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Risk Factors of Work Related Musculoskeletal Disorders among Professional Computer Users in Amman, Jordan.

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ABSTRACT: Work-related musculoskeletal disorders (also known as cumulative trauma disorder, repetitive strain, and over use injuries) can be defined as injuries or disorders of the muscles, nerves, tendons, joints, cartilage, and spinal discs associated with exposure to external risk factors in the workstation.
The purpose of the present study was to investigate the external risk factors of work related musculoskeletal disorders among professional computer users in Jordan. A special questionnaire was developed that consisted of three main sections: personal data, nature of work, and the environment of computer work. None of the participants had a history of any pathology that may cause work related musculoskeletal disorders.
The response rate of the questionnaire was 86.54 % (i.e. 225 responders). Data was analyzed using SPSS version 16. Significant level was taken at $P< 0.05$.
Work related musculoskeletal disorders were defined to the participant as any pain or stiffness or numbness in one or more joint. The majority of respondents were women 69.8%. Job titles included 51 (22.7%) computer programmers, 85 (37.8%) secretaries, 58 (25%) engineers and 26 (11.6%) computer lab supervisors. One hundred seventy (79.6%) of participants were young age (23-35) years. Among all responders, 93.3% suffering of work related musculoskeletal disorders at the time of survey [2009].
Analyzing the factors, which may contribute to work related musculoskeletal disorders, showed that visual problems, head and shoulders posture, and the type of computer used are contributing factors. However, back and legs posture, age, smoking, handedness, working station environment, working hours, and length of breaks did not seem to contribute to work related musculoskeletal disorders
The present study showed that the prevalence of work related musculoskeletal disorders among Jordanian professional computer users are very high. Specific risk factors have been identified in this study. Physical therapists should be more proactive in educating computer users, employers and industrial companies on the proper biomechanics to minimize the incidence of work related musculoskeletal disorders.

Introduction: The indirect costs of work-related musculoskeletal disorders (W-MSDs) including sick leave, loss of productivity and job dissatisfaction have been emphasizing that the preventive issues of W-MSDs should be addressed [1]. Work related musculoskeletal disorders also known as cumulative trauma disorder, repetitive strain, and over use injuries [2; 3], can be defined as "injuries or disorders of the muscles, nerves, tendons, joints, cartilage, and spinal discs associated with exposure to risk factors in the workstation.
Risk factors of W-MSDs could include daily duration of computer work, repetitive movements, static and non-neutral posture [3-5], mismatching between users' criteria and ergonomics designs [6; 7], Level of training and information of computer users about potential ergonomics problems and their cure [6], and psychological factors,
In contrast with studies above, a few prospective studies have supported poor ergonomics could be risk factors [4**]**. Furthermore contributing factors that exist outside of the workplace supported that debate [6; 8; 9].
Ergonomics, also known as human factors," is the scientific discipline seeks to understand and improve human interactions with products, equipment, environments and systems. Drawing upon human biology, psychology, engineering and design " [10].The purpose of this study was 2-folds: a) to study the prevalence of W-MSDs among professional computer users in Jordan. b) To study the risk factor/s which contribute to the incidence of W-MSDs among professional computer users.

Methodology: The present cross-sectional study attempted to determine epidemiology of W-MSDs among Jordanian public office workers by means of a self-reported questionnaire delivered in 2009. Utilizing random sampling, among 5 universities varied between public and private in Amman. Two Hundred sixty six questionnaires were distributed. The participants were classified into four categories according to their job titles which are Computer programmers (computer analysis, developers and designers], secretaries, engineers (engineers of computer, graphics, agricultures) and computers lab supervisors.
The IRB committees at various universities approved the research project.
The most cost-effective and feasible method to assess external exposure in population studies is self reports includes means as questionnaire, diary or interview [11; 12] .Self reports can give some insights, into the occurrence of tasks and activities and the approximate proportion of time on each of them [11]. However quantifying the posture at work period seem to have poor validity and reliability [12] that's what also supported by Cole et al, 2003 [9].

