should be discussed

Conclusions:
1. The authors need to include recommendations from their findings.
2. The authors need to be more specific in explaining what further research can be done by other researchers.

References:
56% of references used were published over the last 10 years, please update the references that authors used

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International Journal of Occupational Safety and Ergonomics

Hand functionality in dentists: The effect of anthropometric dimensions and specialty

--Manuscript Draft--

Full Title:	Hand functionality in dentists: The effect of anthropometric dimensions and specialty
Manuscript Number:	JOSE-2020-0435
Article Type:	Article
Keywords:	Hand strength; Pinch strength; Upper extremity; Dentistry; Anthropometry.
Abstract:	Background: The aim of this study was to investigate the relationship between dentists' hand functionality (handgrip, tip-to-tip, key, and palmar strengths) with dental specialty (maxillofacial surgery, endodontics, pediatric dentistry), socio-demographic factors, and six hand-forearm anthropometric dimensions. Methods: A cross-sectional study was designed in which 720 certified dentists (330 males and 390 females) voluntarily participated in the study. A tape meter (± 0.1cm), and a digital Caliper (± 0.1 mm) were used to measure anthropometric dimensions. Jamar hydraulic dynamometer and pinch gauge were used to measure Handgrip Strength (HGS) as well as tip-to-tip, key, and palmar pinches. Results: Hand strengths decreased with age and clinical experience, and were always greater in male than female dentists. Maxillofacial surgeons of 35-39 years attained the highest values of handgrip and key pinch strengths, while 30-34 years endodontists attained the peak values of tip-to-tip pinch strength. Among measured hand dimensions, forearm circumference was significantly greater in maxillofacial surgeons compared with endodontists and pediatric dentists. Conclusion: Hand functionality is specialty-related among dentists because distinct dental specialties expose practitioners to different task demands. Like any other manual workers, dentists need more ergonomic and usable hand tools tailored not only to the intended application but also to the anthropometry of users.

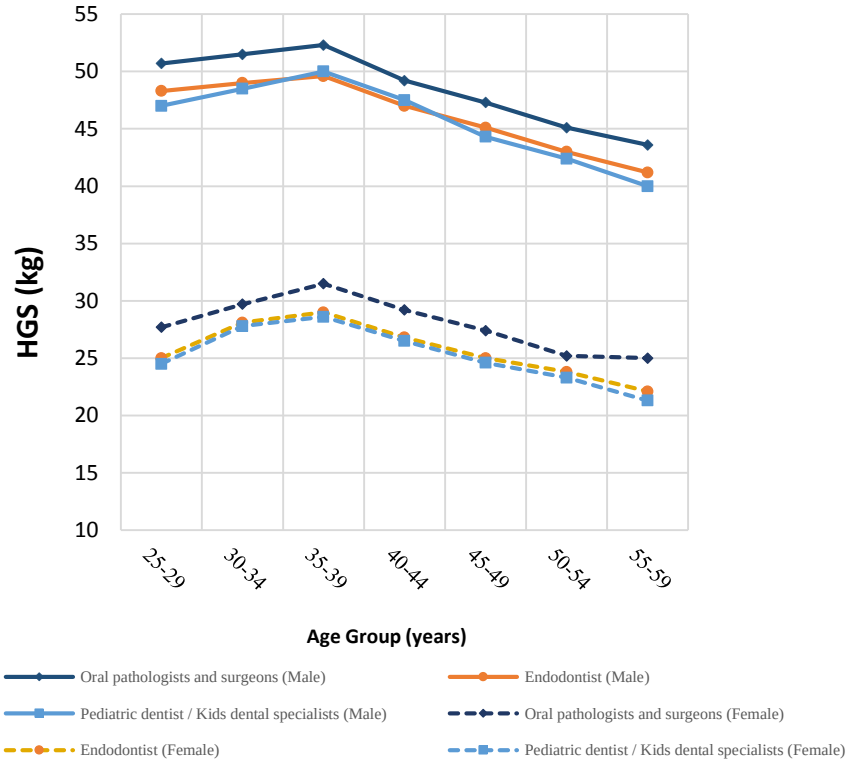
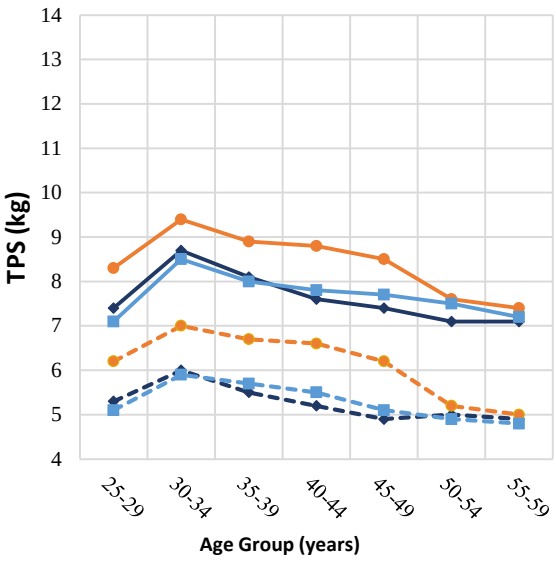
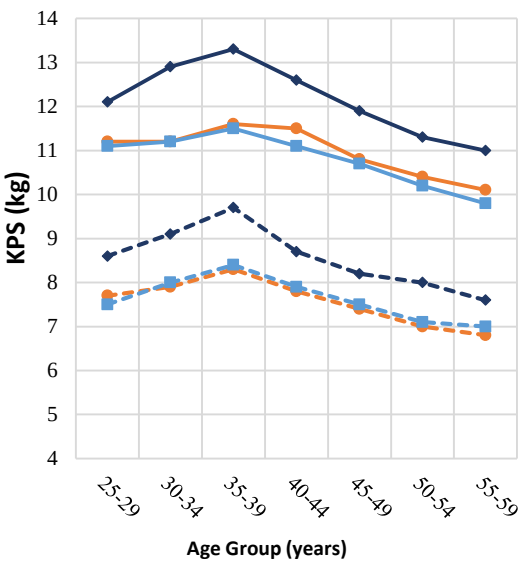


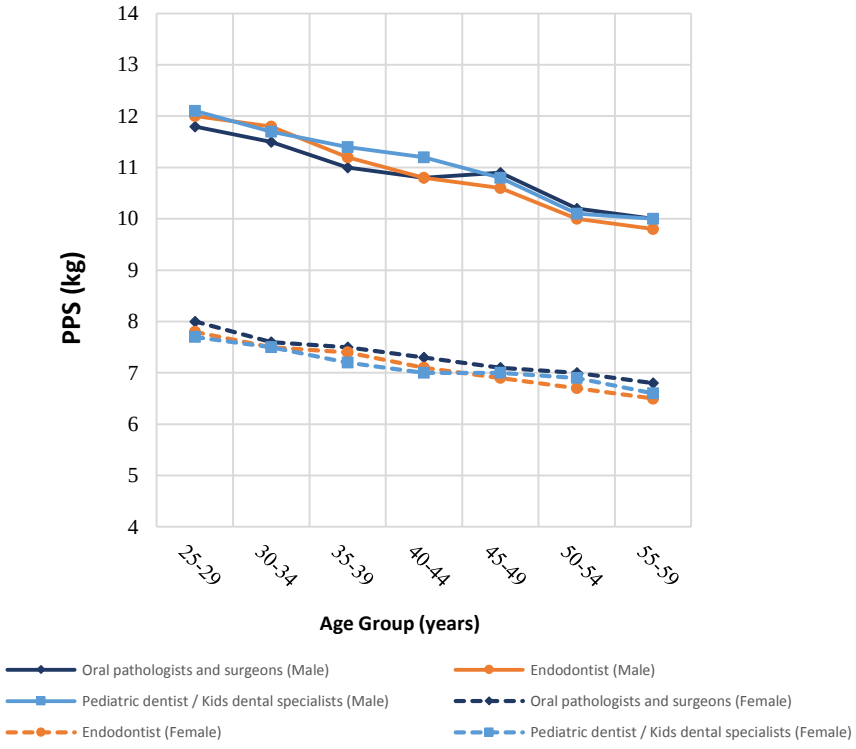
Fig. 1. Mean differences in hand grip strength (kg) by dental specialty, gender, and age.



(a)



(b)



(c)

Fig. 2. Mean differences in (a) tip-to-tip, (b) key, and (c) palmar pinches (kg) by dental specialty, gender, and age.

Table 1. Descriptions of the measured hand-forearm anthropometric dimensions

Dimension (abbreviation)	Description
Hand length (HL)	- The distance between the stylion landmark on the wrist and the tip of the middle finger (dactylion III).
palm length (PL)	- The distance between the stylion landmark on the wrist and the crease at the base of the middle finger.
palm width (PW)	- The distance between the landmarks at metacarpales II and V.
wrist circumference (WC)	- The circumference of the wrist, measured slightly proximal to the styloid process of radius.
forearm circumference (FC)	- The circumference of the forearm at the point of maximum prominence slightly distal to the elbow joint.
forearm length (FL)	- The horizontal distance between points radiale and stylion

Table 2. Descriptive characteristics (Mean±SD) of participants by specialty and gender (n=720)

Variables	maxillofacial surgery (n=225)		Endodontic treatment (n=248)		Pediatric dentistry (n=217)	
	Male	Female	Male	Female	Male	Female
Age (years)	39.5±7.35	37.7±7.91	41.2±6.78	38.5±8.25	40.2±8.22	38.2±8.35
Weight (kg)	77.9±9.10	62.5±8.66	80.6±8.92	63.5±8.61	79.5±7.21	59.8±8.64
Height (cm)	179.2±6.82	163.6±7.10	180.3±6.33	167.3±5.49	178.8±8.25	169.7±6.10
BMI (kg/m^2)	24.2±3.47	20.71±2.10	25.2±3.20	22.3±2.33	23.9±4.25	20.1±3.21
Experience (years)	13.7±4.51	11.2±3.66	15.7±5.81	12.1±6.62	12.8±6.67	10.2±5.31
Right hand (cm)						
HL	19.83±0.91	17.66±0.76	19.70±0.80	17.50±1.00	19.63±0.85	17.45±0.91
PL	11.25±0.51	10.13±0.49	10.95±0.61	10.33±0.65	11.00±0.67	10.00±0.90
PW	9.67±0.28	7.91±0.51	9.44±0.33	7.77±0.60	9.10±0.45	7.75±0.80
WC	17.92±1.00	15.15±0.93	17.70±1.13	15.00±1.10	17.68±0.90	15.17±1.00
FL	26.75±1.71	24.59±1.22	26.50±1.10	24.66±1.11	26.42±1.18	24.30±1.35
FC	28.60±2.10	23.87±1.31	27.20±1.80	22.64±1.23	27.32±2.20	22.70±1.37
Left hand (cm)						
HL	20.10±0.95	17.64±0.83	20.00±1.00	17.60±0.93	19.75±0.80	17.51±0.91
PL	11.20±0.61	10.15±0.64	11.00±0.70	10.22±0.73	11.11±0.73	10.19±0.69
PW	9.10±0.62	7.94±0.73	9.00±0.58	7.81±0.66	9.15±0.70	7.68±0.82
WC	17.67±1.30	14.78±0.88	17.46±1.22	14.88±0.88	17.35±0.92	15.20±0.95
FL	26.47±1.10	24.45±1.30	26.33±1.02	24.51±1.11	26.28±1.25	24.33±1.25
FC	28.42±1.85	23.60±1.74	27.32±1.73	22.53±1.24	27.25±1.90	22.58±1.00

Abbreviations as in Table 1.

Table 3. Mean (Min-Max) of four types of hand strength (kg) by dental specialty, gender, and side.

