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Ahmed Abdalla Jarelnape

**IN THE NAME OF ALLAH,  
THE MOST GRACIOUS,  
THE MOST MERCIFUL**



Kingdom of Saudi Arabia  
Ministry of Education  
Majmaah University



# MJHS

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## About the Journal

# Majmaah Journal of Health Sciences

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The Majmaah Journal of Health Sciences shall be an international peer reviewed journal, which intends to serve researchers through prompt publication of significant advances, and to provide a forum for the reporting and discussion of news and issues concerning health sciences.

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To lead the debate on health and to engage, inform, and stimulate the academicians, researchers, and other health professionals in ways that will improve outcomes for patients.

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To ensure that the results of the research are rapidly disseminated to the practicing clinicians and educators, in a fashion that conveys their significance for knowledge, culture and daily life.

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## Editorial

From Editor's Desk.....



At the outset let me express my gratitude to our beloved Rector Dr.Khalid Bin Saad Al Meqrin and Vice Rector for Graduate Studies and Scientific Research Dr. Ahmad Alromaih for the trust endowed upon me.

It's a high time for humanity in the battle against COVID-19 pandemic; the Ministry of Health has initiated mass vaccination campaign and started more than 500 centers in the Kingdom. The ministry reported that the rate of the vaccination appointments has gone up, as the "Sehhaty" app has made it easy for the citizens and residents to book their appointments and know the location of the centers providing the vaccine. The ministry also reassured the public that the vaccines approved in the Kingdom are effective and safe. The editorial team support and encourage everyone to get vaccinated as early as possible and join the fight against COVID-19 pandemic.

MJHS is happy to bring forth its 2nd issue of Vol 9: 2021 on time. The editorial team strives hard to publish all issues on time; as we believe that being punctual helps to establish reputation of MJHS as dependable and consistent. I express my sincere thanks to the international panel of experts and team of associate editors for their efforts to improve the publication process of MJHS office.

Authors who are submitting their research in MJHS are encouraged to enrich their scientific contributions by plagiarism checking and get their manuscripts professionally edited prior to submission; especially the authors for whom English is a second language. However, the language editing does not guarantee publication and any costs incurred are the sole responsibility of the author.

The editorial team would like to thank all authors, reviewers, readers for your continuous support for the success of MJHS.

**Dr.Khalid Mohammed Alabdulwahhab**

**Editor in Chief**



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Original Article :

## YouTube as a source of patient information for Diabetes: Evaluation of Arabic content

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### Abstract

#### Background & Aims:

We aimed in this study to evaluate the Arabic content related to diabetes mellitus, assess its accuracy, and viewers' responses.

#### Methods:

Using the search term "diabetes mellitus" in Arabic with the filter by relevance function, a YouTube search was performed on May 15, 2018. The first 200 videos were retrieved, and video demographic assessment was recorded (likes, dislikes, and upload dates). The content of videos was classified in three groups as 1) reliable, meaning scientifically accurate for diabetes; 2) misleading, which means the information contained scientifically inaccurate or unproven information; and 3) patient experiences, where the content pertained to the personal experiences of patients and did not provide diabetes medical information.

#### Result:

A total of 1,27000 videos were retrieved, the first 200 videos were evaluated, and 71 videos were excluded. In the classification for accuracy, the researchers showed a very good inter-rater agreement ( $k = 0.84$ ).

### الملخص

#### الخلفية و الاهداف :

تهدف الدراسة لتقييم لمجوى العربي المرتبط بمرض السكري في موق اليوتيوب وتقييمه واستجابة المشاهدين له .

#### طريقة البحث :

باستخدام كلمة البحث « السكري » باللغة العربية باستخدام الفلتر في اليوتيوب بتاريخ ١٤ مايو ٢٠١٨م تم استخراج أول ٢٠٠ فيديو (٢٠٠ فيديو / ١٠ صفحات ) وتم تقسيم الفيديوهات الى ثلاث مجموعات ١. صحيح او دقيق والتي تحتوي على معلومات صحيحة او علميه موثوقه , ٢. غير صحيح او اغير دقيق وهي تحتوي على معلومات علميه غير موثوقه او مغلوطة , ٣. وتجربة المريض والتي لها علاقة بتجربة المرض فقط ولا تستخدم معلومات طبيه .

#### النتائج :

١٢٧٠٠ فيديو استخرجت في البحث تم اختيار اول ٢٠٠ فيديو وتقييمها استبعد ٧١ فيديو اكثر من نصف الفيديوهات اعتبرت صحيحة (٧٨-٦١٪) , ٤٧ غير دقيقه (٣٦٪) , ٤ فيديوهات كتجربة مريض (٣٪). بالنسبة للفيديوهات الغير دقيقه علاج السكري باستخدام الطب البديل بنسبة عالية من المستخدمين ٧٤٪ , ٣٠ فيديو ٢٣ منهم تطرقوا الى العلاج بالاعشاب .

#### الإستنتاج :

هذه الدراسة تدعم أن الفيديوهات العربية الوجوده في اليوتيوب ليس ذو قيمة وفائدة كبيره . الفيديوهات المصنفة انها صحيحة او دقيقه

Overall, more than half were considered reliable (n = 78; 61%), (n=47; 36%) were determined misleading, and (n= 4; 3%) videos as patient experiences. Regarding misleading videos, the treatment of diabetes using alternative medicine comprised the largest group of users at 74.5%, n=30. Of those, 23 of the misleading videos promoted herbal medicine.

#### Conclusion:

This study supports that YouTube videos in Arabic are not very helpful. Overall, reliable content videos received fewer views than those determined to be misleading. Professional institutions, health care providers, and academic sources need more encouragement to develop and upload videos on the management and evidence-based treatment of diabetes.

#### Keywords:

Diabetes mellitus, Arabic, YouTube, patient.

حصلت على نسبة مشاهدة اقل من تلك المصنفة انها غير دقيقه . ان دور المؤسسات الصحية ومقدمي الخدمة والممارسين الصحيين والخبراء والمؤسسات الأكاديمية مهم في تطوير وتقديم فيديوهات لها علاقة بالسكري وعلاجه

## Introduction

People diagnosed with diabetes mellitus (DM) has risen dramatically over the last two decades. More than 382 million cases worldwide have been reported, with 90% of those diagnosed with type-2 diabetes mellitus.<sup>1</sup> In Arab countries, of the 35 million people diagnosed, North Africa and the Middle East lead the world in the highest type-2 diabetes mellitus, where one in 10 people live with the disease. By 2035, the number of people with diabetes is expected to increase by 96.2%.<sup>1</sup> The advent of social media becoming increasingly popular provides a quick and convenient source for patients looking for health-related news and information. Recent stud-

ies have shown that the Internet serves as a primary outlet for patients seeking medical-related knowledge and information. Patients' browsing habits show that 80% of their online activity is seeking knowledge, medical support, and information.<sup>2,3</sup> YouTube serves as the second most popular website visited around the globe and in Arab countries.<sup>4</sup> Unfortunately, after evaluating its content, studies have concluded that YouTube consists of faulty and misleading medical-related content, with the majority of researchers agreeing that patients could be misled or misinformed about their health in accessing the site.<sup>5-11</sup> The Internet poses a major source for diabetic patients to self-educate<sup>12</sup> and is an ev-

er-growing outlet for health organizations and hospitals to inform patients on health-care issues. The quality of those sources, though, is not congruous to the availability of these videos. The enormity in the number of educational videos uploaded to YouTube daily oftentimes makes these videos inaccessible to users.

If diabetes-related material could be presented on YouTube in the Arabic language, it could educate Arabic patients and caregivers in a more meaningful and more widely-understood format.<sup>13</sup> To the best of our knowledge, no studies exist that assess Arabic content provided by YouTube on the subject of diabetes. This study aimed to analyze Arabic content on YouTube for accuracy and assessed viewers' responses as it pertains to diabetes videos.

### Methods

A YouTube search was performed on May 15, 2018, using the search term “diabetes mellitus” in Arabic with the filter by relevance function. Excluded were non-Arabic videos, duplicate videos, and those without audio functions or unrelated to our focus. Cookies and the computer's history were cleared to have no effect on the search results. Overall, 1,27000 videos were found. The first 200 (20 videos/page, ten pages) videos were retrieved as a sample, assuming that most users would not venture

beyond this point. Furthermore, similar sample sizes were used in previous work of qualitative methods assessing YouTube videos compared to our analysis.<sup>14-16</sup>

The video demographic assessment recorded likes, dislikes, upload dates and source information, video length, and the number of views. To assess the number of mean views per day, a calculation was determined to divide the total amount of views by the number of days since the videos had been uploaded online. Classifications were assigned to identify the upload source. These included health care professionals (HCP), personal users, academic/hospital/professional institutions (PA), and others by using information from their YouTube profile in the “about” listing. Independent two researchers watched each video and made determinations regarding their scientific merit and accuracy (Al-nughaymishi and Algeffari). A third independent researcher (Diabetologist Consultant) was used to resolve any disputes between the two researchers on the content of the videos and served as the final decision maker (Almogbel). Three groups of classifications resulted from viewing the contents of the videos as 1) reliable, meaning scientifically accurate for DM; 2) misleading, which means the information contained scientifically inaccurate or unproven information; and 3) patient ex-

periences, where the content pertained to the personal experiences of patients and did not provide DM medical knowledge. If a video content included two categories, reliable and misleading information, “misleading” was used as the default. The videos were further broken down into seven different diet, complications, interviews, education, management, symptoms, and general information.