It has been reported that subjects with musculoskeletal complaints overestimated awkward postures and underestimated postures that are more comfortable in a similar way to subjects without symptoms thus, musculoskeletal complaints did not seem to cause any differential biases in self-reported durations of these postures [12]. So far, Most of existing tools for exposure assessment are research-oriented rather than field oriented [13].

Questionnaire: A special questionnaire was prepared. The questionnaire was distributed to 225 participants who fulfilled the inclusion criteria that are ages 23-50 years, not taking any medications and be pathology free especially: congenital deformities, disc prolapse, diabetes, ovarian cysts, allergy, pregnancy or thyroid problems.
Questionnaire was distributed during work hours and collected in the same day.
Signs and symptoms of W-MSDs were defined as experience of headache, pain, and stiffness, numbness at one or more of joint/s neck, shoulder, elbow, wrist, back, legs and feet while working on a computer related job.
Details on the *individual characteristics* of all office computer users included items such as gender, age, smoking status, vision problems, and handedness were also collected.
Concerning posture questions of computer users at work office consisted of posture of head, shoulder if they are forward/backward or neutral, posture of back weather if supported or not, and posture of legs if supported or not , and posture of feet.
Breaks and ergonomics work (computer use) questions included items such as period of computer use, type of computer, office lighting, work area, height of desk top and chair, lighting, hydraulic chair, arm rest for chair, screen distance, being have back ground of ergonomics, alternating between mouse and keyboard, and having computer accessory as copy holder, foot step.
SPSS version 16.0 software package was used for statistical analysis. Frequency distribution for responses, and cross-tabulations of individual, work posture and ergonomics were studies in association with reported signs and symptoms of W-MSDs. $P<0.05$ was taken as a significant different level.

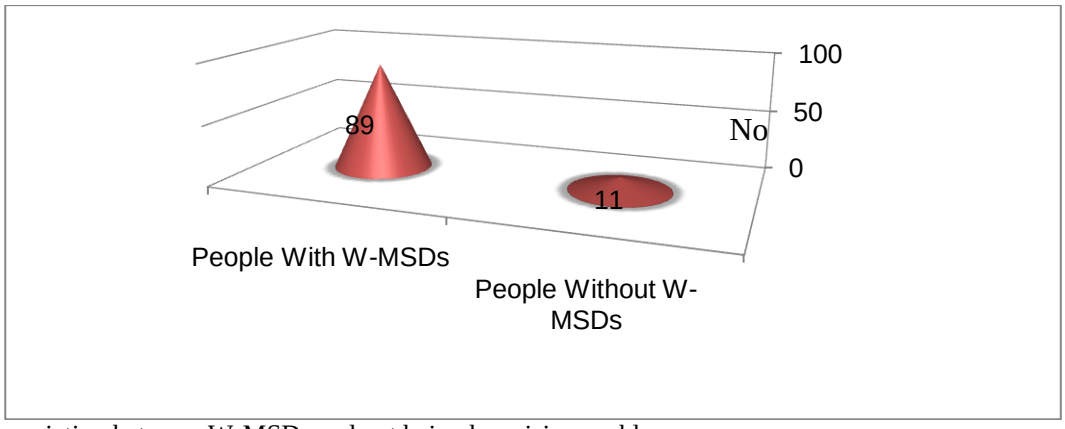
RESULTS: All computer users were provided with self-report questionnaires. The response rate of the questionnaire was 86.54 % (i.e. 225 responders).
Risk Factors of W-MSDs: *Individual characteristics of computer office workers*:
Significant association between gender and W-MSDs with, 96.2% of females had W-MSDs, while only 86% of males had them, $\chi 2= 6.8$, $P <0.05$. However, there was no significant association between W-MSDs and age, experience, smoking and job title. There was no significant association between pain at upper limbs joints and handedness of computer users with $\chi 2=, 077$, $P = 0,962$; table (1) shows that. On other hand significant association between vision problems and W-MSDs was found with $\chi 2=9.30$, $P<0.010$, figure (1) shows that.