	Hand	**maxillofacial surgery**		**Endodontic treatment**		**Pediatric dentistry**	
		Male	Female	Male	Female	Male	Female
HGS	R	48.5 (25.7-65.7)	28.0 (17.6-51.0)	46.2 (26.7-70.0)	25.7 (16.0-51.4)	45.7 (25.0-50.8)	25.2 (15.1-48.2)
	L	43.8 (23.8-61.3)	24.8 (14.8-37.6)	42.0 (21.7-54.3)	22.9 (13.8-34.6)	41.5 (19.1-56.1)	22.5 (14.1-36.7)
TPS	R	7.6 (4.7-11.0)	5.2 (2.9-6.0)	8.4 (4.8-12.0)	6.1 (2.3-8.0)	7.7 (4.0-10.1)	5.3 (2.3-7.3)
	L	7.0 (3.8-9.3)	4.5 (2.1-7.9)	7.8 (5.1-11.5)	5.5 (2.2-8.4)	7.1 (4.6-9.5)	4.7 (2.4-5.2)
KPS	R	12.1 (5.8-16.7)	8.6 (4.0-11.3)	11.0 (6.0-16.0)	7.6 (4.8-11.8)	10.8 (5.2-16.3)	7.6 (5.1-11.3)
	L	11.8 (5.1-15.3)	8.2 (4.3-12.0)	10.5 (5.9-16.2)	7.3 (4.9-10.3)	10.5 (4.7-15.2)	7.2 (4.8-11.0)
PPS	R	12.1 (5.4-19.0)	8.0 (4.0-12.0)	10.9 (5.1-21.0)	7.1 (4.3-11.8)	11.0 (5.0-19.8)	7.1 (4.4-12.7)
	L	12.0 (5.3-20.7)	8.0 (3.7-13.0)	10.8 (4.8-18.9)	7.0 (3.8-13.1)	10.8 (4.5-20.1)	6.9 (4.2-12.0)

HGS: Hand Grip Strength; **TPS:** Tip-to-tip pinch strength, **KPS:** Key pinch strength, **PPS:** Palmar pinch strength, **R:** Right-hand; **L:** Left-hand,

Table 4. Pearson's correlation coefficients between the right-hand strength with socio-demographic and anthropometric variables.

Variables	Maxillofacial surgery				Endodontic treatment				Pediatric dentistry			
	HGS	TPS	KPS	PPS	HGS	TPS	KPS	PPS	HGS	TPS	KPS	PPS
Age	-0.351*	-0.245*	-0.288*	-0.397*	-0.373*	-0.251*	-0.267*	-0.385*	-0.313*	-0.266*	-0.301*	-0.390*
Height	0.510**	-	0.535**	0.475**	0.505**	-	0.511**	0.507**	0.527**	-	0.493**	0.521**
Weight	0.441**	-	0.480**	0.420**	0.418**	-	0.458**	0.439**	0.463**	-	0.405**	0.573**
BMI	0.183*	-	0.227*	-	0.190*	-	0.257*	-	0.231*	-	0.229*	-
Experience	- 0.449**	-0.307*	-0.285*	-0.272*	-0.457**	-0.311*	-0.266*	-0.281*	- 0.501**	-0.290*	-0.257*	-0.261*
HL	0.733**	0.662**	0.872**	0.776**	0.665**	0.650	0.862**	0.653**	0.670**	0.637**	0.845**	0.764**
PL	0.433**	0.201*	0.175*	0.234*	0.401**	0.214*	0.233*	0.251*	0.420**	0.183*	0.221*	0.205*
PW	0.774**	0.211*	0.245*	0.208*	0.685**	0.220*	0.217*	0.242*	0.692**	0.227*	0.233*	0.268*
FL	0.541**	0.608**	0.782**	0.681**	0.507**	0.622**	0.806**	0.673**	0.490**	0.603**	0.767**	0.663**
FC	0.404*	-	0.366*	-	0.390*	-	0.306*	-	0.388*	-	0.285*	-
WC	0.243*	-	0.300*	-	0.257*	-	0.247*	-	0.263	-	0.275*	-

** **P < 0.01 (two-tailed),** * **P<0.05 (two-tailed), Abbreviations as in Table 1.**

Hand functionality in dentists: The effect of anthropometric dimensions and specialty

Abstract:

Introduction: The aim of this study was to investigate the relationship between dentists' hand functionality (handgrip, tip-to-tip, key, and palmar strengths) with dental specialty (maxillofacial surgery, endodontics, pediatric dentistry), socio-demographic factors, and six hand-forearm anthropometric dimensions.

Methods: A cross-sectional study was designed in which 720 certified dentists (330 males and 390 females) voluntarily participated in the study. A tape meter (± 0.1cm), and a digital Caliper (± 0.1 mm) were used to measure anthropometric dimensions. Jamar hydraulic dynamometer and pinch gauge were used to measure Handgrip Strength (HGS) as well as tip-to-tip, key, and palmar pinches.

Results: Hand strengths decreased with age and clinical experience, and were always greater in male than female dentists. Maxillofacial surgeons of 35-39 years attained the highest values of handgrip and key pinch strengths, while 30-34 years endodontists attained the peak values of tip-to-tip pinch strength. Among measured hand dimensions, forearm circumference was significantly greater in maxillofacial surgeons compared with endodontists and pediatric dentists.

Conclusion: Hand functionality is specialty-related among dentists because distinct dental specialties expose practitioners to different task demands. Like any other manual workers, dentists need more ergonomic and usable hand tools tailored not only to the intended application but also to the anthropometry of users.

Keywords: Hand strength, Pinch strength, Upper extremity, Dentistry, Anthropometry.

1. Background

Hand function is substantial for good practice in dentistry. It is determined by the ability to exert adequate force to move muscles, dexterity to perform meticulous movements, and hand-eye coordination when manipulating objects [1]. However, dental profession is subjected to frequent repetitive movements carried out in awkward postures, using hand tools among them some produce high frequency vibration. It requires continues maneuvering of instruments, and is related to high precision demand and sustained static load especially in upper limb regions. Electromyographic recordings from neck, shoulder and arm showed high muscular load on extensor carpi radialis and infraspinatus in dominant side and trapezius in non-dominant side while performing precise tasks with handheld dental instruments [2]. Constant and prolonged wrist flection/extension, forearm rotation, elbow flexion, thumbs hyperextension, neck flexion, shoulder elevation, arms abduction as well as firm grasping on hand tools and ultrasonic instruments, thigh-fitting gloves and cold exposure are among the main biomechanical risk factors in dental work [3–5]. This working condition causes additional strain to musculoskeletal system and its supportive structures, making dental workers more vulnerable than any other health professionals to musculoskeletal symptoms [6]. Musculoskeletal pains may primarily be experienced during physical activities such as gripping and maneuvering of instruments, but they can become persistent or episodic overtime [7]. Study reviews indicate a remarkable prevalence of carpal tunnel syndrome (CTS), as the most common nerve entrapment syndrome, among dental care workers [8].

By definition, the manual dexterity depends closely on power grip and precision grip. Grip and finger to finger prehensions are principal functions of the distal segment of upper limb leading to working performance in dentistry [9]. Maximally resistive tests of grip and pinch strength are widely accepted to provide accurate and reliable markers for the functional ability of the

upper extremity. They measure the muscular force generated by flexor mechanism of the upper extremity [10,11].

Previous literature demonstrated intra- and inter-individual diversities in body dimensions, strength and endurance [12]. To this respect, most of anthropometric outcomes including hand strength vary within a person from infancy to old age, with a clear dominant-to-non dominant side superiority [13,14]. Likewise, persons with greater size particularly in terms of weight, height, BMI, hand length, fingers length, palm width, wrist circumference, and forearm circumference are expected to have greater grasping ability [15–17]. Moreover, the extent of grip and pinch strength required for performing various activities changes as a function of type of task and the tool used. Therefore, the magnitude of grip and pinch strength a person is able to exert may influence his/her career selection. By contrast, forceful and repetitive hand use in occupational duties increases grasping power probably because it simulates the same situation as in regular exercise trainings. For instance, manual workers (e.g. cleaners, brick-field workers) were found to have greater grip strength compared to non-manual workers [18–20].

Dental work includes distinct specialties which, due to the different task demands arisen from each procedure, may differently expose practitioners to the ergonomic risk factors of musculoskeletal disorders (e.g. awkward postures, force exertion and duration) [21]. For example, endodontic treatments comprise prolonged repetitive movements, while tooth extraction is a rapid force exertion. On the other hand, it is unclear whether excessive repeated motions or force exertions may result in different grasping power in dental practitioners who are much frequently engaged in such tasks than their other counterparts. Hence, grasping power may be specialty-related among dentists; the hypothesis that, to the best of our knowledge, has not yet been investigated. Therefore, the present study was designed to evaluate isometric hand strength in dentists of distinct specialties and to explore the potential differences between them. To this respect, we tested four different hand outcomes (i.e. handgrip, tip-to-tip pinch, key

pinch, and palmar pinch strength) among three groups of dental specialists (maxillofacial surgeons, endodontists, and pediatric dentists). The roles of socio-demographic and anthropometric characteristics were also examined.

2. Material and Methods

This cross-sectional study was conducted from May to October 2019. Participants (described below) were approached in public and private dental clinics. Those who agreed to participate were asked to give their informed written consent, to fill out a short developed health screening questionnaire, and to take part in anthropometric measurements and hand strength tests, respectively. In order to investigate the reproducibility and consistency of the questionnaire, reliability coefficients as measured by Cronbach's alpha were calculated. The health screening questionnaire demonstrated good internal reliability with a Cronbach's alpha of 0.812. Measurements were carried out at the beginning of the working session with light clothing but no wearable objects or medical gloves. The study protocol was approved by the local research ethics committee.

2.1. Participants

The study participants were all certified dentists specialized in one of the three specialties of maxillofacial surgery, endodontics or pediatric dentistry. The assignment to the specialty category was based on the proportion of working time passed on the routine practices related to that specialty. Those with no particular treatment preference were not recruited. Finally, a total of 720 dental specialists including 330 males and 390 females participated in the study. None of participants suffered from diagnosed cardiac, pulmonary or neurological diseases. The history of any fracture, surgery or musculoskeletal diseases in the upper extremity region during the past 6 months was absent.

2.2. Measurements

2.2.1. Socio-demographic and anthropometric data

Age (years), gender (male/female), clinical experience (years), hand dominance (right/left), height (cm, rounded to the nearest tenth), weight (kg, rounded to the nearest tenth), and body mass index (BMI, kg/m^2) were recorded. A portable stadiometer (CMS, London, UK) and a portable weighting scale (CAS HE-30; CAS New Zealand Co, Ltd) were used for measuring height and weight. The hand used to hold month mirror during treatment was considered as non-dominant.

The hand-forearm dimensions described in Table 1 were measured on both sides of each participant according to the standardized procedure [22]. Participants were asked to hold their hand and forearm flat in a supinated position, the palm and elbow on a table, the fingers together and the thumb abducted during measurements taken by a JEGS digital caliper (Model: 80519, Columbus, OH 43211, USA; ±0.01mm) and a tape (HaB Essentials SKU: LCR01; ±0.1cm). Each dimension was measured twice and the average was recorded for analysis.

Table 1. Descriptions of the measured hand-forearm anthropometric dimensions

Dimension (abbreviation)	Description
Hand length (HL)	- The distance between the stylion landmark on the wrist and the tip of the middle finger (dactylion III).
palm length (PL)	- The distance between the stylion landmark on the wrist and the crease at the base of the middle finger.
palm width (PW)	- The distance between the landmarks at metacarpales II and V.
wrist circumference (WC)	- The circumference of the wrist, measured slightly proximal to the styloid process of radius.
forearm circumference (FC)	- The circumference of the forearm at the point of maximum prominence slightly distal to the elbow joint.
forearm length (FL)	- The horizontal distance between points radiale and stylion

2.2.2. Hand strength Measurements

Four maximally resistive tests were conducted to measure the maximum isometric handgrip strength (HGS), tip-to-tip pinch strength (TPS), key pinch strength (KPS), and palmar pinch strength (PPS) using calibrated Jamar hydraulic dynamometer and pinch gauge (Saehan Corp., Masan, South Korea). Following the recommendations of the American Society of Hand Therapists, participants seated on a chair with the "shoulder adducted and neutrally rotated, elbow flexed at 90º and the forearm and wrist in neutral position" [23]. HGS was tested first, followed by TPS, KPS and PPS. For handgrip testing, the adjustable handle dynamometer was set at the second position from the inside for all participants. For tip-to-tip prehension, the pinch gauge was grasped between the tips of thumb and index finger. For key prehension, the pinch gauge was squeezed between the thumb pad and the radial side of the middle phalanx of the index finger. In palmar prehension, the pinch gauge was pinched between the pads of thumb, index and middle fingers [24]. Participants were requested to exert as much contraction as they can on the dynamometer handle and pinch gauge for 3 seconds. The instruments were lightly held around the readout dial by the examiner to prevent dropping. Each test was repeated three times and the average was recorded as outcome for analysis. A rest time of at least one minute was respected between successive exertions in order to avoid residual effect of fatigue. The calibration of both instruments was periodically tested during the study.