Descriptive statistics were given for all variables. Interrater agreement was calculated using the Cohen kappa test. The kappa value was classified as a poor agreement when  $<0.20$ , fair when  $0.21-0.40$ ,

moderate when  $0.41-0.60$ , good when  $0.61-0.80$ , and very good when  $>0.81$ . [17] Differences between groups were compared using one-way analysis of variance (ANOVA). A p-value of less than 0.05 was considered significant. All statistical analyses were done on version 20 (SPSS Inc., Armonk, NY: IBM Cor.).

## Result

The initial search using the term “Diabetes Mellitus” in Arabic resulted in finding 1,27000 videos. Out of the first 200 videos (20 videos/page, ten pages), 129 was the final number included in the analysis after 71 videos were excluded (Fig. 1).

Figure 1: Flow diagram showing search strategy:

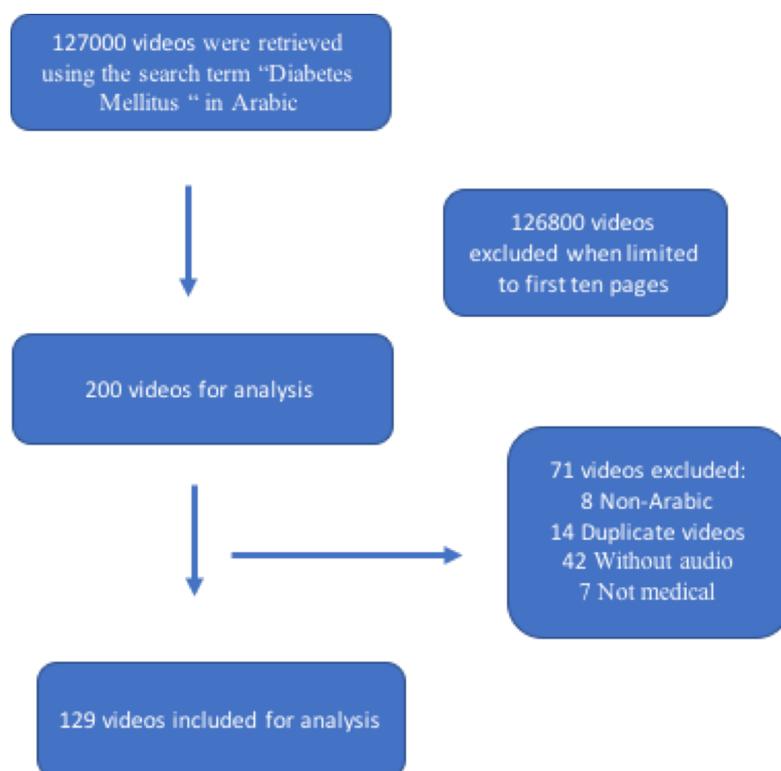


Table 1 provides a list of characteristics for the 129 videos deemed eligible for the analysis. In terms of time, the videos ranged from 40 seconds to two hours long. The median runtime was determined to be 4.1 minutes. The median total number of views was 29,464. The range for the number of views ran between 40 to 3,234,372.

Table 1: Descriptive results of the entire sample (n=129)

|                      | Mean   | Standard deviation | Min | Max     |
|----------------------|--------|--------------------|-----|---------|
| Days since upload    | 888    | 726.2              | 33  | 4004    |
| Views                | 227620 | 558295.9           | 40  | 3234372 |
| Likes                | 2317   | 6582.2             | 0   | 37000   |
| Dislikes             | 174    | 482.9              | 0   | 2800    |
| Video duration (min) | 9.4    | 15.7               | 0.4 | 121.4   |
| views per day        | 484    | 1460.2             | 0   | 9827    |

In the classification for accuracy, the researchers showed a very good inter-rater agreement ( $k= 0.84$ ). Six videos produced a dispute among the two researchers that

resulted in a resolution by virtue of discussion. Table 2 refers to the accuracy of the video.

Table 2: Basic video descriptors by the accuracy of the contents.

| Descriptor                    | Reliable (n=78)  | Misleading (n=47) | Patient Experiences (n=4) | P     |
|-------------------------------|------------------|-------------------|---------------------------|-------|
| Total views                   | 12482917         | 16358514          | 521536                    |       |
| Mean views (SD)               | 160037(528287.7) | 348053(611310.6)  | 130384(216865.6)          | 0.178 |
| Mean days since upload (SD)   | 901(706)         | 831.2(750.8)      | 1287.8(894.1)             | 0.469 |
| Mean views per day (SD)       | 2781047.9)       | 856.3(1966.6)     | 131.5(221.7)              | 0.088 |
| Mean video duration, min (SD) | 7 (10.4)         | 12.0(21.1)        | 17.5(24.6)                | 0.169 |
| Mean likes                    | 1632(6039.2)     | 3412.5(7444.1)    | 3070.3(5953.6)            | 0.363 |
| Mean Dislikes                 | 92 (360.2)       | 320.3(632.6)      | 95.3(169.5)               | 0.041 |

| Upload source | Reliable (n=78) | Misleading (n=47) | Patient Experiences (n=4) |
|---------------|-----------------|-------------------|---------------------------|
| PI            | 8(10.3%)        | 1(2.1%)           | 0(0.0%)                   |
| HCP           | 6 (7.7%)        | 2(4.3%)           | 0(0.0%)                   |
| Personal      | 27 (34.6%)      | 33(70.2%)         | 1(25.0%)                  |
| Other         | 37(47.4%)       | 11(23.4%)         | 3(75.0%)                  |
| Video content | Reliable (n=78) | Misleading (n=47) | Patient Experiences (n=4) |
| Education     | 19(24.4%)       | 1(2.1%)           | 0(0.0%)                   |
| Diet          | 16(20.5%)       | 2(4.3%)           | 0(0.0%)                   |
| Interview     | 2(2.6%)         | 1(2.1%)           | 2(50.0%)                  |

| Upload source       | Reliable (n=78) | Misleading (n=47) | Patient Experiences (n=4) |
|---------------------|-----------------|-------------------|---------------------------|
| Complications       | 10(12.8%)       | 1(2.1%)           | 0(0.0%)                   |
| Symptoms            | 9(11.5%)        | 2(4.3%)           | 0(0.0%)                   |
| Management          | 3(3.8%)         | 32(68.1%)         | 0(0.0%)                   |
| General Information | 19(24.4%)       | 6(12.8%)          | 2(50.0%)                  |

Overall, more than half were considered reliable (n=78; 61%), (n=47; 36%) were determined misleading, and (n= 4; 3%) videos as patient experiences. Regarding the total number of views, 16,358,514 viewed misleading videos, 12,482,917 viewed reliable videos, and patient experiences were viewed 521,536 times. The highest mean number of views belonged to misleading videos ( $348053 \pm 611310.6$ ), followed by reliable videos ( $160037 \pm 528287.7$ ), and patient experiences videos at  $130384 \pm 216865.6$  (ANOVA,  $p=0.178$ ). The mean number for “likes” of reliable videos was  $1632 \pm 6039.2$ , a lower amount than misleading videos at  $3412.5 \pm 7444.1$ , and patient experiences videos at  $3070.3 \pm 5953.6$ . Correspondingly, significant differences in the mean number of “dislikes” (ANOVA,  $p < 0.041$ ) compared to lower numbers for reliable videos. Patient experiences videos regarding length were longer ( $17.5 \pm 24.6$  min) in comparison to reliable videos ( $7 \pm 10.4$  min) and misleading videos ( $12.0 \pm 21.1$  min).

Personal users uploaded many of the videos (47.3%, n=61). 27.1%(n=35) of that videos contain information on the

management of diabetes. Personal users mostly uploaded misleading videos (70.2%, n=33), followed by other users at 23.4%(n=11). Regarding misleading videos, the treatment of diabetes using alternative medicine comprised the largest group of users at 74.5%(n=30). Of those, 23 of the misleading videos promoted herbal medicine, 5 advocated hydro-thermal therapy, and two proposed Ruqya Al Shariah therapy. A trend in alternative medicine video uploads increased over the previous two years, with 2017 figures at 37% (2017; n=11, 37%) and 2018 at 47% (n=14). The highest number of mean views belonged to alternative medicine at 402,483 times compared to other videos at 25,2000 times.

## Discussion

Health education today comes from many resources. Internet videos are used frequently, with YouTube leading the pack. As of June 2018, YouTube consisted of over 5,000,000,000 videos and over 1,000,000,000 hours watched daily by users.<sup>17</sup> The usefulness of videos relative to any given field and the sources used the most have been the subjects of many studies. This study assessed the accuracy and

scientific proven material and information available on YouTube regarding diabetes. Despite different entities increasingly using the Internet to relay medical information, Arabic information related to diabetes on YouTube has not been inspected for accuracy. From our results, we conclude that less than two-thirds of diabetes videos on YouTube provide reliable information. Reliable videos resulted in 60.5%, which is about what previous studies determined in evaluating YouTube videos on medical information in other fields. The range of reliable videos in these studies was between 54.9% to 63.6%, including topics such as gallstone disease <sup>18</sup>, kidney stones <sup>19</sup>, on hypertension <sup>20</sup>, and dialysis <sup>21</sup>.