Table 1: **Association between pain at joints of Upper limbs (UL) and handedness**

handedness	People Without pain at UL.		People With pain at UL.	
	No.	%	No.	%
Right	59	28	150	71.8
left	14	25	9	75
$\chi 2$=,077, P = 0,962				

Figure 1 (A, B): **Association between vision problems and W-MSDs**

A**: Association between W-MSDs and being has vision problems**



B: Association between W-MSDs and not being has vision problems

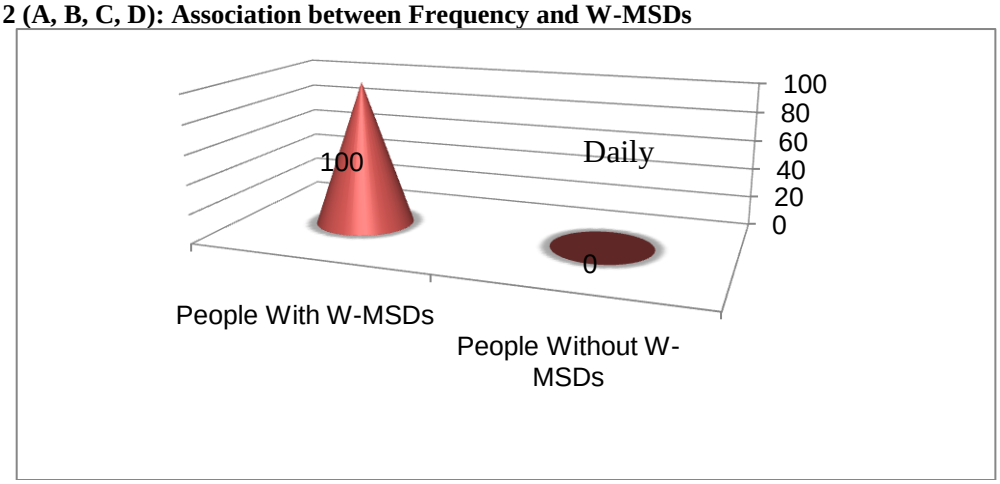
The intensity of pain was recorded according to the simple descriptive pain scale [SDPS] the association was near to be significant between W-MSDs and intensity of pain with $\chi 2$=3.58 ,P< 0.058; table (2) shows that.

Table 2: Association between sever pain and W-MSDs

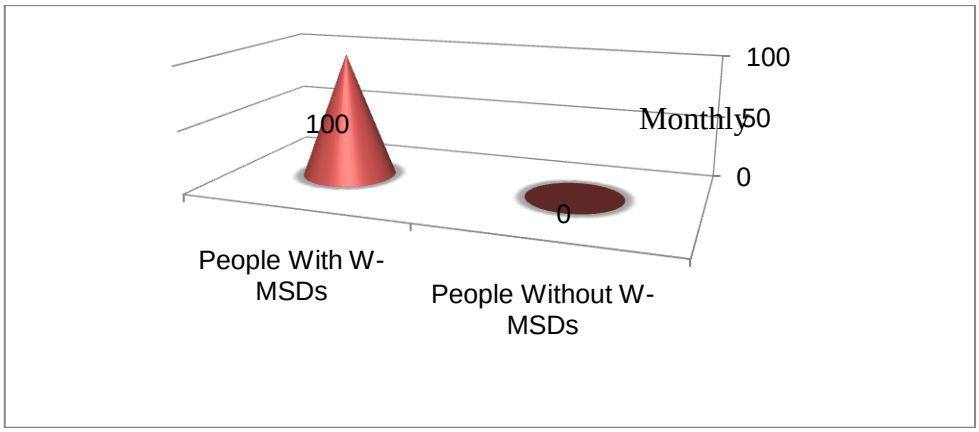
Sever pain [SDPS]	People Without W-MSDs		People With W-MSDs	
	No.	%	No.	%
Not sever pain	15	8.15	169	92
Sever pain	0	0	41	100
$\chi 2$=3.58 ,P< 0.058				