2.3. Statistical analysis

The data distribution normality was evaluated by the Anderson-Darling test. Standard descriptive statistics (mean±SD) were determined for directly measured and derived variables. Test-retest reliability was analyzed using interclass correlation coefficient (ICC). Independent-samples t-test was used to compare grip and pinch strengths between genders. Paired samples t-tests were used to analyze the influence of hand dominancy. One-way ANOVA with Scheffe's post-hoc contrast was used to compare dominant and non-dominant hand strengths, allocated

according to the age-group and dental specialty. Correlation between variables was assessed using Pearson correlation coefficient, while simple and multiple linear regression analyses were used to determine relations and variability between variables. All statistical analyses were performed with the Statistical Package for Social Science (SPSS, version 23.0; SPSS Inc., Chicago, IL). P-values smaller than 0.05 were considered statistically significant.

3. Results

Table 2 represents descriptive statistics of participant characteristics by specialty and gender. The sample consisted of 225 (31.3%) maxillofacial surgeons, 268 (37.2%) endodontists, and 227 (31.5%) pediatric dentists. The participation rate was slightly higher for females than males with 390 (54.2%) females versus 330 (45.8%) males participated. The vast majority of participants (>97%) were right-handed. Ambidexterity was not reported.

Results of test-retest reliability were analyzed from 60 participants out of whole sample. Participants showed high to very high test-retest reliability for both Jamar dynamometer ($0.88 \leq ICC \leq 0.97$; $P \leq 0.001$) and pinch gauge ($0.85 \leq ICC \leq 0.94$; $P \leq 0.001$).

The average of all anthropometric measures was significantly higher in males compared to females ($p<0.001$). No significant differences were found between the hand dimensions of the specialty groups under study, except a significant difference observed between the forearm circumference of maxillofacial surgeons with two other groups of specialists ($p<0.001$). FC was greater in maxillofacial surgeons than endodontists and pediatric dentists but was not significantly different between the two latter groups. Forearm circumference was also the only dimension different between sides which was greater in right than left hand, but only among maxillofacial surgeons ($p<0.001$).

Table 2. Descriptive characteristics (Mean±SD) of participants by specialty and gender (n=720)

Variables	**maxillofacial surgery** (n=225)		**Endodontic treatment** (n=248)		**Pediatric dentistry** (n=217)	
	Male	Female	Male	Female	Male	Female
Age (years)	39.5±7.35	37.7±7.91	41.2±6.78	38.5±8.25	40.2±8.22	38.2±8.35
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BMI (kg/m^2)	24.2±3.47	20.71±2.10	25.2±3.20	22.3±2.33	23.9±4.25	20.1±3.21
Experience (years)	13.7±4.51	11.2±3.66	15.7±5.81	12.1±6.62	12.8±6.67	10.2±5.31
Right hand (cm)						
HL	19.83±0.91	17.66±0.76	19.70±0.80	17.50±1.00	19.63±0.85	17.45±0.91
PL	11.25±0.51	10.13±0.49	10.95±0.61	10.33±0.65	11.00±0.67	10.00±0.90
PW	9.67±0.28	7.91±0.51	9.44±0.33	7.77±0.60	9.10±0.45	7.75±0.80
WC	17.92±1.00	15.15±0.93	17.70±1.13	15.00±1.10	17.68±0.90	15.17±1.00
FL	26.75±1.71	24.59±1.22	26.50±1.10	24.66±1.11	26.42±1.18	24.30±1.35
FC	28.60±2.10	23.87±1.31	27.20±1.80	22.64±1.23	27.32±2.20	22.70±1.37
Left hand (cm)						
HL	20.10±0.95	17.64±0.83	20.00±1.00	17.60±0.93	19.75±0.80	17.51±0.91
PL	11.20±0.61	10.15±0.64	11.00±0.70	10.22±0.73	11.11±0.73	10.19±0.69
PW	9.10±0.62	7.94±0.73	9.00±0.58	7.81±0.66	9.15±0.70	7.68±0.82
WC	17.67±1.30	14.78±0.88	17.46±1.22	14.88±0.88	17.35±0.92	15.20±0.95
FL	26.47±1.10	24.45±1.30	26.33±1.02	24.51±1.11	26.28±1.25	24.33±1.25
FC	28.42±1.85	23.60±1.74	27.32±1.73	22.53±1.24	27.25±1.90	22.58±1.00

Abbreviations as in Table 1.

3.1. Hand strength outcomes

Table 3 represents mean values for four types of hand outcomes in terms of dental specialty, gender, right- and left-hand. Results showed that right-handgrip strength of female dentists was 43% (41%, 44%, and 45% in maxillofacial surgeons, endodontists, and pediatric dentists), and their left-handgrip strength was 45% (47%, 50%, and 51% in maxillofacial surgeons, endodontists, and pediatric dentists) weaker than male dentists.

Comparing three different types of pinch strength, the weakest strength was produced by TPS (the highest mean value: 8.4 kg) versus KPS and PPS with the highest mean values of 12.1 kg

(see table 3). The average values of right-hand TPS, KPS, and PPS for female dentists were about 39% (35.1%, 37.7%, and 45.3% in maxillofacial surgeons, endodontists, and pediatric dentists), 27% (29%, 22%, and 29.6% in maxillofacial surgeons, endodontists, and pediatric dentists), and 29% (17%, 35%, and 35.5% in maxillofacial surgeons, endodontists, and pediatric dentists) weaker than those of male dentists, respectively. Seemingly, the mean values of left-hand TPS, KPS, and PPS in female dentists were 33% (36%, 30%, and 34% in maxillofacial surgeons, endodontists, and pediatric dentists), 31% (30.5%, 30.5%, and 31.4% in maxillofacial surgeons, endodontists, and pediatric dentists), and 35% (33%, 35%, and 36% in maxillofacial surgeons, endodontists, and pediatric dentists) weaker than their male counterparts, respectively.

Table 3. Mean (Min-Max) of four types of hand strength (kg) by dental specialty, gender, and side.

	Hand	**maxillofacial surgery**		**Endodontic treatment**		**Pediatric dentistry**	
		Male	Female	Male	Female	Male	Female
HGS	R	48.5 (25.7-65.7)	28.0 (17.6-51.0)	46.2 (26.7-70.0)	25.7 (16.0-51.4)	45.7 (25.0-50.8)	25.2 (15.1-48.2)
	L	43.8 (23.8-61.3)	24.8 (14.8-37.6)	42.0 (21.7-54.3)	22.9 (13.8-34.6)	41.5 (19.1-56.1)	22.5 (14.1-36.7)
TPS	R	7.6 (4.7-11.0)	5.2 (2.9-6.0)	8.4 (4.8-12.0)	6.1 (2.3-8.0)	7.7 (4.0-10.1)	5.3 (2.3-7.3)
	L	7.0 (3.8-9.3)	4.5 (2.1-7.9)	7.8 (5.1-11.5)	5.5 (2.2-8.4)	7.1 (4.6-9.5)	4.7 (2.4-5.2)
KPS	R	12.1 (5.8-16.7)	8.6 (4.0-11.3)	11.0 (6.0-16.0)	7.6 (4.8-11.8)	10.8 (5.2-16.3)	7.6 (5.1-11.3)
	L	11.8 (5.1-15.3)	8.2 (4.3-12.0)	10.5 (5.9-16.2)	7.3 (4.9-10.3)	10.5 (4.7-15.2)	7.2 (4.8-11.0)
PPS	R	12.1 (5.4-19.0)	8.0 (4.0-12.0)	10.9 (5.1-21.0)	7.1 (4.3-11.8)	11.0 (5.0-19.8)	7.1 (4.4-12.7)
	L	12.0 (5.3-20.7)	8.0 (3.7-13.0)	10.8 (4.8-18.9)	7.0 (3.8-13.1)	10.8 (4.5-20.1)	6.9 (4.2-12.0)

HGS: Hand Grip Strength; **TPS:** Tip-to-tip pinch strength, **KPS:** Key pinch strength, **PPS:** Palmar pinch strength, **R:** Right-hand; **L:** Left-hand,

Figures 1 and 2 are representations of the extent and pattern of fluctuations in isometric hand strength among the studied sample. There were significant main effects for gender (F=168.56,

p<0.01), age (F=281.54, p<0.01) as well as a significant gender by age interaction (F=81.55, p<0.01), indicating that all types of strength outcomes were significantly higher in males than females, whatever the age group.

As shown in Figure 1, HGS reached its peak in the 35-39 years old and decreased thereafter, whatever the specialty and gender of dentists. The peak values of HGS were 52.3±10.1, 49.6±9.7 and 50±9.5 kg for male maxillofacial surgeons, endodontists, and pediatric dentists; and 31.5±7.2, 29±6.5 and 28.6±10.1 kg for their corresponding female counterparts, respectively. Both male and female maxillofacial surgeons had higher mean HGS values than their counterparts in two other groups with p<0.001 (about 3-7% more than endodontists and 4-6% more than pediatric dentists while comparing male practitioners, and about 5-12% more than endodontists and 6-15% more than pediatric dentists while comparing female practitioners). However, no significant differences were found between HGS values of endodontists and pediatric dentists.

Fig. 1

The extent and fluctuations of pinch strength by gender and specialty are shown in Figure 2 (a: TPS, b: KPS, c: PPS) for different age groups. Similar to HGS, the mean values of TPS and KPS showed a slightly increasing curve in both genders up to peak values in certain ages (30-34 years for TPS, and 35-39 years for KPS) and a gradual decrease thereafter. However, this curvilinear pattern was not observed for PPS which decreased progressively with age.

As shown in Figure 2-a, the peak values of TPS were 8.7±1.1, 9.4±1.3 and 8.5±1.1 kg for male maxillofacial surgeons, endodontists, and pediatric dentists and 6.0±1.4, 7.0±1.2 and 5.9±1.2 kg for their corresponding female counterparts, respectively. The highest values of TPS belonged to 30-34 years old endodontists, that was 8% and 10.6% (if male) and 16.7% and 18.6% (if female) greater compared to maxillofacial surgeons and pediatric dentists, respectively (p<0.001). Nonetheless, the TPS level of endodontists (both genders) begin a

rather steep declining from the mid-forties to reach the similar levels as two other studied groups in the fifth and sixth decades of life. No significant differences were found between the TPS values of maxillofacial surgeons with those of pediatric dentists.

Fig. 2

Figure 2-b shows the trajectories of KPS in the right-hand of participants by dental specialty and gender. The peak value of KPS reached 13.3 ±1.8, 11.6±1.9 and 11.5±1.8 kg for 35-39 years male maxillofacial surgeons, endodontists, and pediatric dentists, and 9.7±1.6, 8.3±1.7 and 8.4±1.5 kg for their corresponding female counterparts of the same age range, respectively. Maxillofacial surgeons had about 7-16% higher values of KPS than the other two groups ($p<0.01$). Any notable differences was not observed between the two groups of endodontists and pediatric dentists in terms of KPS levels.

The values of PPS did not differed between the three groups of specialty under study (Figure 2-c).

3.2. Correlations among variables

Table 4 shows the Pearson's correlation coefficients between four types of hand strength with socio-demographic and anthropometric variables for three groups of dental specialists and both genders. Age was negatively correlated with all the measured strength outcomes ($0.25<r<0.39$, $p<0.05$; for all cases). Clinical experience was negatively related with HGS ($r\approx0.5$, $p<0.01$; for all specialties); suggesting that the value of HGS decreases with increasing seniority in dental work. It was also correlated with pinch strength but to a lower extent ($r\approx0.3$, $p<0.05$; for all cases).

Whatever the specialty, height and weight were significantly correlated with all strength outcomes, except with TPS ($0.4<r<0.57$, $p<0.01$; for all cases). Considering hand dimensions, hand length and forearm length were strongly associated with all the four types of strength

(0.5<r<0.86, p<0.01; for all cases). Palm dimensions (length and width) were both correlated with HGS (0.4<r<0.77, p<0.01; for all cases). There were slightly significant correlations between palm dimensions and all types of measured pinch strength (r<0.27, p<0.05; for all cases). Wrist and forearm circumferences were moderately correlated with HGS and KPS (0.2<r<0.4, p<0.05; for all cases), but not with TPS and PPS.

Table 4. Pearson's correlation coefficients between the right-hand strength with socio-demographic and anthropometric variables.