The videos determined to be misleading – many of which associated with alternative medicine, endorsed known myths and inaccurate information about the management of diabetes. Interestingly, those videos earned more YouTube views than reliable videos. The data about these investigations and studies point to a contradiction in results; nevertheless, most researchers agree that websites such as YouTube play a critical role in educating and informing the public.<sup>19,22,23</sup> This inclination also applies to YouTube videos that pertain to medical-related issues.<sup>18,20,21</sup> The popularity of videos being used as a source of information cannot be denied, regardless of factors

leading to contributions in the number of views or the content. The study presented here highlights that many of the misleading videos include alternative medicine information. Regardless of the lack of evidence or effectiveness alternative medicine provides, these videos were viewed widely all over the world. The reported prevalence in the use of alternative therapies for diabetes was pointed out in Kamel et al. as 64% in Saudi Arabia.<sup>24</sup> Given the popularity, YouTube users in Saudi Arabia are more likely to view alternative medicine videos classified as misleading.

In another study referencing cervical cancer, Adhikari et al.<sup>25</sup> found that most of the videos were being uploaded by physicians. Additionally, Gunes et al. <sup>7</sup> found that videos on varicose veins were mostly being uploaded by professional health providers. In this study, a very small amount of content was attributed to the hospital or academic professionals. The impact of what healthcare professionals contribute on YouTube is quite small and possibly intentional, given the amount of erroneous information on this platform. These results show consistency with other research and suggest that the impact is minor when healthcare professionals and organizations become involved in the manufacturing of YouTube content on health-related matters.<sup>26</sup> Personal uploads and news sourc-

es were uploaded more than professional or academic sources. Personal stories, alternative medicine information, or entities selling or advertising services on the management of diabetes were shown to be more popular in uploads from independent users. This warrants discussion.

The limitations of our research include first the ever-changing Internet media environment concerning the date and time of performing searches. Second, this study used keyword searches on YouTube (diabetes mellitus in the Arabic language) using the first ten pages (20 videos/page) as its sample. The videos were then sorted by relevance, a default setting on YouTube's platform that might have affected the results due to advertisements. Although this could factor in, the results showed consistency compared to other research on health-related content and information. It also points to an unlikely event that missing variables have any real effect on outcomes.

### **Conclusion:**

To conclude, this study supports that YouTube videos in Arabic are helpful. However, some of them have misleading information. Overall, reliable content videos received fewer views than those determined to be misleading. Professional institutions, health care providers, and academic sources need more encouragement to develop

and upload videos on the management and evidence-based treatment of diabetes. The popularity of the YouTube platform warrants further efforts to increase accuracy and promote science-based information on diabetes.

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Original Article :

## Complete Blood Counts among chronic patients of Helicobacter pylori infection

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### Abstract

#### Background and Aims:

Helicobacter pylori infection has a suggested association with hematological alterations and common peptic ulcer disease manifestation. This study aims to investigate the influence of H. pylori infection on Complete Blood Counts (CBC).

#### Methods:

A case-controlled study was carried out in 2018 at National Health Insurance Hospital, Kosti, Sudan. Out of one hundred and thirty recruited participants, 80 had confirmed H. pylori infection categorized as the case group, while 50 healthy participants were enrolled as a control group. All subjects were screened for H. pylori infection. Complete blood count was analyzed from EDTA blood samples of the participants using an automated hematology analyzer (Sysmex KX-21, Tokyo, Japan). Peripheral Blood Picture (PBP) was examined using Romanowsky stains.

#### Results:

Our findings showed significantly lower mean values of tRBC, Hb, HCT, MCV, and neutrophils count among H. pylori infection patients than the control

### المخلص

#### الخلفية و الاهداف :

تعتبر جرثومة المعدة من الجراثيم ذات معدل انتشار عالي وتسبب تغيرات في صورة الدم الكاملة للمرضي كالأعراض المرتبطة بفقير الدم وتعتبر أيضا مسبب رئيسي لقرحة المعدة. والتدفئة وتهدف هذه الدراسة لمعرفة صورة الدم الكاملة لدي المرضي المصابون بجرثومة المعدة ومقارنة نتائجهم بصورة دم لأشخاص أصحاء غير مصابين بجرثومة المعدة.

#### طريقة البحث:

أجريت الدراسة الحالية بمستشفى التامين الصحي بكوستي في ولاية النيل الأبيض بالسودان في الفترة من مايو إلي أكتوبر بمشاركة ثمانون من المرضي الذين اثبتت التحاليل الطبية اصابتهم بجرثومة المعدة مثلوا مجموعة الدراسة، وتم اختيار خمسون شخص آخر كمجموعة ضابطة متطابقة مع مجموعة الدراسة في الجنس والعمر حيث تم عمل صورة دم كاملة للمجموعتين.

#### النتائج:

أظهرت نتائج الدراسة أن متوسط قيمة تعداد كريات الدم الحمراء، تركيز الهيموغلوبين، الهيماتوكريت، متوسط حجم الخلية والخلايا العدلية أقل وذات دلالة إحصائية جوهرية مقارنة بالمجموعة الضابطة بينما متوسط تعداد الخلايا الليمفاوية كان أكثر وذو دلالة إحصائية لدي المصابين بجرثومة المعدة مقارنة بتعداد الخلايا الليمفاوية لدي مجموعة الأشخاص الأصحاء. لم يظهر متوسط تعداد كريات الدم البيضاء ومتوسط تعداد الصفائح الدموية ومتبقي عناصر صورة الدم

group. The mean values were  $(4.2 (\pm 0.7) \times 10^{12}/L$  vs.  $4.8 (\pm 0.3) \times 10^{12}/L$ ;  $12.04 (\pm 1.84) \text{ g/dl}$  vs.  $13.4 (\pm 1.4) \text{ g/dl}$ ;  $34.2 (\pm 6.1) \text{ l/l}$  vs.  $37.2 (\pm 4.2) \text{ l/l}$ ;  $83.1 (\pm 6.7) \text{ fl}$  vs.  $86.6 (\pm 4.9) \text{ fl}$ ; and  $49.56 \pm 12.23\%$  vs.  $53.6 \pm 7.8$  respectively). On the other hand, the mean value of lymphocyte counts was significantly higher in *H. pylori*-infected patients than in the control group ( $41.9 \pm 11.1\%$  vs.  $35.7 \pm 7.3$ ). No significant differences were found between *H. pylori* infected patients and the healthy control group regarding the counts of total white blood cells (WBCs), platelets, monocytes, and eosinophils. Morphological blood film examination showed oval-shaped teardrops, microcytic hypochromic picture, lymphocytosis, neutropenia, and adequate platelets.

#### Conclusion:

There were significant effects on some hematological parameters in patients with *H. pylori* infection.

#### Keywords:

*Helicobacter pylori*, Complete Blood Counts, Total White Blood Cell counts, Platelet counts, Anemia, Sudan

الكاملة أي فروقات جوهرية ذات دلالة إحصائية بين المجموعتين. وخلصت الدراسة إلى تأثير واضح وكبير لبعض عناصر صورة الدم الكاملة لدى الأشخاص المصابين بجرثومة المعدة مقارنة مع الأشخاص الأصحاء.

## Introduction

*Helicobacter pylori* is a Gram-negative micro-aerophilic bacterium that is the most common cause of chronic infection in humans worldwide.<sup>1</sup> Approximately 4.4 billion individuals were infected globally with *H. pylori* during 2015, with the prevalence from 8.7% to 85.5%, increasing with age and large variations regarding race, ethnicity, socioeconomic status, and geographical area, with over 80% being in developing countries<sup>2-7</sup>. Recently many researchers reported *H. pylori* to be

the principal cause of chronic gastritis and a main etiological agent for anemia, gastric cancer, peptic ulcer disease, ischemic cerebrovascular disease, mucosa-associated lymphoid tissue (MALT), lymphoma, dermatologic, neurologic disorders, metabolic and cardiopulmonary diseases.<sup>2,8-12</sup> Furthermore, previous studies reported the association of *H. pylori* infection with many hematological manifestations, such as vitamin B12 deficiency, iron deficiency anemia (IDA), and Idiopathic Thrombocytopenic Purpura (ITP).

<sup>13-14</sup> The frequency of anemia is high in many countries infected by *H. pylori*, schistosomiasis, and malaria, particularly in developing countries with serious public health problems. <sup>15, 16-18</sup> Given the high prevalence of *H. pylori* infection reported in Sudan, as the commonest etiological factor of gastritis,<sup>19</sup> our current study rationale is to explore and establish the effect of these bacteria on the hematological parameters in Sudanese *H. pylori*-infected patients to help in the management of *H. pylori*, which is highly recommended for high-risk populations <sup>8, 20</sup>.

### Methodology

**Study design and study setting:** A case-control study was carried out at National Health Insurance Hospital, Kosti, Sudan, from May to October 2018.