A strong significant association was found between, W-MSDs and frequency of sings with $\chi 2$ = 1.034E.2, P <0.00, However, the association between W-MSDs and visiting physician with $\chi 2$=24.328 ,P< 0.00 showed in figures (2) and (3) respectively . However, the highest proportions of participants who was visiting specialized physician was 13.3%, followed by 4 % physiotherapist visit, then 3.6% proportions of participants who didn't visit physician. Never the less no significant association was found between W-MSDs and treatment described.

Figure 2 (A, B, C, D): Association between Frequency and W-MSDs

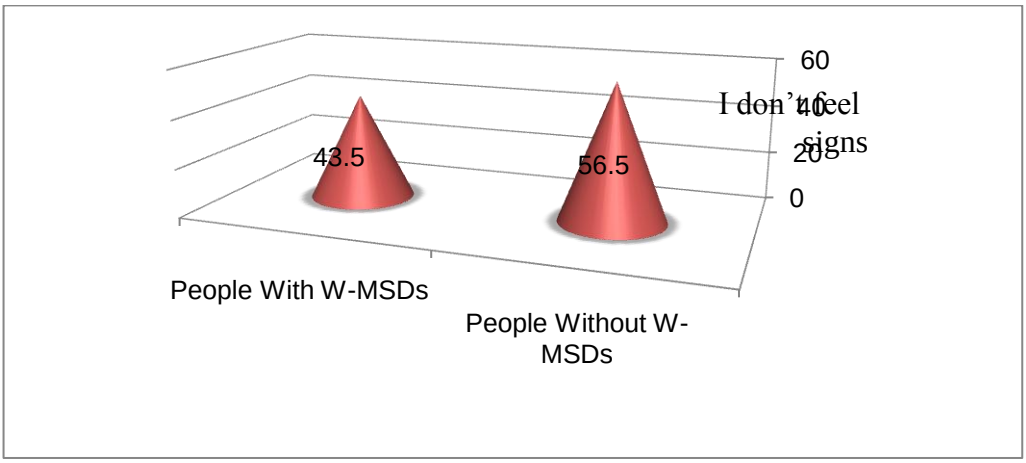


A: Association between W – MSDs and daily frequency of signs and symptoms



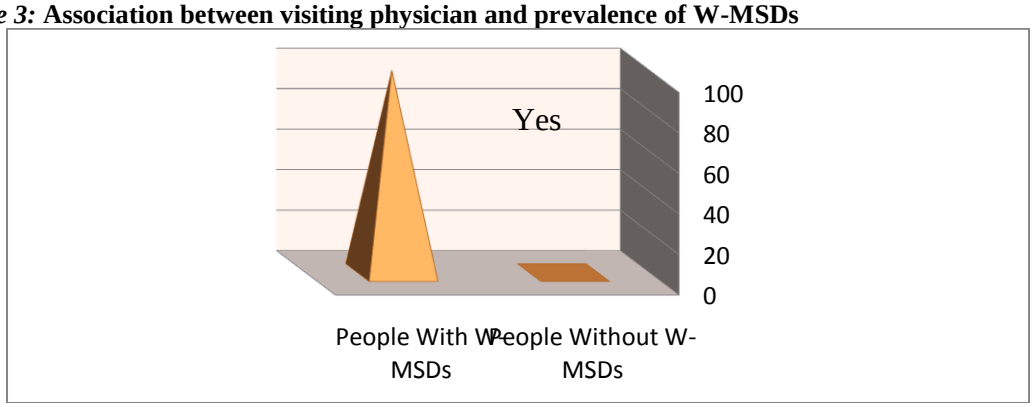
B: Association between W-MSDs and monthly frequency of sings and symptoms