Variables	Maxillofacial surgery				Endodontic treatment				Pediatric dentistry			
	HGS	TPS	KPS	PPS	HGS	TPS	KPS	PPS	HGS	TPS	KPS	PPS
Age	-0.351*	-0.245*	-0.288*	-0.397*	-0.373*	-0.251*	-0.267*	-0.385*	-0.313*	-0.266*	-0.301*	-0.390*
Height	0.510**	-	0.535**	0.475**	0.505**	-	0.511**	0.507**	0.527**	-	0.493**	0.521**
Weight	0.441**	-	0.480**	0.420**	0.418**	-	0.458**	0.439**	0.463**	-	0.405**	0.573**
BMI	0.183*	-	0.227*	-	0.190*	-	0.257*	-	0.231*	-	0.229*	-
Experience	- 0.449**	-0.307*	-0.285*	-0.272*	-0.457**	-0.311*	-0.266*	-0.281*	- 0.501**	-0.290*	-0.257*	-0.261*
HL	0.733**	0.662**	0.872**	0.776**	0.665**	0.650	0.862**	0.653**	0.670**	0.637**	0.845**	0.764**
PL	0.433**	0.201*	0.175*	0.234*	0.401**	0.214*	0.233*	0.251*	0.420**	0.183*	0.221*	0.205*
PW	0.774**	0.211*	0.245*	0.208*	0.685**	0.220*	0.217*	0.242*	0.692**	0.227*	0.233*	0.268*
FL	0.541**	0.608**	0.782**	0.681**	0.507**	0.622**	0.806**	0.673**	0.490**	0.603**	0.767**	0.663**
FC	0.404*	-	0.366*	-	0.390*	-	0.306*	-	0.388*	-	0.285*	-
WC	0.243*	-	0.300*	-	0.257*	-	0.247*	-	0.263	-	0.275*	-

** **P < 0.01 (two-tailed),** * **P<0.05 (two-tailed), Abbreviations as in Table 1.**

4. Discussion

The main aim of the present study was to investigate whether the functionality of the upper extremity is specialty-related among dentists and be modulated by socio-demographic and anthropometric factors. The results showed that the functionality of dentists' hand varies as a function of the specialty predominantly performed by them and the type of prehension.

This could be in fact due to the different task demands imposed by distinct dental specialties on dentists. Our results showed that maxillofacial surgeons attained the greatest HGS and KPS. Forceps, surgical curettes, angular elevators and surgical hand-pieces are hand tools usually used in maxillofacial surgery to remove teeth, exostoses, tissue or debris from bony socket, loosen tooth or small root fragments from bony socket. These tools generally requires power grip and precision grip for providing adequate push-pull forces and better control. Forceps, for example, are hinged non-locking grasping tools existed in a variety of types. Some of these surgical tools (e.g. extraction forceps) require considerable amount of force exertion by holding the tool in a clamp formed by flexed fingers and palm with opposing pressure applied by the thumb, while others (e.g. thumb forceps, curettes) need a precise prehension by pinching the handle tissues between the flexor aspects of finger and thumb [25]. According to Dong et al. (2006), periodontal scaling implies more pulling than rotating motions compared to root planning, with an average pinch force of 11 to 20% of the maximum voluntary contraction for extended periods [26]. Moreover, surgeons was reported to have stronger HGS compared with physiotherapists and nurses, because surgery need much essential grip strength to be accomplished [27]. Our findings demonstrated that forearm circumference was bigger in maxillofacial surgeons than endodontists and pediatric dentists. Increased forearm circumference may be considered as a surgery-related anthropometric changes which due to its relationship with higher HGS and KPS could account for the greater values of these two types of hand strength among maxillofacial surgeons compared with endodontists and pediatric

dentists. Suedbeck (2016) revealed that forceful gripping and grasping with spreading hand is related to the reinforcement of forearm muscles [37]. Manual workers engaged in moderate forceful tasks such as housekeeping were found to have greater forearm circumference as well as higher grip strength compared with office workers [20].

In the same way, the highest levels of TPS observed in endodontists may be attributed to their common use of endodontic instruments for performing root canal treatment. This procedure includes high repetitive motions while maintaining endodontic file firmly between the tip of thumb and the tip of index finger. Excessive and prolonged application of tip-to-tip prehension may have a training effect on endodontic therapists, explaining their highest level of TPS. However, we observed that the age-related decline in TPS was steeper among endodontists than maxillofacial surgeons and pediatric dentists. In accordance with Ding et al. (2013), we suggest that hand overuse in stereotyped repetitive tasks such as root preparation may accelerate the age-related decline in pinch strength [28]. It is also documented that the extent of variation in dental tasks can influence the maximum attainable palmar pinch strength among dentists [28]. The methodology approach of the present study was to recruit dentists who spent the majority of their working time on only one of the distinct dental specialties, resulting in a predefined minimum level of variability in their working activities. This could explain the similar values of PPS among dentists under study.

Moreover, it is well documented that decreased physical functionality is an obvious consequence of ageing [29,30]. The HGS variations across the life course observed in the present study follows the curvilinear pattern reported by other researchers in general [17,31] and working populations [19,20]. By contrast, the number of studies conducted on pinch strength norms is limited. For instance, studies conducted on western populations showed different types of pinch strength relatively stable until the age of 55 to 59 years in American and 65 to 70 years in British adults [31,32]. However, the age-related increasing in HGS, TPS

and KPS of dentists in the first decade of working life may be related to the nature of dental tasks which simulates regular exercise training condition in the musculoskeletal structure of the upper extremity, as happens in the case of athletes [33]. The same was previously observed for grip force in manual workers [20]. Despite this, our results showed that the youngest maxillofacial surgeons (25-30 years) had higher maximum attainable HGS and KPS compared to the other two specialty groups of the same age range. Two explanations could account for this difference. It is possible that the work-related effects on physical performance appear since earlier stage of carriers than has been studied here. If so, it could be assumed that all dentists have similar values of hand strength at base, but frequent implementation of surgery procedures improved the level of HGS and KPS in maxillofacial surgeons very soon. Yi et al. (2013) showed that high musculoskeletal disorders afflict first year dental postgraduates at the beginning of their carrier [21]. In addition, high force demand of maxillofacial surgery may lead stronger dentists to select it as their predominant task, while those with weaker hand functionality probably prefer to alternate other activities. These need to be investigated in further studies in which younger dental practitioners be included. The same argumentations could be used for explaining the higher TPS observed in young endodontists compared to maxillofacial surgeons and pediatric dentists.

In line with previous studies, gender effect was clearly confirmed on hand strength outcomes; male dentists being always stronger than females [28]. The behavior of surface EMG power spectrum was previously found to be significantly different between male and female for triceps brachii, anconeus and biceps brachii muscles across force levels of 10-80% of the maximal voluntary contraction [34]. Skin fold thickness and fiber type properties particularly in terms of fiber size were stated as reasons for this gender effect [34]. In agreement with the literature, measured hand anthropometric dimensions were larger in males than females [35,36]. Work experience is another factor modulating dentists' hand functionality [38,39]. We

observed that longer clinical experience is associated with lower hand strength outcomes. Several reasons could account for this finding. The increase in work experience is nearly along with aging, which is negatively related with physical strength. In addition, the longer is the years on clinical work, the longer is the exposure time to various biomechanical risk factors of MSDs, and the greater is the risk of the work-related MSDs to become persistent [3,6,8].

Conclusions

Dentists' hand functionality depends on the type of task predominantly performed by them. Stereotyped repetitive dental tasks may primarily increase some types of hand strength among dentists but may make them vulnerable to certain cumulative trauma disorders over time. This issue is worthy to be more investigated in future studies. Dentists are recommended to alternate between various tasks, and to respect adequate break time between patients. Findings may provide useful guidelines for designing much ergonomic dental tools.

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From: **Iwan Muhamad Ramdan** iwanmuhamadramdan@gmail.com
Subject: Re: Ms_AJAEES_64646: Invitation to Review Manuscript for Asian Journal of Agricultural Extension, Economics & Sociology
Date: 5 January 2021 06.45
To: Managing Editor 23 editor.23@sciencedomain.biz

IR

Ms. Ruma Bag.
Asian Journal of Agricultural Extension, Economics & Sociology

I hereby submit the results of an article review with the topic: " **Transforming activity groups to business units - Emerging Fisherwomen managers in Kerala, India** (**Ms_AJAEES_64646**)"

Thank you for inviting me to become a reviewer for The Asian Journal of Agricultural Extension, Economics & Sociology, if there are more articles related to my area of expertise, I will be excited to review them.

Iwan Muhamad Ramdan, BSN., MHSc., Dr(PH).
Faculty of Public Health, Mulawarman University
Jl. Sambaliung, Campus of Gunung Kelua,
Samarinda, East Kalimantan. Postcode 75119
Telp. 0541.7031343 Fax. 0541.202699

On Sat, Jan 2, 2021 at 6:36 PM Managing Editor 23 <editor.23@sciencedomain.biz> wrote:

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> Dear Colleague,
>
> I am approaching you with the peer-review request of the below mentioned manuscript submitted in Asian Journal of Agricultural Extension, Economics & Sociology.
>
> This journal is indexed in Index Copernicus (ICV: 100), CNKI (China), NAAS (Score: 4.35), Google Scholar, etc
>
> Manuscript Title*:* **Transforming activity groups to business units - Emerging Fisherwomen managers in Kerala, India**
>
> Manuscript Number: **Ms_AJAEES_64646**
>
> I would be grateful if you would kindly find some time to review the above mentioned manuscript and send your valuable comments within **07 calendar days (07 Jan'2021).**
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Journal Name:	Asian Journal of Agricultural Extension, Economics & Sociology
Manuscript Number:	**Ms_AJAEES_64646**
Title of the Manuscript:	**Transforming activity groups to business units - Emerging Fisherwomen managers in Kerala, Indi**
Type of the Article	**Original Research Article**

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	Reviewer's comment	**Autho** *highlig his/he*
Compulsory REVISION comments		
Minor REVISION comments	1. In the introduction, the research gap is not clear and the research objectives are not stated 2. In the Data and methodology section, it is necessary to add the type of research used, the calculation of the number of samples, a brief description of the questionnaire used, validity and reliability tests, data collection methods, data analysis methods and statistical tools used. 3. In the results and discussion section, the authors have not included the characteristics of the respondents and the results of the research have not been fully discussed 4. Research conclusions and suggestions need to be improved according to the research objectives and discussion results.	
Optional/General comments	The results of this study are quite interesting and sufficient to provide useful information, but need improvement in each section	

	Reviewer's comment
Are there ethical issues in this manuscript?	*(If yes, Kindly please write down the ethical issues here in details)* No research ethics problem was found in this manuscript
Are there competing interest issues in this manuscript?	The author does not include competing interest issues in this manuscript, the author shc include it
If plagiarism is suspected, please provide related proofs or web links.	No plagiarism was found in this manuscript

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Guideline	MARKS of this manuscript
Give OVERALL MARKS you want to give to this manuscript (Highest: 10 Lowest: 0) **Guideline:** Accept As It Is: (>9-10) Minor Revision: (>8-9) Major Revision: (>7-8) Serious Major revision: (>5-7) Rejected (with repairable deficiencies and may be reconsidered): (>3-5) Strongly rejected (with irreparable deficiencies.): (>0-3)	**Minor Revision (8.5)**

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Original Research Article

Transforming activity groups to business units - Emerging Fisherwomen managers in Kerala, India

Abstract

The fisheries sector in Kerala, on account of its management initiatives on fisheries sustainability and fisher welfare, posses a unique example for the other coastal states. The state has pioneered many novel management measures and fisher welfare programmes which led to commendable socio-economic standards comparable even with the Western world. Post Tsunami during 2004 in Kerala wreathed havoc in terms of inventory and human losses which led to the initiation of Society for Assistance to fisherwomen (SAF) under the umbrella of Department of Fisheries, Government of Kerala. Over the years SAF planned and implemented many flagship programmes among which Theeramythri was instrumental in empowering women. Currently, there are more than 1200 units providing meaningful employment to more than 5000 women. The fisher empowerment improved considerably post joining SAF from 0.41to 0.64. The empowerment determinants included economical (30.7%), legal (22.81%), political (20.18%) social (14.91%) and psychological (11.4%). SAF envisioned transforming these groups from a mere activity group into viable business units with more financial outlays, repayments, commitment at self-sufficiency, getting more collateral financial support. In the mission toward converting activity groups into business, SAF provided additional fund on a short term basis which included revolving fund, technology fund and shift to business. The study assessed the impact of these funds in augmenting the performance of over 600 activity groups in Kerala. The results showed that both sale turnover and income increased consequent to receipt of additional fund. The repayment rates were also high at 80 percent showing promising future.