**Participants and sample size:** Following exclusion and inclusion criteria, one hundred and thirty participants were randomly recruited in the current study. Eighty participants had *H. pylori* infection (16 males, 64 females), aged 16-55 years, mean age (32.95±10.39); As a control, we selected 50 healthy persons matched in age and gender without gastrointestinal tract infection, and with negative *H. pylori* laboratory tests, who attended the National Health Insurance Hospital and agreed to participate.

### Data collection:

Data was collected using a structural interviewing questionnaire, including personal and clinical information and laboratory investigations. Three ml of venous blood was taken and collected in sterile dry plastic syringes using standard venipuncture technique from each participant after sterilizing the puncture site with 70% ethanol. The samples were collected in Plain containers to detect antibodies against *H. pylori* organisms. The former centrifuged at 2000 rpm (revolutions per minute) for 15 minutes. ICT was carried out on the supernatant sera without preservation or delay. The ICT utilizes a combination of *Helicobacter pylori* antigen-coated particles and anti-human IgG to detect *H. pylori* antibody selectively and qualitatively in the serum.

The blood samples were collected in Ethylenediaminetetraacetic Acid (EDTA) containers were used for determination of Complete Blood Counts (CBC) using hematology-automated analyzer (Sysmex KX-21, Tokyo, Japan). Peripheral Blood Picture (PBP) was examined after staining with Romanowsky stains.

Stool samples were collected in clean, dry containers, which were examined immediately by mixing small stool amounts with ICT antigen solution. One drop of this mixture was thoroughly mixed and incu-

bated for 1 minute and then read.

#### *Inclusion and Exclusion Criteria:*

All included participants reported gastritis symptoms, had a laboratory-confirmed diagnosis of *H. pylori* infection and attended Kosti National Health Insurance Hospital. Patients were excluded from participation if they had been diagnosed with blood diseases, cardiovascular disease, or hemorrhagic disease. Also excluded were patients taking medication affecting blood parameters, those with gastric malignancy or malignant diseases, and those with other causes of thrombocytopenia. Finally, some patients who refused to participate were also excluded.

#### *Statistical analysis:*

Laboratory results were analyzed by IBM SPSS (Statistical Package for the Social Sciences) version 25. Descriptive statistics and frequency distribution were performed. Mean (M) and standard deviation ( $\pm$ SD) were calculated, and a comparison was made with a two-tailed Student's t-test to explore any significant difference between *H. Pylori* infected patients and healthy individuals' control group. The al-

pha error of 0.05 and P-value  $\leq$ 0.05 was considered significant.

#### *Informed consent:*

Before collecting the blood samples, each participant completed the informed consent form. Parents completed and signed an informed consent form for patients below 18 years old.

#### *Ethical approval:*

This was obtained from the research and ethics committee of El Imam El Mahdi University, Faculty of Medical Laboratory Sciences.

#### **Results:**

80% of the current study participants were female, 20% were male amongst both the case and control groups, 40% and 46% of the patients and controls were aged between 25-34 years old. 28.7% and 26% were between 35-44 years old, 23.8% and 20% were 45-55 years old, while 7.5% and 8% were aged between 15-24 years old. The mean age for the *H. pylori* infection group was  $32.95 \pm 10.39$  years old and  $31.36 \pm 8.75$  for the control group, with no statistically significant difference between the two groups (p-value = 0.900) (Table 1).

Table 1. *H. pylori* infected patients and control group age and gender

| Parameter | Category | H. pylori infected<br>N=80 | Control group<br>N=50 | t | P-value |
|-----------|----------|----------------------------|-----------------------|---|---------|
|           |          | Frequency (%)              | Frequency (%)         |   |         |
| Gender    | Male     | 16 (20)                    | 10 (20)               |   |         |

| Parameter        | Category        | H. pylori infected<br>N=80 | Control group<br>N=50   | t    | P-value |
|------------------|-----------------|----------------------------|-------------------------|------|---------|
|                  |                 | Frequency (%)              | Frequency (%)           |      |         |
| Gender           | Female          | 64 (18)                    | 40 (80)                 | 0.90 | 0.37    |
|                  | Total           | 80 (100)                   | 50 (100)                |      |         |
| Age distribution | 15-24 years old | 6 (7.5)                    | 4 (8)                   |      |         |
|                  | 25-34 years old | 32 (40)                    | 23 (46)                 |      |         |
|                  | 35-44 years old | 19 (23.8)                  | 10 (20)                 |      |         |
|                  | 45-55 years old | 23 (28.7)                  | 13 (26)                 |      |         |
|                  | Mean ± SD       | 32.95±10.39<br>years old   | 31.36±8.75<br>years old |      |         |

Table 2 shows red cells indices of H. pylori infected and control group while Table 3 shows the white cells parameters in these groups.

Table 2. Red blood cell indices of the participants

| Variable                   | H. pylori infected patients (%)<br>N=80 | Control group N (%)<br>N=50 |
|----------------------------|---|-----------------------------|
| <b>Hb</b>                  |   |                             |
| <13.5 g/dl                 | 56 (70%)                                | 29(58%)                     |
| 13.5-17.5 g/dl             | 24(30%)                                 | 21(42%)                     |
| >17.5 g/dl                 | 0(0%)                                   | 0(0%)                       |
| <b>PCV</b>                 |   |                             |
| <40 l/l                    | 71(88.7%)                               | 40(80%)                     |
| 40-52 l/l                  | 8 (10%)                                 | 10 (20%)                    |
| >52 l/l                    | 1(1.3%)                                 | 0(0%)                       |
| <b>RBCs</b>                |   |                             |
| <4.5 x 10 <sup>12</sup>    | 56 (70%)                                | 1 (2%)                      |
| 4.5-6.5 x 10 <sup>12</sup> | 23(28.7%)                               | 49(98%)                     |
| >6.5 x 10 <sup>12</sup>    | 1(1.3%)                                 | 0(0%)                       |
| <b>MCV</b>                 |   |                             |
| <80 fl                     | 22(27.4%)                               | 4(8%)                       |
| 80-95 fl                   | 53(66.3%)                               | 45(90%)                     |
| >95 fl                     | 5(6.3%)                                 | 1(2%)                       |
| <b>MCH</b>                 |   |                             |
| <27 pg                     | 17(21.3%)                               | 2(4%)                       |
| 27-34 pg                   | 60 (75%)                                | 48(96%)                     |
| >34 pg                     | 3(3.7%)                                 | 0(0%)                       |

| Variable    | H. pylori infected patients (%)<br>N=80 | Control group N (%)<br>N=50 |
|-------------|---|-----------------------------|
| <b>MCHC</b> |   |                             |
| <20%        | 0(0%)                                   | 0(0%)                       |
| 20-35%      | 52(65%)                                 | 30 (60%)                    |
| >35%        | 28(35%)                                 | 20(40%)                     |

Key: Hb = Haemoglobin concentration; PCV= Blood Cell Volume; RBCs = Red Blood Cells Count; MCV= Mean Cell Volume; MCH = Mean Cell Haemoglobin; MCHC= Mean Cell Haemoglobin Concentration.

Table 3: TWBC, PLT, and Differential White Blood Cell Counts group.

| Variable                       | H. pylori infected patients (%)<br>N=80 | Control group N (%)<br>N=50 |
|--------------------------------|---|-----------------------------|
| <b>TWBC</b>                    |   |                             |
| <4×10 <sup>3</sup> /l          | 9(11.3%)                                | 2(4%)                       |
| 4-11×10 <sup>3</sup> /l        | 68(85%)                                 | 47(94 %)                    |
| >11×10 <sup>3</sup> /l         | 3(3.7%)                                 | 1(2%)                       |
| <b>PLt</b>                     |   |                             |
| <150×10 <sup>3</sup> /l        | 1 (1.3%)                                | 0(0%)                       |
| 1 5 0 - 400×10 <sup>3</sup> /l | 70(87.4%)                               | 45(90%)                     |
| >400×10 <sup>3</sup> /l        | 9(11.3%)                                | 5(10%)                      |
| <b>Neutrophil</b>              |   |                             |
| <40%                           | 16(20%)                                 | 2(4%)                       |
| 40-80%                         | 2(2.5%)                                 | 2(4%)                       |

| Variable          | H. pylori infected patients (%)<br>N=80 | Control group<br>N (%)<br>N=50 |
|-------------------|---|--------------------------------|
| >80%              | 62(77.5%)                               | 46(92%)                        |
| <b>Lymphocyte</b> |   |                                |
| <20%              | 1(1.3%)                                 | 0(0%)                          |
| 20-40%            | 35(43.7%)                               | 44(88%)                        |
| >40%              | 44(55%)                                 | 6(12%)                         |
| <b>Monocyte</b>   |   |                                |
| <4%               | 10(12.5%)                               | 6(12%)                         |
| 4-10%             | 70(87.5%)                               | 42(84%)                        |
| >10%              | 0(0%)                                   | 2(4%)                          |
| <b>Eosinophil</b> |   |                                |
| 1%                | 18(22.5%)                               | 2 (4%)                         |
| 2-4%              | 41(51.3%)                               | 26(52%)                        |
| >4%               | 21( 26.2)                               | 22(44%)                        |