C: Association between W-MSDs and frequency of sings and symptoms once a week

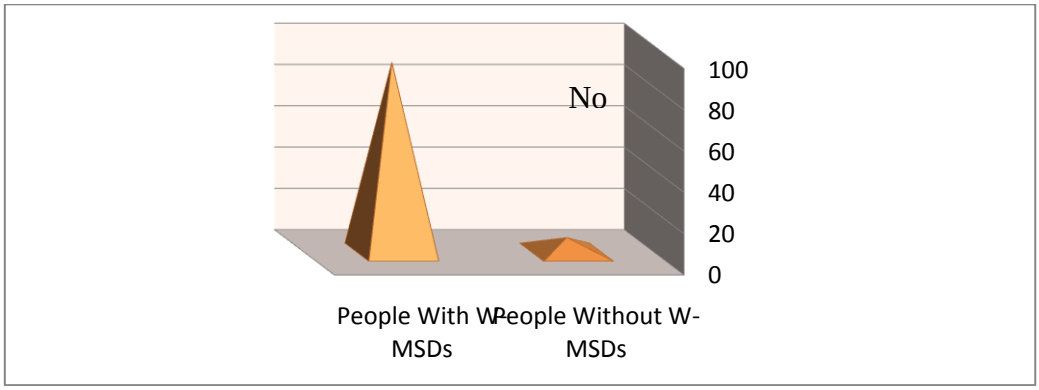


D: Association between W-MSDs and frequency of no sings and symptoms

Figure 3: **Association between visiting physician and prevalence of W-MSDs**



A: Association between W-MSDs and being visit physician



B: Association between W-MSDs and not being visit physician

Posture of computer user at office work:

A significant association between W-MSDs and posture of head, to be more significant with forward head posture than neutral, then posterior head posture with **$\chi 2$= 10.4**, P <0.016; table (3) shows that.

Table 3: Association between W-MSDs and posture of head during computer work

Posture of head	People Without W-MSDs		People Without W-MSDs	
	No.	%	No.	%
Backward	3	23	10	77
Forward	5	3.5	140	97
Neutral	6	10	56	90.3
$\chi 2$= 10.4 , P <0.016				

No significant association was found between W-MSDs and posture of those joints during computer work: shoulder, elbow, wrist, back, thighs or foot. Interestingly a strong significant association was found between W-MSDs and methods of how computer users can minimize theirs discomfort, which indicated that most of computer users 98.8% use different methods of breaks, changing sitting position and decreasing load of work, followed with 94% changing theirs sitting position as a means to minimize the discomfort, then 93% of users using breaks, and finally 91% of users decreasing load of work only; with **$\chi 2$**= 31.23 , P< 0.00; table and figure (4) shows that.

Table 4: Association between W-MSDs and methods of reducing discomfort at computer work.

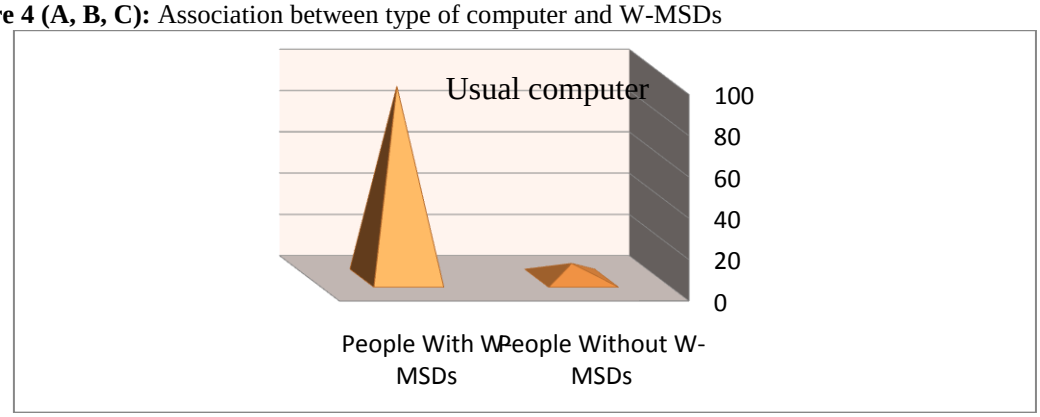
Discomfort (S&S)↓ by	People Without W-MSDs		People With W-MSDs	
	No.	%	No.	%
↓load of work	2	9	21	91
Change sitting position	1	5.3	18	95
Breaks	5	6.1	77	94
All above	1	1.16	85	99
$\chi 2$= 31.23 , P< 0.00				

Again a strong significant association was found between W-MSDs and number of hours of using the computer at office work **$\chi 2$= 15.4**, P <0.004.