Key words: Theeramythri, Empowerment, Fisherwomen, Impact

Introduction

The fisheries sector in Kerala, on account of its management initiatives on fisheries sustainability and fisher welfare, posses a unique example for the other coastal states. The state has pioneered many novel management measures and fisher welfare programmes which led to commendable socio-economic standards comparable even with the Western world. For women empowerment,

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Comment [1]: The research gap in this section is not clear

state government has initiated many programs with the support of other local bodies including government and non-government organizations like Kudumbashree program, Gender park etc. It has created many opportunities for women to come forward to main stream of the society and engaging in many public activities (Sayyid Abdulla Shakir 2017). Post Tsunami during 2004 in Kerala wreathed havoc in terms of inventory and human losses which led to the initiation of Society for Assistance to fisherwomen (SAF) under the umbrella of Department of Fisheries, Government of Kerala during 2005 as a charitable society. Over the years SAF planned and implemented many flagship programmes among which Theeramythri was instrumental in empowering women. Theeramythri is a unique livelihood support program for fisherwomen aimed to improve the income and quality of life by providing the alternative livelihood to fisherwomen. It also provides the marketing support to the units working under Theeramythri. The main focus is on the overall empowerment of fisherwomen and currently, there are more than 1200 units providing meaningful employment to more than 5000 women. The different categories of activity groups include Tailoring and garments, Fish, Food, Provisional store, Supermarket and coir and "Others" catering to location specific areas and demand driven. The major effort to popularise micro-finance in Kerala has the twin aims of poverty alleviation and women's empowerment, this seems justified. Then try to place the 'micro-finance revolution' in Kerala within the larger historical trajectory of successive 'regimes of empowerment' in order to understand the different political stakes in each, and their implications for gender politics (J. Devika et al 2007)

SAF has a strong budget position for the implementation of the Theeramythri groups. There are different kinds of funds which are made available to the activity groups. In the business cycle it could be revolving fund, technology fund or shift to business devoid of interest. A Revolving fund (RF) is provided as working capital support for existing enterprises. The working capital support for the revolving fund is given to the activity groups without charging interest. The loans extended from the existing revolving fund have already emerged as an important source of working capital funds for the groups. Groups, that had gone down in performance due to problems in working capital management have benefited from this opportunity.SAF provides technology improvement support that focuses on technical improvement, replacement and repairs, technical support, and application of new and appropriate technologies. The activity groups implemented by SAF need to be developed by extensive application of new and appropriate technologies in various micro enterprises. These increase the demand for interventions in technology improvement and skill training. Shift to business fund must be allotted only at the time where there is no other option left out for reviving the activity group. They can be linked to take loan from banks as that will create the institution for hard work to

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Comment [3]: What is Theeramythri groups?

revive the group. Over the last decade the activity groups has been provided with these funds to improve the sales volume and market development. Women empowerment and economic development are closely related: in one direction, development alone can play a major role in driving down inequality between men and women; in the other direction, empowering women may benefit development (Esther Duflo 2012)

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Data and methodology

The study is based on the primary data collected from the different activity groups of SAF across nine districts of Kerala viz., Thiruvananthapuram, Kollam, Kottayam, Alappuzha, Ernakulam, Trisshur, Malapuuram, Kozhikode, and Kannur using simple random sampling method. A total of 600 samples were collected using a well structured questionnaire. The sample distribution encompassed groups which had availed Revolving Fund (N-345), Technology fund (N-195), and Shift to business (N-70) using a pretested structured survey scheduled

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Comment [6]: How was this total of 600 samples obtained, using a specific sample formula? write down the sample calculation formula along with the reference

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Comment [7]: Please write a brief description of the main points of the questionnaire that the researcher uses, what does the questionnaire cover? Is the validity and reliability of the questionnaire tested? explain how the data collection method used by the researcher, did it visit the respondents one by one, or used other methods?

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Comment [8]: Is this "N" the number of samples? If yes, the number exceeds 600 samples.

The revolving fund schedule is designed to elicit information on socio economic and demographic characteristics of the respondents, details of the group members(current and drop outs), capital formation, revolving fund, assets holding before and after receiving the revolving fund. The motivation to get revolving fund or its utilization was analysed based on the order of preference of the given parameters by the respondents. A comparative study of revolving fund and other financial sources of the respondents were evaluated to analyse the credit accessibility of the revolving fund. Moreover the benefits gained after receiving fund and the short comings in revolving fund as well as business were also clearly explained in the schedule. The schedule on technology fund elicited information such as capital formation since inception, installment received and payables by different activity groups. This gives information regarding the necessity and optimal utilization of the fund by evaluating their asset purchase and growth. The schedule also point outs the relevance of technology fund, the necessity of providing technology fund, optimal utilization pattern of the activity, motivation to get and provide the technology fund, benefits after receiving the technology fund, shortcoming in the technology fund, and in the business. The schedule on shift to business depicts the information regarding the reasons for shift in business and its benefits after shifting the business. It also derives the economic wellbeing of the activity group, with special focus on the changes in the empowerment level of the activity groups and the influence of funds such as revolving fund and technology fund. The problems faced by the group members after shifting the business as well as status of the assets and liabilities of the group prior to shift in business and vice versa were also clearly discussed in the schedule.

In order to analyse the data, the primary statistical tool of percentage analysis and Garrett ranking have been carried out to assess various financial parameters of the study. The Garrett ranking Technique was employed to rank the constraints.

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Comment [9]:
Write down the references you use
List the tools / software you used in this research

Results and discussions

The data was collected, analysed and the results are discussed under the following heads

.....

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Comment [10]: In this section you have written the results of your research well, but you have not discussed them completely. You can discuss it by:
1. Restate the findings and accomplishments,
2. Evaluate how the results fit in with the previous findings do they contradict, qualify, agree or go beyond them ?,
3. List potential limitations to the study,
4. Offer an interpretation / explanation of these results and ward off counter-claims,
5. State the implications and recommend further research.

Revolving fund

A Revolving fund (RF) is provided as working capital support for existing enterprises. The working capital support for the revolving fund is given to the activity groups without charging interest. The loans extended from the existing revolving fund have already emerged as an important source of working capital funds for the groups. Groups, that had gone down in performance due to problems in working capital management have benefited from this opportunity.

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Comment [11]: It will be more interesting if you write down the characteristics of the research respondents first

Most of the activity groups started in between 2009 and 2012 (42 per cent). 30 percentages of the activity groups started before 2009 and 28 percent started after 2012. Average hours spend per a day by a person in all the sectors is 7.5 hours. When comparing the different sectors, the maximum hours spend per day in supermarket sector (10 hours). This is due to the working time of the supermarkets is high when compared to other sectors. The average working hours per day is minimum in Tailoring and garments sector (7 hours). It is shown in the figure 1

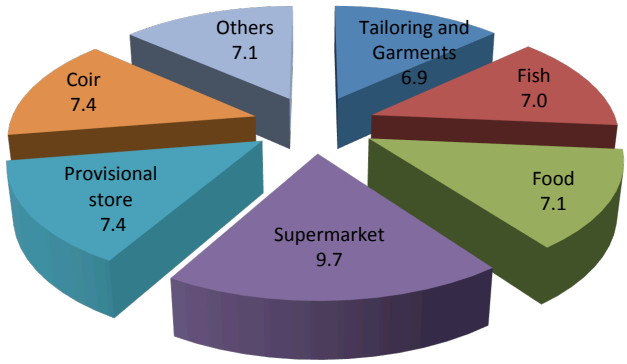

Figure 1: Average hours spend per day

When considering the revolving fund received by the sectors,anaverage of Rs. 33160 received by all the sectors.Highest amount received by Supermarket sector (Rs.49743) and lowest amount received by the provisional store sector (Rs. 25390).It is shown in Figure 2.

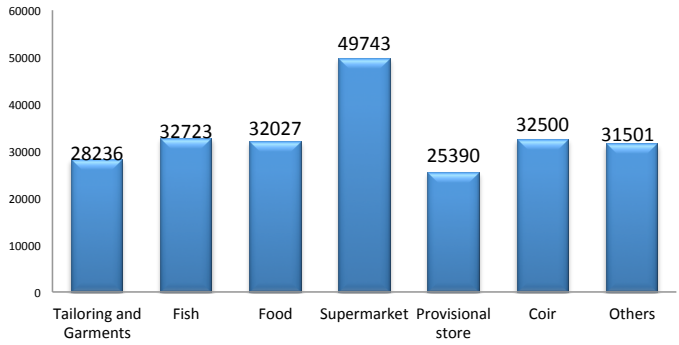

Figure 2: Average Revolving fund received

The ratio of amount received and amount repaid is calculated. Figure 3 shows that highest ratio in provisional store sector followed by the fish sector and lowest ratio in supermarket sector. This is due to the variation in revolving fund received. Supermarket sector received more amount and provisional store sector received less amount among the sectors.

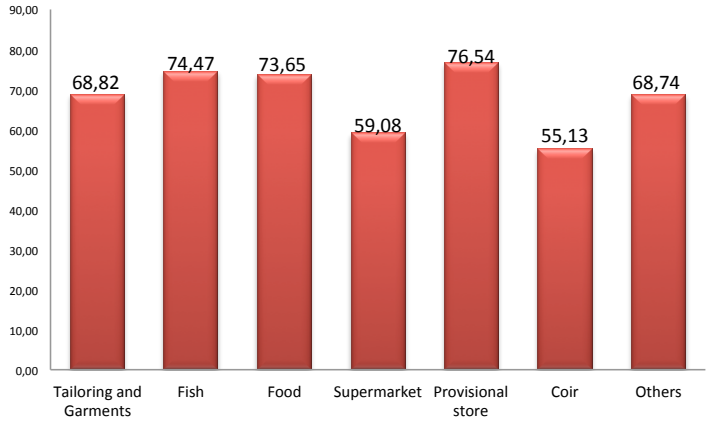

Figure 3: Ratio of amount received and amount repaid

Impact on Revolving Fund

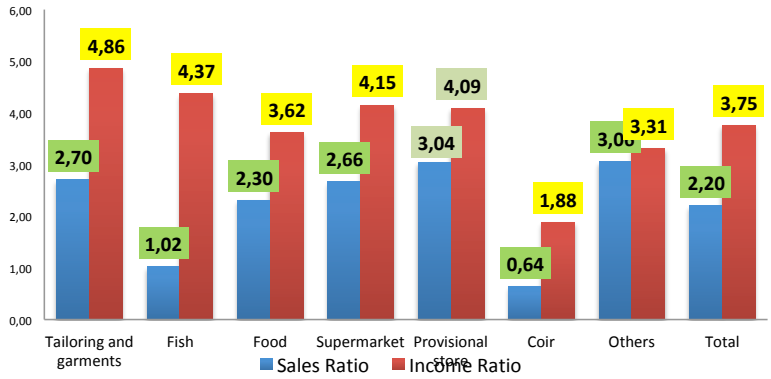

Figure 4: Impact on Revolving Fund

After receiving the revolving fund, the sales as well as income of different activity groups increased. The sales ratio and income ratios are shown in figure 4. It indicates that both the sale and income increased in provisional store sector. And also the sales and income increased in other sector.

By dissecting "Other" sector to find the progressing groups in the sector. The most number of groups in the other sector is the flour mill (43 per cent) followed by the beauty parlour (10 per cent). In the case of revolving fund received, beauty parlour groups received high (11.8 per cent). From figure 5, the sales and income are increased in beauty parlour and flour mill.

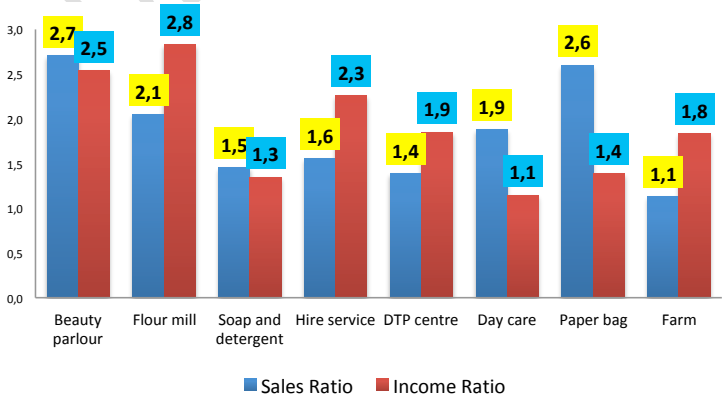

Figure 5: Dissecting others

Motivation to get a revolving fund / Utilization of the revolving fund

From table 1 the major attribute selected for the motivation to get a revolving fund is enhancing the sales volume. Increasing the personal income is the second major attribute. Other attributes selected are purchasing the raw materials, ease of availability and creation of job opportunity.

Table 1: Utilization of the revolving fund

Attributes	Score	Rank
Enhance the sales volume	68	I
Increase the personal income	59	II
Purchasing the raw materials	54	III
Ease of availability	53	IV
Creation of job opportunity	52	V
Low cost and high business performance	48	VI
Meeting the day to day expenses	47	VII
Less burden and procedures	46.5	VIII
Marketing the products	46	IX

Benefits after receiving the Revolving Fund

The main benefit after receiving the revolving fund is the increase in savings and income followed by increase in sales volume. Motivation / leadership and more accountability / responsibility are the other major benefits after receiving the revolving fund.