Key: TWBC = Total White Blood Cells Counts; PLt = Platelets count

The mean of red blood cell counts (RBCs), haemoglobin (Hb), Haematocrit (Hct), mean cell volume (MCV), neutrophil and

lymphocyte were  $4.2 \times 10^{12}/L$  ( $\pm 0.7$ ) vs.  $4.8 \times 10^{12}/L$  ( $\pm 0.3$ );  $12.0 \text{ g/dl}$  ( $\pm 1.8$ ) vs.  $13.4 \text{ g/dl}$  ( $\pm 1.4$ );  $34.2 \text{ l/l}$  ( $\pm 6.1$ ) vs.  $37.2 \text{ l/l}$  ( $\pm 4.2$ );  $83.1 \text{ fl}$  ( $\pm 6.7$ ) vs.  $86.6 \text{ fl}$  ( $\pm 4.9$ ); and  $49.6\%$  ( $\pm 12.2$ ) vs.  $53.6\%$  ( $\pm 7.7$ ) and  $41.9\%$  ( $\pm 11.1$ ) vs.  $35.7\%$  ( $\pm 7.3$ ) in cases with H. pylori and controls respectively. Our findings show that some hematological parameters, RBCs, Hb, Hct, MCV, and neutrophil were significantly decreased among the case group compared to the control group (p values = 0.001, 0.001, 0.003, 0.002, and 0.001 respectively) except lymphocyte count, which was significantly elevated in H. pylori infected patients over controls, with p-value  $< 0.01$ , as shown in Table 4,5.

Table 4. Results of red cell indices among H. pylori infected patients against control samples

| Parameter            | Patient M ( $\pm$ SD)<br>(N=80) | Control M( $\pm$ SD)<br>(N=50) | P-value     |
|----------------------|---------------------------------|--------------------------------|-------------|
| Hb g/dl              | 12.04 ( $\pm 1.84$ )            | 13.4 ( $\pm 1.4$ )             | $< 0.001^*$ |
| PCV l/l              | 34.2 ( $\pm 6.1$ )              | 37.2 ( $\pm 4.2$ )             | $< 0.003^*$ |
| RBCs $\times 10^6/L$ | 4.2 ( $\pm 0.7$ )               | 4.8 ( $\pm 0.3$ )              | $< 0.001^*$ |
| MCV fl               | 83.1 ( $\pm 6.7$ )              | 86.6 ( $\pm 4.9$ )             | $< 0.002^*$ |
| MCH pg               | 28.8 ( $\pm 7.3$ )              | 30.4 ( $\pm 2.2$ )             | 0.062       |
| MCHC%                | 34. ( $\pm 2.5$ )               | 34.9 ( $\pm 1.9$ )             | $< 0.185$   |

Key: - M=Mean; \*Significance at the level  $\leq 0.05$

Table 5: Results of TWBC, PLT, and Differential White Blood Cell Count among H. pylori infected patients against control samples

| Parameter            | Patient M ( $\pm$ SD)<br>(n=80) | Control M( $\pm$ SD)<br>(N=50) | P-value     |
|----------------------|---------------------------------|--------------------------------|-------------|
| TWBC $\times 10^3/l$ | 6.0 ( $\pm 2.09$ )              | 6.4 ( $\pm 1.9$ )              | 0.818       |
| PLt $\times 10^3/l$  | 284.9 ( $\pm 77.3$ )            | 292.4 ( $\pm 69.4$ )           | 0.556       |
| Neutrophil%          | 49.56 $\pm$ 12.23%              | 53.6 ( $\pm 7.8$ )             | $< 0.001^*$ |
| Lymphocyte%          | 41.9 ( $\pm 11.1$ )             | 35.7 ( $\pm 7.3$ )             | $< 0.004^*$ |

| Parameter   | Patient M ( $\pm$ SD)<br>(n=80) | Control M( $\pm$ SD)<br>(N=50) | P-value |
|-------------|---------------------------------|--------------------------------|---------|
| Eosinophil% | 3.4 ( $\pm$ 2.2)                | 4.7 ( $\pm$ 2.4)               | 0.673   |
| Monocyte%   | 5.4 ( $\pm$ 3.0)                | 6.2 ( $\pm$ 2.7)               | 0.113   |

Key: - M=Mean; \*Significance at the level  $\leq 0.05$

No significant differences between our study groups were observed in the following parameters: TWBCs, platelet, monocyte, and eosinophil counts. They were  $6.0 \times 10^3/l$  ( $\pm 2.1$ ) vs.  $6.4 \times 10^3/l$  ( $\pm 1.9$ );  $284.9 \times 10^3/l$  ( $\pm 77.3$ ) vs.  $292.4 \times 10^3/l$  ( $\pm 69.4$ ); monocyte 5.4 % ( $\pm 3.0$ ) vs. 6.2 ( $\pm 2.7$ )%; eosinophil 3.4 ( $\pm 2.2$ )% vs. 4.7 ( $\pm 2.4$ )%; MCH 28.8 pg ( $\pm 7.3$ ) vs. 30.4 pg ( $\pm 2.2$ ) and MCHC 34.4% ( $\pm 2.5$ ) vs. 34.9% ( $\pm 1.9$ ) respectively, as shown in Tables 4,5. Peripheral blood picture of most *H. pylori* infection patients was microcytic hypochromic RBCs. Macro-ovalocytes, anisocytosis, poikilocytosis with teardrop, target red cells, and Echinocyte were observed. However, the normocytic and normochromic picture was observed in some patients with *H. pylori* infection. White blood cell morphology of *H. pylori* infection patients showed lymphocytosis and neutropenia.

### Discussion

*H. pylori* are closely related to hematological disorders such as iron deficiency anemia (IDA) and primary immune thrombocytopenia (ITP).<sup>11</sup> The current study aims to detect the effects of *H. pylori* infection

on hematological parameters among Sudanese patients attending Kosti health insurance hospital and compare their results with those of healthy individuals. Our findings were in accordance with recent studies that were conducted in other ethnic groups<sup>21,22</sup> and another study done in Sudan<sup>12</sup>, which stated a decrease in some hematological parameters (Hb, Hct, MCV, and neutrophil counts) in *H. pylori* patients. Our findings were, however, not in agreement with the results of the study done in Saudi by Nahla KI and co-workers who found no association between *H. pylori* and hematological parameters.<sup>23</sup> Furthermore, a retrospective study was conducted between 2012 to 2016 in China by MeiYX et al.<sup>24</sup>, who found that *H. pylori* infection may reduce the level of Hb and, in turn, may be responsible for causing anemia in a Chinese population. In contrast, previous studies were carried out in a Nigerian tertiary educational institution by Benjamin OE and co-workers<sup>25</sup> who mentioned a non-significant difference in MCV values and another study done among Palestinian adult patients infected with *H. pylori* by Saleh NM and Wesam MA<sup>26</sup> who conclud-

ed similar results regarding MCV which was not the same as that found here. Our results are in agreement with the previous study done by Waleed S et al. <sup>27</sup> in 2016 in Taif City, Saudi Arabia and the study done by Saleh NM and Wesam MA <sup>26</sup>, while inconsistent with the study by Ashraf AT, et al. <sup>28</sup>, in 2015 in Egypt who reported insignificant difference in RBCs counts. Our results are consistent with the previous study done in Palestine by Saleh NM and co-workers <sup>26</sup>, who reported a low level of MCH and MCHC in patients with *H. pylori* infection <sup>12,27</sup>. On the other hand, our current findings are consistent with the study done by Elham AI et al. <sup>12</sup> in Sudan and inconsistent with other studies that concluded high total WBCs count in patients with *H. pylori* infection patients compared to controls <sup>26,27</sup>. Concerning Platelet counts, our results revealed no statistically significant difference between *H. pylori* infection patients and the control group; this finding was in line with other studies <sup>26, 28</sup>. Regarding the Neutrophil counts and the lymphocyte counts, our findings were with other studies <sup>29,30</sup>, which indicated that *H. pylori* infection may be related to anemia with high neutrophil and low lymphocyte counts. The significant increase in lymphocyte count may be due to inflammations caused by *H. pylori* infection. The possible reasons for the differences and similarities

in blood parameters with other mentioned studies may include the degree of severity of *H. pylori* infection, the demographic data such as the age of the participants, and the sample size. Our findings concerning the highly variable peripheral blood film morphology are consistent with earlier studies <sup>12,31</sup> that reported oval-shaped, teardrops, microcytic hypochromic pictures among *H. pylori* infection patients.

### **Conclusion**

From this study, we conclude that some hematological parameters, including Hb, Hct, MCV, and neutrophil counts, were decreased among *H. pylori*-infected patients. In contrast, lymphocyte counts were found to be higher among these patients. Therefore, *H. pylori* infection is a cause of anemia and must be considered while investigating and managing anemic patients (especially with the acid-peptic disease).

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### **Conflict of Interest:**

The authors declared no conflict of interest.

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Original Article :

## Prevalence, Predictors and Prognostic Impact of Renal Dysfunction among Hospitalized Patients with Systolic Heart Failure

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### Abstract

#### Background and Aims

The interaction between heart and kidneys has increased, and parts of the pathophysiological background for the cardiorenal syndrome have been established. This study aimed to determine the prevalence, predictors, and prognostic impact of Renal Dysfunction (RD) among hospitalized patients with systolic Heart Failure (HF).