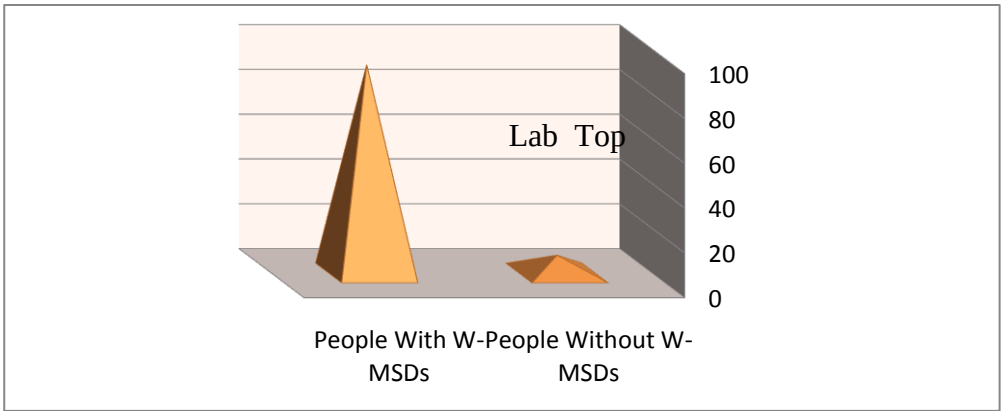
The sort of activities done during the breaks (some sports, change sort of task work, or both) tended to be significantly related to W-MSDs; $\chi 2$= 8.61, P<0.072.

Regarding type of computer, a strong significant association was found between W-MSDs and type of computer being used, to be most significantly associated with using both types of computers [desk top and lab top] 97.4%, and the lowest with usual type of computer 92.8%; with $\chi 2$= **15.4** , P <0.004; figure shows that (4).

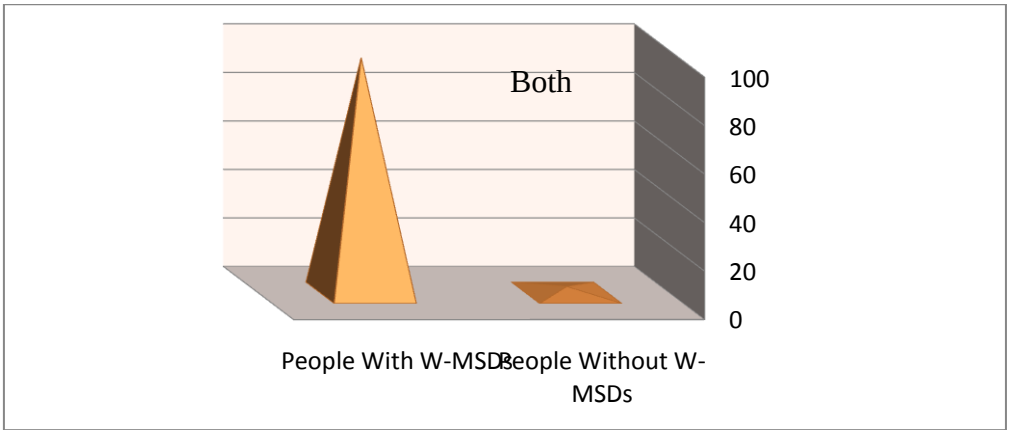
Figure 4 (A, B, C): Association between type of computer and W-MSDs



A: Association between W-MSDs and usual computer being used.