Table 2: Benefits after receiving the Revolving Fund

Attributes	Score	Rank
Increase in savings and income	71	I
Increase in Sales volume	64	II
Motivation / Leadership	52	III
Improved in basic facilities and amenities	50	IV
More Accountability/ responsibility	47	V
Risk takers	44	VI
More employment opportunities	43	VII

Marketing skills improved	42	VIII

Shortcomings in the Revolving fund

When considering the shortcomings in the revolving fund, inadequate fund is in the first position followed by lack of awareness. Other constraints are lack of skill in managing money and long procedures

Table 3: Shortcomings in the Revolving fund

Constraints	Score	Rank
Inadequate funds	64	I
Lack of awareness	53	II
Lack of skill in managing money	52	III
Long procedures	47	IV
Delay in disbursal of fund	45	V
Technical support from SAF	38	VI

Shortcomings in the Business

The main constraint in the business is the competition in the market followed by lack of institutional linkages and lack of branding.

Table 4: Shortcomings in the Business

Constraints	Score	Rank
Competition in market	63.4	I
Lack of Institutional linkages	61.0	II
Lack of branding	57.7	III
Unexpected expenses	56.6	IV
Inadequate funds	55.0	V
Lack of skill in business planning	53.4	VI
Seasonality of business	53.3	VII
Inadequate operational space	50.7	VIII
Raw material shortage	50.0	IX

Lack of skill up gradation	48.9	X
Quality issues	45.7	XI
Absenteeism	44.6	XII
Conflicts among members	44.0	XIII
Technical support from SAF	41.0	XIV
Delay in disbursal	39.3	XV
Fund spent on other uses	36.3	XVI

Technology fund

SAF provides technology improvement support that focuses on technical improvement, replacement and repairs, technical support, and application of new and appropriate technologies. The activity groups implemented by SAF need to be developed by extensive application of new and appropriate technologies in various micro enterprises. These increase the demand for interventions in technology improvement and skill training.

Most of the activity groups started before 2009 (42.4 per cent). 41.2 percentages of the activity groups started in between 2009 and 2012 and 16.4 percent started after 2012. Average hours spend per a day by a person in all the sectors is 7.3 hours. When comparing the different sectors, the maximum hours spend per day in supermarket sector (9.5 hours). This is due to the working time of the supermarkets is high when compared to other sectors. The average working hours per day is minimum in Coir sector (6.3 hours). It is shown in the figure

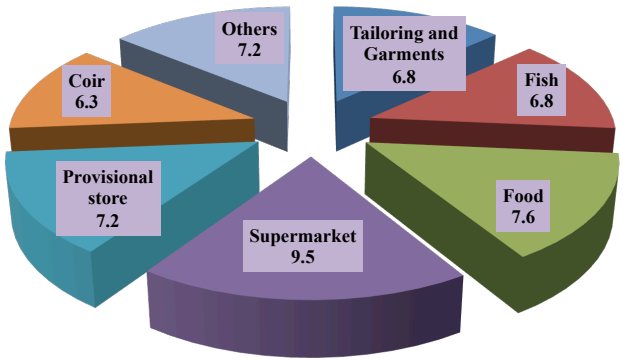

Figure: 6 Average hours spend per day (Technology fund)

Technology fund received

An average of Rs.29446 is received as the technology fund and an average of Rs 23400 is repaid by different sectors. The highest amount is received by the other sector as technology fund (17.6 percentages) followed by supermarket sector (16.6 percentages). The least amount received by coir sector (11.8 percentages).

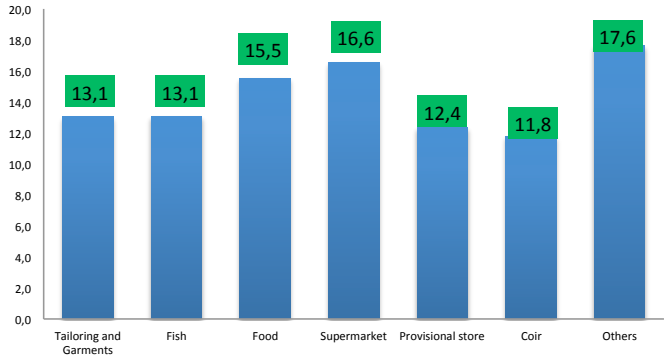

Figure 7: Technology fund received

When calculating the ratio of fund received and spends, provisional store sector shows the highest ratio (89.61) followed by the coir sector (87.24).

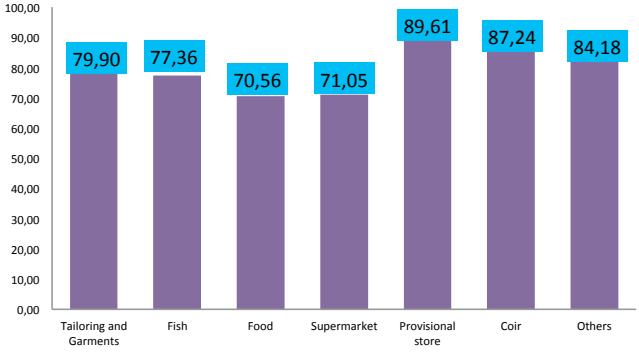

Figure 8 Ratio of Technology fund received and Amount spend for repairing the equipment

Impact on Technology Fund

After receiving the technology fund the sales and income of the activity groups increased. From figure 9 the sales and income increased most in provisional store sector.

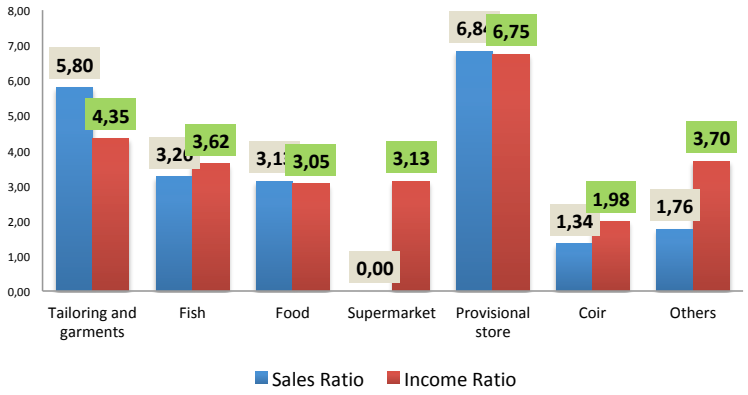

Figure 9: Impact on Technology Fund

By dissecting others, the most number of groups is the flour mill (35 per cent) followed by hire service (23 per cent). High amount received as the technology fund by the akshaya centre (33.1 per cent). From figure 10 the most progressive group is hire service.

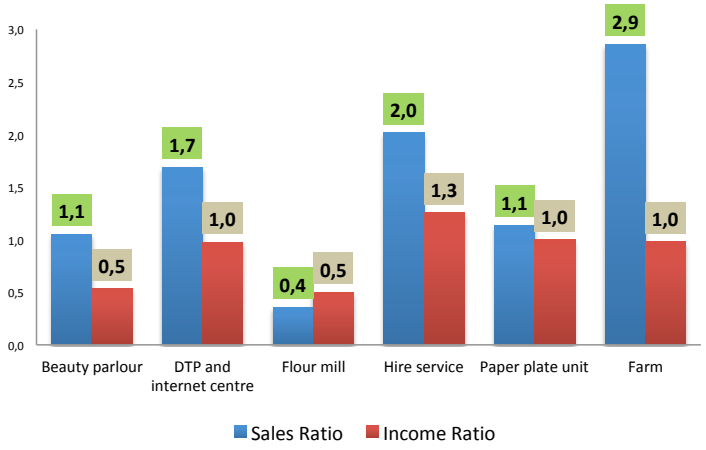

Figure 10: Impact on technology fund- Other sectors

Reason for availing Technology fund

The main attribute selected by the groups as the reason for availing technology fund is enhance the productivity and sales volume followed by increase the income. To meet the demand and ease of availability are other reason for availing technology fund.

Table 5: Reason for availing Technology fund

Attributes	Score	Rank
Enhance the productivity and sales volume	64	I
Increase the income	60.3	II
To meet the demand	57.4	III
Ease of availability	53.6	IV
Creation of job opportunity	48.1	V
Providing best service by saving time	47.7	VI
Low cost and high business performance	47.1	VII
To stay competitive	43.1	VIII
Less burden and procedures	41.3	IX

Benefits after receiving the Technology fund

The main benefit after receiving the technology fund is the increase in sales volume and increase in savings and income. Improvement in the basic facilities and amenities and meeting the demand are the other benefits.

Table 6: Benefits after receiving the Technology fund

Attributes	Score	Rank
Increase in Sales volume	66.6	I
Increase in savings and income	64.9	II
Improvement in the basic facilities and amenities	53.1	III
Meeting the demand	50.4	IV
Motivation / Leadership	48.7	V
Providing the best service by saving time	48	VI
More employment opportunities	47.4	VII
More Accountability/ responsibility	47.1	VIII

The main constraint in the short comings in the technology fund is the inadequate fund and long procedures. The main constraints in shortcomings in the business are competition in market, inadequate funds and lack of skill up gradation

Shift to business

Shift to business fund must be allotted only at the time where there is no other option left out for reviving the activity group. They can be linked to take loan from banks as that will create the

institution for hard work to revive the group. Most of the activity groups started before 2009 (44.6 per cent). 33.8 percentages of the activity groups started in between 2009 and 2012 and 21.5 percent started after 2012. When comparing the sales, income and expenditure; the sales is high in fish sector but the income is low. This is due to the high expenditure. When comparing the different sectors the income is high in food sector. This is due to the less expenditure.

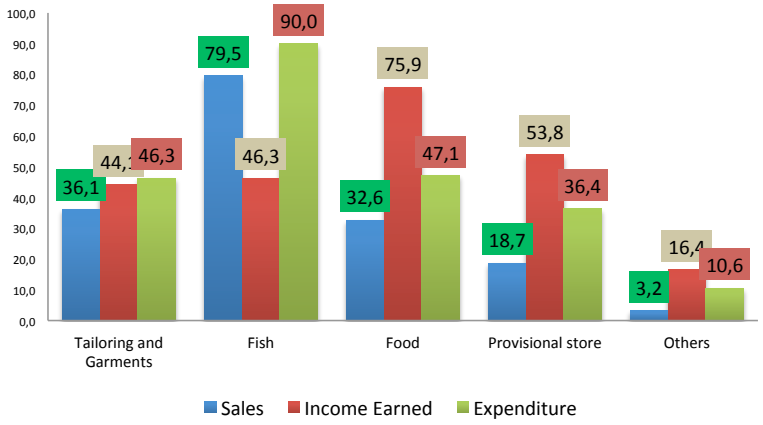

Figure 11:the sales, income and expenditure

Reasons for shift in business

There are several reasons for shifting the business. The main reason is better chance of developing new revenue followed by Current business activities, products and services don't generate the revenue, necessary to sustain profit. Economic reality, crisis and pressure and change in customer preference are the other reason for shift in business.

Table 7: Reasons for shift in business

Constraints	Score	Rank
Better chance of developing new revenue	68.6	I
Current business activities, products and servicesdon't generate the revenue, necessary to sustain profit	65.2	II
Economic Reality	63.4	III
Crisis and pressure	55.8	IV
Change in customer preference	49.8	V

Custom demand	49.6	VI
Increase in consumer demand	48	VII
customers	47.4	VIII
Not able to keep a quality image	47.2	IX
Seasonality of business	46.6	X
Social Demand	45.6	XI
Social pressure	39	XII
Governmental regulations	33.2	XIII

Benefits after shifting the business

The major benefit after shifting the business is increase the personal income and enhances the sales volume. To meet day to day expenses and creation of job opportunities are the other benefits.

Table 8: Benefits after shifting the business

Attribute	**Score**	**Rank**
Increase the personal income	60	I
Enhance the sales volume	56.2	II
To meet day to day expenses	49	III
Creation of job opportunity	47.6	IV
Low cost and high business performance	43.4	V
To market the products	39	VI

Problems faced after shifting the business is the another main factor considering. The main constraint is the inadequate fund and lack of skill in managing money. Lack of proper planning and lack of awareness are the other problems.