#### Methods

This a cross-sectional study included 1559 patients, who were admitted with a diagnosis of systolic HF during the period from 1-March-2011 till 20-June-2019 at Madinah cardiac center. RD was defined as estimated glomerular filtration rate < 60 mL/min/1.73 m<sup>2</sup>.

#### Results

Of the total of 1559 patients, 67.2% were males, 51.3% were hypertensive, 56.1% were diabetic and 49.1% were anemic. 60.9% of patients had RD. HF patients with RD were significantly older ( $p<0.001$ ), had a history of Hypertension (HTN) ( $p<0.001$ ), Diabetes Mellitus (DM) ( $p<0.001$ ), anemia ( $p<0.001$ ), stroke ( $p<0.003$ ) and smoking ( $p<0.001$ ). Multivariate analysis showed that older age (OR, 1.1; 95% CI, 1.05-1.07;  $p<0.001$ ), history of DM (OR, 1.5; 95%

### الملخص

#### الخلفية و الاهداف :

ازدادت العلاقة بين القلب والكلى، وجزء من الخلفية الفسيولوجية بينهما تم معرفتها. تهدف هذه الدراسة لوصف معدلات الإصابة بقصور وظائف الكلى وتحديد الأسباب المؤدية إليه وتأثيره بين المرضى المصابين بفشل القلب.

#### طريقة البحث

شملت هذه الدراسة المقطعية 1559 مريضاً بفشل القلب في الفترة ما بين 1 مارس 2011 حتى 20 يونيو 2019 في مركز أمراض وجراحة القلب بالمدينة المنورة. تم تقسيم المرضى الى مجموعتين على أساس معدل الترشيح الكلوي الخاص بهم. تم تعريف قصور وظائف الكلى إذا كان معدل الترشيح الكلوي اقل من 60 مل/دقيقة/1.73م<sup>2</sup>.

#### النتائج

67,2% من العينة كانوا ذكورا، 51,3% كانوا مصابين بارتفاع ضغط الدم، 56,1% كانوا مصابين بمرض السكر و 49,1% كانوا مصابين بفقر الدم. وبينت الدراسة ان من إجمالي 1559 مريضاً بفشل القلب، 60,9% كانوا مصابين بقصور وظائف الكلى. ولوحظ ان المرضى المصابين بقصور وظائف الكلى كانوا أكبر سنا ( $p<0.001$ ). بالإضافة إلى وجود تاريخ مرضي لمرض السكري ( $p<0.001$ )، الضغط ( $p<0.001$ )، فقر الدم ( $p<0.001$ )، الجلطة الدماغية ( $p=0.003$ ) اوالتخخين ( $p<0.001$ ). تحليل متعدد المتغيرات أظهر ان كبار السن (OR, 1.1; 95% CI, 1.05-1.07;)

CI, 1.14-1.86;  $p=0.003$ ), HTN (OR, 1.4; 95% CI, 1.11-1.81;  $p=0.005$ ), and anemia (OR, 1.6; 95% CI, 1.30-2.06;  $p<0.001$ ) were the predictors of RD. Patients with RD had a significantly higher death rate and total length stay ( $p<0.001$ ). However, the hospitalization rate was not significant ( $p=0.111$ ).

#### Conclusion

About 60.9% of systolic HF patients had RD. Older age, history of DM, HTN, and anemia were predictors of RD. Patients with RD had a higher death rate and a total length of stay.

#### Keywords

Renal Dysfunction, Heart Failure, Glomerular Filtration Rate, Cardiorenal Syndrome

OR, 1.5; 95% CI, 1.14-1.86;) مرض السكري ( $p<0.001$  OR, 1.4; 95% CI, 1.11-), مرض الضغط المرتفع ( $p=0.003$  OR, 1.6; 95% CI, 1.30-2.06;) وفقر الدم ( $p=0.005$  1.81;  $p<0.001$ ) كانت أسباب هامة للأصابة بقصور في وظائف الكلى. أظهرت الدراسة أيضا أن معدل الوفاة وفترة التنويم بالمستشفى كان أعلى لدى المرضى المصابين بقصور وظائف الكلى مقارنة بغير المصابين ( $p<0.01$ ).

#### الخلاصة

تقريبا 60,9% من مرضى فشل القلب كان لديهم قصور في وظائف الكلى. كبار السن والمرضى الذين يعانون من مرض السكري، الضغط المرتفع، او فقر الدم كانت أسباب هامة للأصابة بقصور في وظائف الكلى. معدل الوفاة وفترة التنويم بالمستشفى لدى المرضى المصابين بقصور في وظائف الكلى كان أعلى.

#### الكلمات المفتاحية

قصور وظائف الكلى، فشل القلب، معدل الترشيح الكلوي، متلازمة القلب والكلى

## Introduction

Heart Failure (HF) is defined as an abnormality in cardiac structure or function that leads to the inability of the heart to maintain sufficient blood flow to meet the physiological requirements of the metabolizing tissues or can do so at the expense of high filling pressure<sup>1</sup>. HF has become a high priority health issue due to its high prevalence particularly among the older age group, and the high rates of associated morbidity and mortality<sup>2,3</sup>. Renal Dysfunction (RD) is a disorder of gradual or permanent loss of the renal function, resulting in renal failure<sup>4</sup>. The diagnosis of RD is often made based on estimated Glomerular Filtration Rate (eGFR) which provides a more precise approximation of

renal function than elevated serum creatinine alone<sup>5</sup>.

Our knowledge about the interaction between kidneys and heart has increased over the years, and many parts of the pathophysiological background of the cardiorenal syndrome have been recognized<sup>6</sup>. The heart and renal function are closely linked together by the sympathetic nervous system and neurohormone<sup>3</sup>. The cardiorenal syndrome is complex, as renal diseases and HF share the same risk factors, which they work together and potentiate each other HF is associated with a reduction in renal blood flow and a further decrease in eGFR<sup>6</sup>. Progressive renal ischemia leads to activation of renin angiotensin aldosterone system (RAAS) and increase in sympathet-

ic activity, which is a normal phenomenon but have toxic effects on the renal tissues if they are prolonged<sup>7</sup>. Angiotensin Converting Enzyme Inhibitors (ACEIs) are pivotal in the management of systolic HF, by blocking the RAAS which preserves renal function and decreases mortality rate<sup>8</sup>.

Renal dysfunction in HF patients has a critical role in the pathophysiology and progression of HF over time<sup>9</sup>. HF patients had volume overload which leads to an increase in the central venous pressure in their blood vessels with low systemic pressure, which leads to compromise in the renal perfusion pressure. Also, there is an activation of intrarenal sensors and arterial baroreceptors leading to the activation of the sympathoadrenal system, the RAAS, and intravascular volume. These factors will lead to intrarenal and peripheral vasoconstriction, which causing a further decrease in the renal blood flow and eGFR, leading to RD<sup>15</sup>.

Given the growing incidences of RD among HF patients, it is important to know the predictors and prognostic impact of RD among patients with HF. This study aimed to determine the prevalence, predictors, and prognostic impact of RD in hospitalized systolic HF patients in Madinah cardiac center.

## Material and Methods

### *Study design, study period, and study setting*

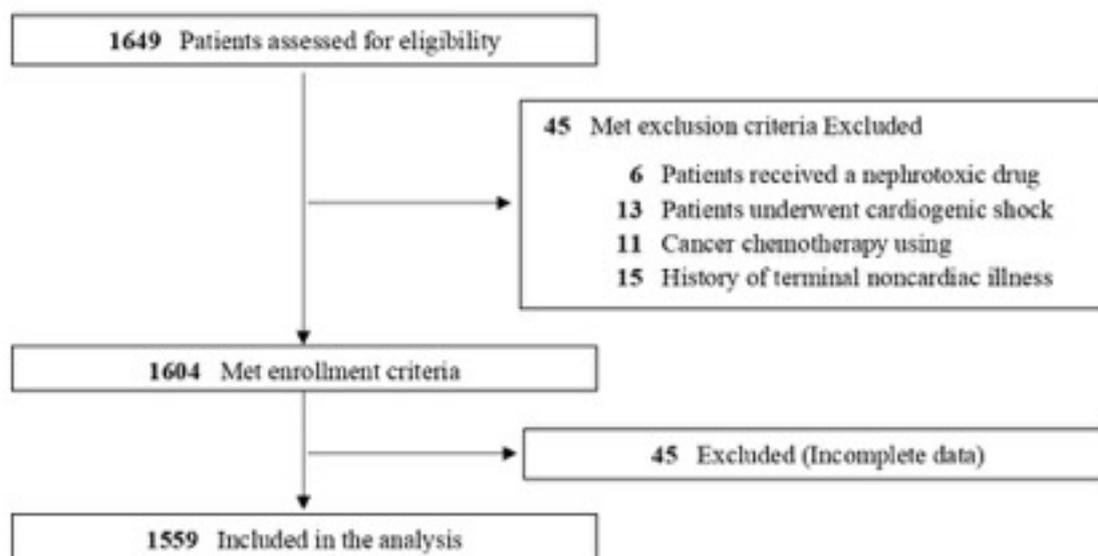
This a cross-sectional study was conducted at Madinah cardiac center involving patients with HF registered in the health management information system database during the period from 1-March-2011 till 20-June-2019.