B: Association between W-MSDs and using both types of computer .



C: Association between W-MSDs and type of computer and W-MSDs

No significant association was found between W-MSDs and ergonomics items. However only a strong significant association was found between W-MSDs and comfortable support for lumber area as W-MSDs to be highest with those who didn't used lumber support 98.4%; with $\chi 2$= 11.87, P<0.001, table (5) shows that .

Table (5): Association between W-MSDs and comfortable support for lumbar area at chair

Support of lumbar area by chair is it comfortable.	People Without W-MSDs		People With W-MSDs	
	No.	%	No.	%
Yes	13	13.13	86	87
No	2	2	124	98.4
$\chi 2$= 11.87 , P<0.001				

Finally, in comparing between standers of Jordanian's parameters and standers of American International Standers Institution [ANSI], 23% of The height of desk top table in Jordan have same parameters of ANSI, while 69.8% of chair height have the same of ANSI, and 33% of users have the distance away of the screen as in same parameter of ANSI. Whenever it was found 98.7% of users with W-MSDs have same parameters of ANSI for screen distance, While 96% of users with W-MSDs have same ANSI parameter's for desktop height, and 92% of users with W-MSDs have same ANSI parameter's of chair height; table (6) shows that.

Table 6: comparison between ANSI standards and Jordan computer office work parameters

Items	People Without W-MSDs		People With W-MSDs	
	No.	%	No.	%
Table(desktop) 57.5-70cm (ANSI)	2	4	50	96.15
Chair 38-52.5cm(ANSI)	12	8	145	92.4
Screen Distance 30-40cm (ANSI)	1	1.3	74	99

DISCUSSION: This cross-sectional study was attempted to examine the prevalence of W-MSDs among professional computer users in Jordan, via a questionnaires distributed among office workers in Universities varied between public and private ones in order to describe external risk factors that may contribute to the W-MSDs. The results showed that 93.3% of the participants are suffering of W-MSDs at the time of survey. This number is high when compared with other studies, for example 20% in the study done by Bhanderi.

Proportion of acute cases was 7.6%, followed with sub acute cases 24%, while the highest proportion was for chronic cases 52.4%, where as 10.2% of people reported no signs and symptoms.

Findings of this study showed that risk factors of W-MSDs among computer users at office work are: gender, vision problems, sort of activities at breaks, chair support of lumbar area, frequency of symptoms and duration, type of computer being used, factors that decreases discomforts and severity of pain. Such that findings also supported by different studies [11; 15; 16; 17].

Oxygen consumption gradually declines after age 20 years; this is due to a reduction in cardiac output. Which might be due to a loss of muscle function since heart is an essential muscle [18]? However, there was no significant association between W-MSDs and age in this study, which seems to disagree with other studies [15; 17]. The explanation here was expected to be both groups were close in age.

Spyropoulos *et al* have found association between W-MSDs and smoking, however, there was no association between W-MSDs and smoking at this study this could be due to that this study included small number of smokers.

In the present study, the prevalence of W-MSDs was higher among females than males (96.2% vs. 86%). This could be due to the cultural factor that females in addition to their job they have to work at house along with their children, which may add stress to their muscles and body mechanics. Additionally males tend to spend more time out side the house that gives them longer break from the computer. Other reasons were added by Bridger, which included that the lower upper body strength for females, so lower oxygen consumption than males. In addition, they have higher percentage of fat than males and thus reduce their aerobic capacity. Never the less this significant association similar to one study its findings statistically were not significant [15]. Bridger stated that clinically physical performance for most aspects should be considered and should be based on the ability to carry out critical job functions.

It was noted that in the current study the distance between computer users and screen 30-40 cm that was in accordance with ANSI standards, however, it had been office –work experience of most participants complained of an uncomfortable chair height reported by a non-significant association between W-MSDs and chair height. This may confirm that there were factors other than chair height could be potential risk factors for W-MSDs. this resulted in none significant association with W-

MSDs, Spyropoulos *et al*, reported significant association between prevalence of LBP (Low Back Pain) among office computer users and body distance from the computer screen that was 50-100 cm.