Table 9: Problems faced after shifting the business

Constraints	**Score**	**Rank**
Inadequate funds	62.4	I
Lack of skill in managing money	57.2	II
Lack of proper planning	50.2	III
Lack of awareness	49.6	IV
Couldn't get the expected demand	48.4	V
Couldn't able to maintain quality of the product	43	VI
Conflicts among members	38.8	VII

Conclusion

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2. the suggestions you provide follow the discussion you have done in the results and discussion section

The SAF aimed at improving the income and quality of life by providing alternative livelihood to fisherwomen. The financial ratios assessed across the different categories of enterprises indicated better sales turn over and income ratios. The major benefit included an increase in sales volume, motivation/leadership, improved in basic facilities and amenities more accountability/ responsibility risk-takers more employment opportunities marketing skills improved.The result shows that the average hours spend per a day by a person in all the sectors is 7.5 hours. When comparing the different sectors, the maximum hours spend per day in supermarket sector (10 hours). This is due to the working time of the supermarket is high when compared to other sectors. The average working hours per day is minimum in Tailoring and garments sector (7 hours). When considering the revolving fund received by the sectors, an average of Rs. 33160 received by all the sectors. Highest amount received by Supermarket sector (Rs.49743) and lowest amount received by the provisional store sector (Rs. 25390). The ratio of amount received and amount repaid is calculated and the highest ratio in provisional store sector followed by the fish sector and lowest ratio in supermarket sector. This is due to the variation in revolving fund received. Supermarket sector received more amount and provisional store sector received less amount among the sectors. An average of Rs.29446 is received as the technology fund and an average of Rs 23400 is spent by different sectors. The highest amount received by the other sector as technology fund (17.6 percentages) followed by supermarket sector (16.6 percentages). The least amount received by coir sector (11.8 percentages). When calculating the ratio of fund received and spends, provisional store sector shows the highest ratio (89.61) followed by the coir sector (87.24). The results also indicated the need for identifying non-traditional business "Other" enterprises for the future target younger fisherwomen group members.

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Ms_INDJ_64507: Invitation to Review Manuscript for International Neuropsychiatric Disease Journal

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Original Research Article

Diseases of *burnout* during the pandemic of the new Coronavirus in intensive care physicians and its impact on serving the population

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ABSTRACT

The mental health issue during the COVID-19 pandemic must consider different populations: doctors / health professionals; general population and patients with mental disorders. When analyzing the stress-generating environment, such as intensive care units and emergencies, one must keep in mind the great demand for work and overload of professionals who are in this current pandemic scenario. Thus, this study aims to review the literature on the problems arising from the *Burnout* Syndrome in intensive care physicians during the COVID-19 pandemic. This study constitutes a descriptive bibliographic review on information about the main mental health complications of intensive care physicians directly involved in coping with the COVID-19 pandemic. The searches were performed in bibliographic databases Medline, Embase, Pubmed and Central, after the re-reading of each article, the data of interest were extracted and analyzed in a descriptive way for the composition of this work. Among the factors that modify the working environment of intensive care physicians working in the front line to combat COVID-19, are: limited hospital resources, threat of exposure to the virus as an additional occupational risk, longer shifts, disturbed sleep patterns, subsequent high dilemmas regarding duties with the patient versus fear of exposure to family members, increased workload, increased physical and mental fatigue, stress, anxiety and physical exhaustion. That said, measures must be taken to support intensive care groups in this phase of global public health. The measures include psychological counseling, organization of the workday, provision of personal protective equipment and training on safety measures. The present review showed evidence of how accentuated the cases of burnout and other emotional manifestations related to work stress worsened with the pandemic of COVID-19. Such emotional conditions have a negative impact on the care of patients undergoing intensive care units, as work stress causes illness, low motivation, unproductiveness and less self-confidence in their own work skills.

Keywords: Burnout syndrome; COVID-19; Intensive care unit; Mental health.

1. INTRODUCTION

Health institutions are dealing with a new scenario of health and safety actions aimed at the various professionals involved in the care of the population [41]. These are facing the pandemic caused by the worldwide outbreak of the disease caused by the new Coronavirus, Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), called COVID-19 [55,60].

First reported in Wuhan province, China, in December 2019, infectious disease COVID-19 is a new disease, unlike others caused by Coronavirus, such as severe acute respiratory syndrome (SARS) and respiratory syndrome of the East Medium (SROM), having been declared a pandemic by the World Health Organization on 11 March 2020 [60]. It is a disease with rapid transmissibility among individuals who may be symptomatic or not, whose outbreaks can grow rapidly and exponentially, with a higher lethality than that of seasonal flu [11].

The COVID-19 pandemic has produced significant numbers of infected people and deaths worldwide. According to the report by the World Health Organization, as of December 7, 2020, 66,243,918 confirmed cases and 1,528,984 deaths from the new Coronavirus were reported in the world, mainly affecting the Americas and Europe [33].

SARS-CoV-2 has specific characteristics (genetic structure and pathogenic mechanisms) that pose great challenges for the prevention and treatment of infection, which can directly impact the mental health of professionals who care for infected people [32]. In its form of severe manifestation, COVID-19 is associated with severe acute respiratory syndrome. Patients who develop this form can quickly evolve to death [55].

In the absence of vaccines and proven effective treatment, social distancing strategies have been identified as the most important intervention for the control of COVID-19 [60]. However, for health care teams, especially those professionals who are in direct care of patients with suspected or confirmed diagnosis of COVID-19 in primary care services, emergency care units and hospitals, the recommendation to remain at home does not apply [51].

The problems that public health has faced, when confronting the multiple challenges triggered by the outbreak of COVID-19, are unparalleled in history [14]. With regard also to mental health care in times of crisis, health professionals are among the groups most vulnerable to the emotional and psychological consequences of the pandemic.

Such a scenario can cause burnout (work-related stress), depression, anxiety, among others, harming even more the coping with the disease [35], requiring even more dynamism in the face of changes, which shows the vulnerability of health resources in the world based on this “new occupational normality” [11]. Nevertheless, there is the unhealthiness and challenges of different hospital units, which perform both emergency and elective care, for example, the operating room and the Intensive Care Units (ICU), which together have increased and expanded the offer of intensive care [21,26].

As COVID-19 spread globally, saturating health systems and causing them to collapse, the number of patients admitted to intensive care has grown, adding to challenges related to working conditions that, in a way, negatively impacted health mental health of professionals in intensive care units with symptoms such as stress, anxiety, insomnia and depressive symptoms [20,56]. Considering that ICUs represent exhausting and tense environments, intensivists are more exposed to physical and emotional stress and, consequently, to psychological disorders [2].

The mental health issue in the COVID-19 Pandemic must consider different populations: doctors / health professionals; general population; patients with mental disorders, among others [49]. A considerable proportion of health professionals experienced symptoms of depression, anxiety, insomnia, stress, especially women, and those on the front line, directly involved in diagnosing, treating or providing care to patients with suspected or confirmed diagnosis of COVID-19 [23]. These findings suggest that professionals at the front line are at high risk of developing mental health problems and need supportive interventions [43].

As for intensivists, they daily face unstable working conditions, in an environment marked by lack of security, inadequate infrastructure (in some cases) and inherent risks. This influences high levels of professional exhaustion, physical and psychological illness, poor quality of life and health care [5]. Such situations are more common to professionals working on the front line to combat COVID-19, due to long working hours, concern about the patients' health status and the shortage of personal protective equipment (PPE), especially in countries with limited resources [38].

The high levels of stress represent a serious threat to the mental health of health professionals, increasing the rates of anxiety, depression, post-traumatic stress disorder and negative social behaviors that can imply the effectiveness of their workday [27,12].

When analyzing the stress-generating environment, such as the Intensive Care Unit and emergencies, one must keep in mind the great demand for work and overload of health professionals who are in this current pandemic scenario. Therefore, this work aims to review the literature on *Burnout* Syndrome in intensive care physicians during the COVID-19 pandemic.

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1.1 *Burnout* Syndrome and COVID-19

In view of the sudden appearance of this new form of acute respiratory syndrome caused by the new Coronavirus, the challenge faced by health professionals in maintaining their own physical and mental health became evident [5]. Countries such as China, Germany and the United States have disclosed their experiences in coping with the mental health of health professionals, offering an overview related to the psychological suffering of those on the front line of care [23,36,53].

It is inevitable that health professionals, especially doctors, working tirelessly on the front line, are more vulnerable to emotional issues, as they also deal with their feelings of helplessness, failure, stress due to conditions and work overload, uncertainties about the disease and treatment, fear of contracting and transmitting the virus, and / or difficulty dealing with the loss of their patients [62].

The literature reports that several health professionals were traumatized by the SARS epidemic and suffer from persistent psychiatric symptoms even afterwards, such as post-traumatic stress, showing that mental health care for these professionals should start immediately [61].

Mental illnesses such as depression, anxiety, stress and BO, were responsible for countless absences from work. In recent years, BO has become a significant psychosocial problem, caused by chronic stress administered unsuccessfully in the workplace [8]. It is a psychic disorder of a depressive character, preceded by intense physical and mental exhaustion caused by excessive and prolonged levels of stress (tension) at work, interfering with mental health and reduced professional effectiveness [3]. It is considered as a social problem of great relevance, being investigated in several countries [60].

BO involves three interdependent factors: emotional exhaustion, depersonalization and low professional achievement or inefficiency [35]. Emotional exhaustion represents the individual component, with feelings of being demanded beyond your resources. Depersonalization refers to the interpersonal component and, at high levels, can give an initial impression of defense and protection, but with a risk of chronification of distance. Ineffectiveness is the self-assessment component, usually accompanied by feelings of incompetence and low productivity [52].

BO is currently included in the International Classification of Diseases ICD-11 under the code QD85 (formerly Z73 by the ICD-10 system) [59]. Its symptoms are associated with anxiety, depression, less satisfaction, post-traumatic stress disorder [4].

In view of the current public health scenario, health professionals are the most exposed to the risks of infection and consequently are the most likely to develop some psychological syndrome [33]. The dangers include greater exposure to the pathogen, long working hours, emotional stress, fatigue, physical and mental exhaustion syndrome inherent to work (BO), stigma and physical and psychological violence [61].

Given the highly contagious nature of SARS-CoV-2 and the rapid spread of the COVID-19 pandemic, there was a lack of preparedness and insufficient training for the challenge posed on health systems, as well as the limited supplies of PPE for ICU teams, including anesthesiologists, intensivists, pulmonologists, nurses, respiratory therapists and other frontline providers in most affected areas [44].

Among the aspects that changed the work environment and that can directly interfere in the mental health of intensive care physicians working in the front line of the fight against COVID-19, are the lack of PPE; the restricted number of beds and mechanical fans; lack of knowledge and training to serve this specific population; level of complexity and severity of patients, in addition to the lack of specific and effective treatment for the disease; wear and tear generated by the inability to meet the demand of patients seeking care; need to deal with the increase in the volume of deaths, including family members and co-workers [29].

Recalling that the work of the professional working in the ICU is exhaustive, requiring in addition to qualified technical knowledge, special skills; attention; quick thinking; ability to balance emotionally to deal with the adversities that arise in their daily work [6].

The biggest challenges experienced by doctors and intensivists in the face of the pandemic include not only the increased workload created by such an outbreak, but also the fear of contagion for them and their families, as well as working with new protocols and lack of PPE [3].

Considering the importance of intensivists for the care of critically ill people, and that the repercussions of BO can lead to incapacity for work and compromise patient care, the early identification of the syndrome's development stage can support interventions, individual and / or organizational, to prevent these situations [25].

1.2 Impacts and interventions

BO is associated with an increase in cases of medical suicide, as well as substance abuse, which can contribute to the instability of the health infrastructure, promoting an increase in staff turnover, early retirement and a percentage reduction

in professional effort. These consequences are certainly undesirable in the context of a pandemic that requires greater resources and health reserves [34,4].
Some studies have identified factors associated with mental health outcomes in intensive care physicians. These are: (1) limited hospital resources, (2) threat of exposure to the virus as an additional occupational risk, (3) longer shifts, (4) disturbed sleep patterns, (5) work life balance, (6) subsequent high dilemmas regarding patient duties versus fear of exposure to family members (7) increased workload, (8) increased physical and mental fatigue, (9) stress and anxiety and (10) physical exhaustion. All of these factors were identified as the main factors that contribute to the increase in physical and mental fatigue, anxiety, stress and exhaustion [1,9,7,13, 23,24,39,48]. These authors also emphasize that the worker falls ill due to issues more linked to the work context than individual characteristics.

These consequences are of sufficient importance that immediate efforts focused on prevention and direct intervention are necessary to address the impact of the outbreak on mental health, not only individual (in the case of intensive care doctors), but also population [17].

Previous epidemiological studies have verified the psychological impacts caused by the outbreak of the Serious Acute Respiratory Syndrome, caused a significant increase in cases related to mental disorders during and after the epidemic among health professionals [40,47]. In parallel to this, the COVID-19 pandemic added new factors to the development of BO in intensive care physicians.