### *Study population*

The systolic HF registry gathered from an electronic medical records system was retrieved. A total of 1649 patients were identified as having a documented clinical diagnosis of HF and performed a serum creatinine test in the last hospital admission to calculate eGFR.

Patients with systolic HF defined as Left Ventricular Ejection Fraction (LVEF)  $\leq$  45% were included in the study. Patients who had received any nephrotoxic drugs within two days before admission or had cardiogenic shock within one month before admission and those who undergoing cancer chemotherapy were excluded from the study. The presence of terminal non-cardiac illness which could influence the prognosis was set as an exclusion criterion as well. Ninety patients were excluded, 45 of them met the exclusion criteria and the other 45 had incomplete data. The remaining 1559 patients constituted the population of this study [Figure 1].

Figure 1



*Blood measurements and eGFR estimation*  
GFR was estimated depending on the equation made by the chronic kidney disease epidemiology collaboration

$$\text{GFR} = 141 \times \min(\text{Scr} / \kappa, 1)^\alpha \times \max(\text{Scr} / \kappa, 1)^{-1.209} \times 0.993^{\text{Age}} \times 1.018$$

[if female]  $\times 1.159$  [if black] where:

Scr is serum creatinine in mg/dL,  $\kappa$  is 0.7 for females and 0.9 for males,  $\alpha$  is -0.329 for females and -0.411 for males,<sup>10</sup>. Patients were divided into normal renal function and RD according to eGFR (mL/min/1.73 m<sup>2</sup>). eGFR  $\geq 60$ ; normal function, and eGFR  $< 60$ ; RD [11]. Anemia was defined as Hemoglobin (Hb) level  $< 13$  g/dl and  $< 12$  g/dl in male and female respectively, according to world health organization criteria for anemia<sup>12</sup>.

Demographic variables, cardiac and non-cardiac history, medications, and laborato-

ry data including renal function tests, complete blood cells count, and lipid profile were retrieved from the electronic medical records.

#### *Ethical Approval*

Research ethics committee of Taibah University and the ethical committee board of Madinah cardiac center approved this study protocol (approval number: IRB00010413). All study parts were conforming to the declaration of Helsinki Ethical Principles for medical research involving human subjects as revised in 1975<sup>13</sup>.

#### *Statistical Analysis*

Data were analyzed using the Statistical Package for Social Science software version 23. Continuous data were presented as mean  $\pm$  Standard Deviation (SD) as they were normally distributed when tested by the Shapiro-Wilk test, while the categor-

ical data were presented as frequencies and percentages. Baseline demographic and clinical variables were compared between two groups by using the Pearson chi-squared test for categorical variables. To assess whether the continuous variables differed among the study two groups, we used the independent sample t-test. The predictors of RD were determined by using binary logistic regression. P-value was

considered significant if it is  $\leq 0.05$ .

## Results

Out of 1559 patients included in the analysis, 1047 (67.2%) were males, 585 (37.5%) had a history of acute coronary syndrome (ACS), 799 (51.3%) were hypertensive, 874 (56.1%) were diabetic, 280 (18.0%) were smokers, 766 (49.1%) were anemic at the time of admission, and 188 (12.2%) were on ACEIs (Table 1).

Table 1. Sociodemographic and clinical characteristics of the study population

| Variables                                 | Number (n=1559) | (%)    |
|---|-----------------|--------|
| <b>Gender</b>                             |                 |        |
| Male                                      | 1047            | (67.2) |
| Female                                    | 512             | (32.8) |
| <b>Cardiac History</b>                    |                 |        |
| Atrial Fibrillation                       | 208             | (13.3) |
| Arrhythmias                               | 96              | (6.2)  |
| Valvular Heart Disease                    | 344             | (22.1) |
| Acute Coronary Syndrome                   | 585             | (37.5) |
| Rheumatic Heart Disease                   | 34              | (2.2)  |
| Family History of Coronary Artery Disease | 41              | (2.6)  |
| Percutaneous Coronary Interventions       | 142             | (9.1)  |
| Coronary Artery Bypass Grafting           | 91              | (5.8)  |
| Valve Replacement                         | 35              | (2.2)  |
| Cardiac Device                            | 96              | (6.2)  |
| Cardiac Arrest                            | 47              | (3.0)  |
| <b>Noncardiac History</b>                 |                 |        |
| Current Smoker                            | 280             | (18.0) |
| Anemia                                    | 766             | (49.1) |
| Hypertension                              | 799             | (51.3) |
| Diabetes Mellitus                         | 874             | (56.1) |
| Cerebrovascular Diseases                  | 100             | (6.4)  |
| Peripheral Vascular Disease               | 20              | (1.3)  |
| Dyslipidemia                              | 117             | (7.5)  |
| <b>Preadmission Medications</b>           |                 |        |
| Aspirin                                   | 69              | (4.4)  |

| Variables                                | Number (n=1559) | (%)    |
|--|-----------------|--------|
| Gender                                   |                 |        |
| Clopidogrel                              | 224             | (14.4) |
| Angiotensin Converting Enzyme Inhibitors | 188             | (12.1) |
| Calcium Channel Blockers                 | 31              | (2.0)  |
| Beta Blockers                            | 264             | (16.9) |
| Digoxin                                  | 143             | (9.2)  |
| Anticoagulants                           | 96              | (6.2)  |
| Diuretics                                | 107             | (6.9)  |
| Statin                                   | 179             | (11.5) |
| Ferrous Sulfate                          | 87              | (5.6)  |

About 60.9% of patients had RD. Patients with RD were significantly older. Mean  $\pm$  SD of age was  $70\pm 11$  years in patients with RD compared to  $57.7\pm 14$  years in patients without RD ( $p<0.001$ ). A slightly higher increase in mean Systolic Blood Pressure (SBP) at admission was significant in patients with RD. Mean SBP was  $119\pm 23$  mmHg in patients with RD compared to  $116\pm 15$  mmHg in patients without RD ( $p=0.006$ ). However, diastolic blood pressure didn't change between the two groups.

Patients with RD were significantly had a history of ACS ( $p=0.002$ ), rheumatic heart disease ( $p<0.043$ ), Hypertension (HTN) ( $p<0.001$ ), Diabetes Mellitus (DM) ( $p<0.001$ ), anemia ( $p<0.001$ ), stroke ( $p<0.003$ ) and smoking ( $p<0.001$ ). Among all HF patients who used beta blockers, 52.7% of them had RD, compared to 47.3% without RD ( $p=0.003$ ). There was no significant association in valvular heart disease, atrial fibrillation, using ACEIs,

prior percutaneous coronary interventions, or coronary artery bypass grafting.

Regarding laboratory data, patients with RD exhibited a significantly lower hematological profile. Mean  $\pm$  SD of Hb level on admission was  $12.2\pm 2.2$  g/dl and  $13.3\pm 2.2$  g/dl in patients with RD and without RD, respectively ( $p<0.001$ ). Mean  $\pm$  SD of low-density lipoprotein was  $2.2\pm 1.0$  mmol/L in patients with RD compared to  $2.4\pm 1.1$  mmol/L in patients without RD ( $p<0.001$ ). Mean  $\pm$  SD total cholesterol was  $4.0\pm 1.3$  mmol/L and  $3.7\pm 1.3$  mmol/L in patients with RD and without RD, respectively ( $p=0.005$ ). Detailed clinical characteristics and laboratory data are shown in (Table 2).

Table 2. Baseline clinical characteristic and laboratory data stratified by renal function (n=1559)