Significant association was found between W-MSDs and factors as head posture, vision problems that were in accordance with [17]. Chair comfortable support for lumbar area, such that's factors alone or in combinations may promote bending body forward leading to pathological cascade of W-MSDs ,this findings similar to study of Spyropoulos *et al*, who reported that the higher prevalence of LBP among office workers who tend to bent body forward during work office.

In spite of that sitting in proper postures was one of the main suggestions of participants, no significant association was found between sitting posture during working office and chair arm rests, that in accordance with findings of [19] who applied his study among Jordanian people..

Ninety nine percent of people with W-MSDs had vision problems, 15.6% of those people were using improper glasses/lenses [visual aids] which may forces them to deviate from neutral posture to get clear vision of screen, this findings supported also in [15; 16].

However in study of [15] there was significant association between hours of using computer and computer health problems, where as at this study it was observed that no significant association among Jordanian people, which wasn't confirmed in [19] study who reported that sitting for long periods on chair may increase the risk for LBP among Jordanian people because sitting for long periods is believed to cause blood circulation problems leading to W-MSDs .

Although no significant association was found at this study between W-MSDs and hours of computer work, there was association between severity of pain and W-MSDs, that's indicated risk factors of W-MSDs for those computer users related strongly to posture "mainly head posture", followed by sort of activities during breaks ,then vision problems, further more psychosocial status and may have even minor effects.

Interestingly there was association between presence of W-MSDs and minimizing discomfort at hours of computer work, as it was reported by most of participants that their discomfort at work decreased with one or in combinations with decreasing load of work, changing sitting position and breaks that's scientifically expected as static posture able to cause discomforts, anyhow "comfort is not exist if discomfort is present in any part of the body" [16], even fixed resting posture cannot maintained for long periods, however practicing some relevant exercises within work hours some times is not acceptable socially in particular for women.

In spite of that one of the main recommendations of computer users in this study was mostly the need for breaks, in the current study breaks had not a significant association with the prevalence of W-MSDs, that's in accordance with [14; 15]. However, it was observed that relative significant association of W-MSDs with the sort of activities at breaks as practicing some exercises, change task, praying and other activities would confirm that.

At this study there was no significant association between W-MSDs and alternate between using trackball and / or keyboard, although it was found that with specific interventions at mouse trackball [as changes in depth, height] had a significant improvements in reduction of upper extremity pains [15].

Type of computer and W-MSDs was significantly associated, with the highest of being work on both types of computers thus observed commonly among computer programmers, followed with laptop computer work, actually this is was expected as working on laptop increases discomforts via maintaining static posture at different joints in particular upper limbs and limited free joint motions due to limited surface are of laptop itself, thus was in accordance with [16].

The association between posture of [shoulders, elbows, wrists, thighs and foot] joints of computer users at work and W-MSDs wasn't predicted that's either due to level of questions relevant to posture weren't appropriate to level of understanding of participants, or really there were other factors may in association with W-MSDs. However, depending on interviewing of some participants some of them reported that they have idea about proper posture for working on computer but did not follow them, while others really were eager to learn more about ergonomics instructions. Any how, one's try to give correct answers to three opening questions 'Yes, it can, yes, it does, and yes it is' [18].Sample size and or level of honesty of participants might played role in giving further clarifications to the results of this study, along with its only expressed association and not causation between risk factors and W-MSDs. Finally According to the results of the this study, different individual, ergonomics and workstations factors appeared to have associations with prevalence of W-MSDs, so far such factors have a direct or indirect pathways affects computer users health's and identify risk factors that may not currently increase risk factors, but may increase risk of aggravation or injury in the future .Purchasing of fit furniture and proper equipment will not solve all W-MSDs, Physical therapists should be more proactive in educating computer users, employers and industrial companies on the proper biomechanics to minimize the incidence of work related musculoskeletal disorders.

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