In this regard, several measures must be taken to support this group of doctors in this phase of global public health. Such measures include psychological counseling, organization of the workday, salary adjustment, provision of PPE and training on safety measures [3].

Although each individual has several psychological baselines, providing subsidies for mental health as a preventive action is important for everyone [50], since mental health education, along with subsequent prevention and mitigation, is critical at times like this [54].

One form of intervention would be for hospitals to promote policies aimed at minimizing the risk of negative psychological effects experienced during the pandemic [39]. The provision of psychological support through, for example, Cognitive-Behavioral Therapy (CBT) focused on trauma is a means of intervention that covers specific and non-specific methods (with respect to mental disorders) that, based on proven specific knowledge about the different disorders and psychological knowledge regarding the way human beings modify their thoughts, emotions and behaviors, aim to systematically improve the problems treated. This measure proved to be useful in previous periods after epidemics and natural disasters [39].

There is also prevention by psychoeducation, based on psychoemotional self-care activities. In times of pandemic, it is necessary to think about how to treat stress and trauma and to develop psychological tools with the objective of protecting against traumatic stress and BO [25].

Stress management and prevention in professionals is necessary, regardless of the epidemiological state installed. Understanding the needs of the workforce is crucial for the development of recruitment and retention strategies, as healthcare organizations must control costs and increase productivity by providing healthy work environments [31].

2. METHODOLOGY

2.1 Methods/Approach

This study constitutes a descriptive bibliographic review on information about the main mental health complications of intensive care units' physicians directly involved in coping with the covid-19 pandemic.

Searches will be conducted in Medline, Embase, Pubmed and Central bibliographic databases, using the following descriptors: "Coronavirus", "Sars-CoV-2", "Covid-19", "*Burnout* syndrome", "Intensive care doctors", "*Burnout* syndrome, Physicians", "Intensive care unit".

After selecting the articles, exploratory reading will be performed; selective reading and choice of material appropriate to the objectives and theme of this study; analytical reading and analysis of the texts, ending with the performance of interpretative reading and writing of the manuscript. then, the body of the study will be constituted, grouping the most discussed themes in the following categories: Covid-19, mental health, *burnout* syndrome, occupational risks. from this stage, the entire theoretical framework in line with the study theme will be analyzed and discussed.

2.2 Data Collection and Sampling

Data collection for this review was carried out from October 2020 to December 2020, through the selection of articles available in full in Portuguese and English. For this, an online search was carried out in journals in the area of concentration of Health Sciences, targeting the electronic bibliographic databases: MEDLINE (Medical Literature Analysis and Retrieval System Online / PubMed), EMBASE (Elsevier) and CENTRAL (The Cochrane Central Register of Controlled Trials The Cochrane Library), in order to concisely organize and synthesize information. Subsequently, there was an analysis of the selected material, in order to respond to the objectives of the study.

2.3 Data Analysis

After rereading each article, the data of interest were extracted and analyzed in a descriptive manner for the composition of this work. As recommended by the guidelines for the development of literature reviews, the main results of the listed studies were summarized. All ethical principles related to the process of constructing a literature review were observed, and the studies reviewed and incorporated into the manuscript were cited and referenced. The present work assures the ethical aspects, guaranteeing the authorship of the researched articles, using for citations and references of the authors.

3. RESULTS AND DISCUSSION

The emergence of the COVID-19 pandemic demonstrated several weaknesses in the affected countries with regard also to the mental health care of health professionals, especially intensive care doctors, in times of crisis. However, it was possible to evidence some experiences to offer strategies to promote mental health care for this group in question (Table 1). These strategies and interventions can be adopted in the face of this pandemic scenario.

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Table 1. Strategies and Interventions to prevent BO, acute stress disorder and post-traumatic stress disorder, in intensive care physicians related to the COVID-19 pandemic. Adapted from Sousa Júnior and collaborators (2020) and Restauri and collaborators (2020).

Strategies / Interventions	Potential benefits
Promote educational actions on Burnout Syndrome and other psychological disorders via expert panel discussions.	Increases awareness and early intervention.
Psychological monitoring	Early intervention.

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Comment [3]: Please add:
1.The methods used to evaluate and synthesize findings of the studies.
2.Data extraction and quality assessment

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Comment [4]: Please add a flow chart of the document selection process that you use along with the number and results

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Comment [5]: Please make a table of search results for the electronic journal database (the number and results that match the eligible criteria)

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Comment [6]: This article will be more interesting and more complete in scope if the author adds more research articles about BO to Healtworkers related to Covid-19. For example, author for example, the author can read several articles at the following link:
1.file:///Users/macbookpro/Downloads/COVID-19-SULTANA-July-4-FINAL.pdf
2.https://clinicaltrials.gov/ct2/show/NCT04474080
3.https://associationofanaesthetists-publications.onlinelibrary.wiley.com/doi/10.1111/anae.15180
4.https://www.researchgate.net/publication/344496537_Burnout_in_hospital_medical_staff_during_the_COVID-19_pandemic_diagnosis_treatment_and_prevention
5.https://www.researchgate.net/publication/340634505_Burnout_Among_Healthcare_Providers_During_COVID-19_Pandemic_Challenges_and_Evidence-based_Interventions
6. ect…

Counseling services	Increases awareness and early intervention.
Accommodations during working hours	It eases work stress.
Flexibility of working hours	It eases work stress.
Planning educational actions aimed at self-help and metal health	Increases the feeling of security and stability
Training and guidance for intensive care professionals in the fight against Coronavirus	Decreases exposure and mitigates concerns about contracting the virus
Organizational functioning and proper working conditions	Promotes flexibility and eases job stress.
Promote support and good relationship between team and management through dialogue	Strengthens interpersonal relationships and improves teamwork.

These observations can be used to form organizational strategies that aim to reduce the effect of BO in intensive care physicians during the current public health scenario. Additional organizational strategies serve to combat the physical exhaustion of doctors and other health professionals within ICUs, which can improve working relationships and reduce conflicts, improve self-control and flexibility [37,10].

Different approaches aimed at minimizing occupational stress experienced by intensive care physicians during the COVID-19 pandemic were analyzed. Among the strategies capable of alleviating stress in a pandemic situation are those related to the environment and the workday, such as the creation of systems capable of managing the stress of professionals, flexible working hours and support for health professionals in the face of the pandemic. [9].

It is worth mentioning that BO is common among intensive care physicians of different specialties. It is characterized by cumulative involvement of emotional exhaustion, depersonalization and non-professional achievement [18]. Regarding the current pandemic caused by the new Coronavirus, several factors may have exceeded occupational fatigue and BO in doctors in intensive care units [44].

The literature reports that during the pandemic the possibility of developing BO increased. While the male gender was a predictor of depersonalization (PD), the female gender showed a significant association with greater emotional exhaustion (EE). This same study also evaluated emotional exhaustion due to infection or death by COVID-19 among colleagues or family members [3]. Previous studies have already pointed out that about 50% of intensive care physicians had different BO or some psychological dysfunction [16].

In the face of the COVID-19 crisis, there is great pressure in relation to the resources of the ICUs worldwide, increasing the risk of physical and mental exhaustion of the professionals of this unit, as well as the lack of inputs to carry out the work safely. The prevalence of BO among Dutch intensivists was low, and as a result of the new Coronavirus pandemic this prevalence has only increased [29]. The same author reports that the rate of BO in intensivists corresponds to 8%, followed by a high involvement in work 38.9%. The same study found that BO was negatively associated with both the engagement of these professionals at work and the ability to deal with their own problems and overcome difficult moments such as the COVID-19 pandemic.

With regard to psychosocial and mental health effects, since the World Health Organization declared the outbreak of the new Coronavirus as a Public Health Emergency of international importance, several factors associated with the mental health of health professionals who are in line with in the face of the COVID-19 combat, it came to the fore. Exposure to these traumatic and stressful events can lead to the development of acute stress disorder and, ultimately, trigger post-traumatic stress disorder. Likewise, BO is driven by increased exposure to stressors in the workplace that results in emotional exhaustion, depersonalization and a decreased sense of personal fulfillment [34].

Stress and anxiety experienced at work are motivators for both BO and acute stress disorder and post-traumatic stress disorder, which can have a major negative impact on the health system and patient safety [39].

In this sense, the COVID-19 pandemic represents a perfect scenario to cause chronic stress in the work environment, resulting in high rates of physical and mental exhaustion that can trigger symptoms of acute traumatic stress imposed by the pandemic [39]. Exploring the intersection of these two phenomena is necessary to inform interventions.

Symptoms related to post-traumatic stress disorder fall into three categories which include reliving the event, feeling of emotional numbness or depersonalization and symptoms of increased arousal (difficulty sleeping, easily irritated or angry, difficulty concentrating) [39.17].

Large-scale disasters are associated with significant increases in mental health disorders, both in the immediate and post-trauma period, leading to increased rates of post-traumatic stress disorder, depression and mental disorders caused by substance abuse [17]. Likewise, BO is associated with higher rates of substance abuse, depression and suicide [15].

People respond to emergencies and disasters in various ways, in table 2 we can observe the psychosocial and mental health responses resulting from events that cause some psychological effect, whether in the short, medium or long term [57].

Table 2. Individual reactions to the disaster. Adapted from Williams et al. (2014).

Psychosocial and mental health effects
1. Immediate and short term: • suffering; • acute stress reactions; • neuropsychological changes in response to acute stress.
2. Medium and long term: • sadness; • depression; • impact on personality; • anxiety disorders; • mental disorders, mental disorder; • post-traumatic stress disorder; • persistent suffering maintained by secondary stressors;
3. Short to medium term •Anguish.

Concerns have already arisen about the negative psychological effects of the pandemic, such as fatigue, anxiety, depression, post-traumatic stress disorder [20].

The pandemic is also likely to cause changes in other factors that affect well-being, such as organization structure, team roles, autonomy and availability [19]. Also, according to the same author, there was a significant increase in BO cases during the COVID-19 pandemic, which causes the physical and psychological exhaustion of the entire multidisciplinary intensive care team and which directly implies the well-being and quality of work in the ICUs.

Other additional characteristics associated with BO extracted from the literature include: age, female gender, conflicts in interprofessional relationships, sleep disorders and inexperience [30,37,22]. Those related to the COVID-19 pandemic are: high workload, inefficiency and lack of resources, lack of meaning at work, lack of control and flexibility, loss of social support at work and lack of work-life integration, leading to clinical exhaustion in the intensive care setting [19].

The high demand in health services during the COVID-19 pandemic was characterized as one of the main factors of emotional distress among health professionals, since this finding corroborates the relationship between BO and increased workload among intensive care physicians [28]. The same author reports that doctors in intensive care units have higher rates of BO compared to doctors in other specialties.

Each subspecialty inherent in the groups that make up ICUs (for example, anesthesiology, intensive care medicine, respiratory physiotherapy, nursing and others) follows the guidelines provided by their respective professional societies for different procedures. However, holistic efforts to align these guidelines are absent in most cases, resulting in teamwork problems, confusion and frustration, which can be a major work stress [44].

With the pandemic, several gaps in the health system were exposed, including the need for proactive investment to increase preparedness for epidemics and pandemics [44]. Thus, longitudinal studies should be designed to assess the long-term impact of the COVID-19 pandemic on the physical and mental well-being of intensive care physicians, as well as health professionals who are at the forefront of combating the new Coronavirus.

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4. CONCLUSION

Considering the importance of intensivists for the care of critically ill people, and that the repercussions of BO can lead to incapacity for work and compromise the care of patients in great need of assistance, the early identification of the development stage of this syndrome can support interventions individual and organizational measures to prevent these situations.

Based on publications that address the impacts of stress in hospital environments, especially in intensive care units where psychological and emotional pressure is prevalent, the present review showed evidence of how severe the cases of BO and other emotional manifestations of work stress worsened with the COVID-19 pandemic.

Such emotional conditions have a negative impact on the care of patients undergoing treatment in the ICUs, as stress at work causes illness, little motivation, unproductivity and less self-confidence in their own work skills. That said, strategies to promote and protect the health of these workers must be discussed and implemented in hospitals.

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Comment [7]: Author /s needs to add burnout management to the ICU staff. This section will be very useful for readers/can be used as a reference in managing BO during the Covid-19 pandemic

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Comment [8]: If the researcher has written goals and objectives in detail in the introduction, in this section it remains only to answer them based on the previous analysis and discussion.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

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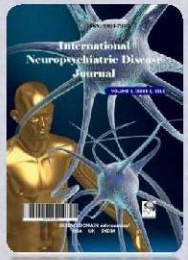

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