| Clinical Variable           | Renal Dysfunction<br>(n=949) (60.9%) |        | Normal Renal Function<br>(n=610) (39.1%) |        | OR (95% CI) |                 | P value |
|-----------------------------|--------------------------------------|--------|--|--------|-------------|-----------------|---------|
|                             | Number (%) / Mean $\pm$ SD           |        |  |        |             |                 |         |
| Age                         | 70 $\pm$ 11                          |        | 57 $\pm$ 14                              |        |             |                 | <0.001  |
| SBP mmHg                    | 119 $\pm$ 23                         |        | 116 $\pm$ 15                             |        |             |                 | 0.006   |
| DBP mmHg                    | 65 $\pm$ 8                           |        | 66 $\pm$ 7                               |        |             |                 | 0.965   |
| Gender                      |                                      |        |  |        |             |                 |         |
| Female                      | 348                                  | (68.0) | 164                                      | (32.0) | 1.575       | (1.261 – 1.967) | <0.001  |
| Male                        | 501                                  | (57.4) | 446                                      | (42.6) |             |                 |         |
| Cardiac History             |                                      |        |  |        |             |                 |         |
| Atrial fibrillation         | 136                                  | (65.4) | 72                                       | (34.6) | 1.250       | (0.921 - 1.697) | 0.152   |
| Arrhythmias                 | 54                                   | (56.3) | 42                                       | (43.8) | 0.816       | (0.538 – 1.238) | 0.338   |
| Valvular heart disease      | 195                                  | (56.7) | 149                                      | (43.3) | 0.800       | (0.628 – 1.020) | 0.072   |
| ACS                         | 385                                  | (65.8) | 200                                      | (34.2) | 1.399       | (1.131 - 1.732) | 0.002   |
| Rheumatic Heart Disease     | 15                                   | (44.1) | 19                                       | (55.9) | 0.500       | (0.252 – 0.991) | 0.043   |
| Family History of CAD       | 25                                   | (61.0) | 16                                       | (39.0) | 1.004       | (0.532 - 1.897) | 0.989   |
| PCI                         | 94                                   | (66.2) | 48                                       | (33.8) | 1.287       | (0.895 – 1.852) | 0.173   |
| CABG                        | 63                                   | (69.2) | 28                                       | (30.8) | 1.478       | (0.936 – 2.335) | 0.092   |
| Valve Replacement           | 18                                   | (51.4) | 17                                       | (48.6) | 0.674       | (0.345 – 1.319) | 0.247   |
| Cardiac Device              | 86                                   | (89.6) | 10                                       | (10.4) | 1.108       | (0.562 - 2.181) | 0.768   |
| Cardiac Arrest              | 44                                   | (93.6) | 3  | (6.4)  | 0.638       | (0.196 - 2.080) | 0.452   |
| Medical History             |                                      |        |  |        |             |                 |         |
| Current Smoker              | 137                                  | (48.9) | 143                                      | (51.1) | 0.551       | (0.425- 0.715)  | <0.001  |
| Anemia                      | 526                                  | (68.7) | 240                                      | (31.3) | 1.917       | (1.559 – 2.358) | <0.001  |
| Hypertension                | 570                                  | (71.3) | 229                                      | (28.7) | 2.502       | (2.030 – 3.084) | <0.001  |
| Diabetes Mellitus           | 607                                  | (69.5) | 267                                      | (30.5) | 2.280       | (1.852 – 2.806) | <0.001  |
| Cerebrovascular Diseases    | 75                                   | (75.0) | 25                                       | (25.0) | 2.008       | (1.262 – 3.195) | 0.003   |
| Peripheral vascular disease | 16                                   | (80.0) | 4  | (20.0) | 2.598       | (0.864-7.808)   | 0.078   |
| Medications                 |                                      |        |  |        |             |                 |         |
| Aspirin                     | 42                                   | (60.9) | 27                                       | (39.1) | 1.000       | (0.610 – 1.640) | 1.000   |
| Clopidogrel                 | 146                                  | (65.2) | 78                                       | (34.8) | 1.240       | (0.922 – 1.667) | 0.154   |
| ACEIs                       | 105                                  | (55.9) | 83                                       | (44.1) | 0.790       | (0.581 – 1.075) | 0.132   |
| Beta Blockers               | 139                                  | (52.7) | 125                                      | (47.3) | 0.666       | (0.510 – 0.869) | 0.003   |
| Digoxin                     | 79                                   | (55.2) | 64                                       | (44.8) | 0.775       | (0.548 – 1.096) | 0.148   |
| Anticoagulants              | 88                                   | (91.7) | 8  | (8.3)  | 0.852       | (0.405 - 1.794) | 0.674   |
| Diuretics                   | 56                                   | (52.3) | 51                                       | (47.7) | 0.687       | (0.464 – 1.019) | 0.061   |
| Statin                      | 116                                  | (64.8) | 63                                       | (35.2) | 1.209       | (0.873 - 1.674) | 0.809   |
| Ferrous Sulfate             | 48                                   | (55.2) | 39                                       | (44.8) | 0.780       | (0.505 – 1.205) | 0.797   |
| Laboratory Variables        |                                      |        |  |        |             |                 |         |
| Complete Blood Count        |                                      |        |  |        |             |                 |         |
| Hemoglobin(g/dl)            | 12.2 $\pm$ 2.2                       |        | 13.3 $\pm$ 2.2                           |        |             |                 | <0.001  |

| Clinical Variable   | Renal Dysfunction<br>(n=949) (60.9%) | Normal Renal Function<br>(n=610) (39.1%) | OR (95% CI) |  | P value |
|---|--------------------------------------|--|-------------|--|---------|
|   | Number (%) / Mean ± SD               |  |             |  |         |
| HCT%  | 37.5±6.3                             | 40.3±6.0                                 |             |  | <0.001  |
| RBC ×10 <sup>12</sup> /μL   | 4.3±0.8                              | 4.7±0.8                                  |             |  | <0.001  |
| MCV fL  | 87.1±7.7                             | 86.1±7.5                                 |             |  | 0.495   |
| WBC ×10 <sup>3</sup> /μL  | 10.5±6.2                             | 8.9±3.8                                  |             |  | <0.001  |
| Platelet Count×10 <sup>3</sup> /μL  | 256.8±97.5                           | 266.9±97.5                               |             |  | 0.237   |
| Kidney Function Tests   |                                      |  |             |  |         |
| eGFR  | 38±14                                | 80±19                                    |             |  | <0.001  |
| Creatinine (μmol/L)   | 166.0±79.9                           | 87.4±16.8                                |             |  | <0.001  |
| BUN (mmol/L)  | 13.3±8.7                             | 6.2±2.6                                  |             |  | <0.001  |
| Lipid Profile   |                                      |  |             |  |         |
| LDL (mmol/L)  | 2.4±1.1                              | 2.2±1.0                                  |             |  | <0.001  |
| HDL (mmol/L)  | 0.9±0.4                              | 0.9±0.5                                  |             |  | 0.201   |
| Triglycerides (mmol/L)  | 1.2±0.7                              | 1.3±0.7                                  |             |  | 0.156   |
| Total cholesterol (mmol/L)  | 4.0±1.3                              | 3.7±1.3                                  |             |  | 0.005   |
| Sodium (mEq/L)  | 136.6±8.2                            | 137.4±5.4                                |             |  | 0.080   |
| Troponin (mcg/L)  | 4.9±11.8                             | 1.8±6.9                                  |             |  | <0.001  |
| SBP; Systolic Blood Pressure, DBP; Diastolic Blood Pressure, ACS; Acute Coronary Syndrome, PCI; Percutaneous Coronary Interventions, CAD; Coronary Artery Diseases, CABG; Coronary Artery Bypass Grafting, ACEI; Angiotensin Converting Enzyme Inhibitors, HCT%; Hematocrit, RBC; Red Blood Cells, MCV; Mean Corpuscular Volume, WBC; White Blood Cells, eGFR; estimated Glomerular Filtration Rate, BUN; Blood Urea Nitrogen, LDL; Low Density Lipoprotein, .HDL; High Density Lipoprotein |                                      |  |             |  |         |

Multivariate analysis showed that older age (OR, 1.1; 95% CI, 1.05-1.07; p<0.001), history of DM (OR, 1.5; 95% CI, 1.14-1.86; p=0.003), HTN (OR, 1.4; 95% CI, 1.11-1.81; p=0.005), and anemia (OR, 1.6; 95% CI, 1.30-2.06; p<0.001) were the independent predictors of RD (Table 3).

Table 3. Risk factors of renal dysfunction in systolic HF patients

| Variables               | Sig    | Exp(B) | 95% C.I. for EXP(B) |       |
|-------------------------|--------|--------|---------------------|-------|
|                         |        |        | Lower               | Upper |
| Age                     | <0.001 | 1.064  | 1.054               | 1.073 |
| Female                  | 0.311  | 1.139  | 0.885               | 1.466 |
| Acute coronary syndrome | 0.368  | 1.116  | 0.879               | 1.416 |
| Diabetes mellitus       | 0.003  | 1.456  | 1.141               | 1.858 |
| Hypertension            | 0.005  | 1.420  | 1.112               | 1.814 |
| Anemia                  | <0.001 | 1.637  | 1.300               | 2.060 |

Patients with RD had a significantly higher death rate compared to patients with normal renal function. About 86.9% of the patients who died had RD (p<0.001). Total length stay was higher among patients with RD. Mean ± SD of the total length of stay was 8±21 days in patients with RD compared to 5±6 days in patients without RD (p<0.001). However, there was no difference regarding the hospitalization rate

between the two groups (Table 4).

Table 4. Outcomes comparison for HF patients with or without renal dysfunction

| Outcomes                     | Renal Dysfunction<br>(n=949) (60.9%) | Normal Renal Function<br>(n=610) (39.1%) | OR (95% CI)           | P value |
|------------------------------|--------------------------------------|--|-----------------------|---------|
|                              | Number (%) / Mean ± SD               |  |                       |         |
| Death                        | 721 (86.9)                           | 26 (31.1)                                | 4.972 (3.247 – 7.614) | <0.001  |
| Hospitalization rate         | 1.86±1.61                            | 1.73±1.46                                |                       | 0.111   |
| Total length of stays (days) | 8±21                                 | 5±6                                      |                       | <0.001  |

## Discussion

RD in HF patients is becoming more frequent and severe<sup>13</sup>. In the current study, we found that 60.9% of systolic HF patients had RD (defined as eGFR <60ml/ml/min/1.73m<sup>2</sup>). Previous studies reported a high prevalence of RD in HF patients<sup>14</sup>. A recent retrospective cohort study showed that the overall prevalence of RD was 89%<sup>3</sup>. Similarly, a meta-analysis evaluated the association between RD and HF revealed that 63% of patients had RD<sup>15</sup>. Ronco et al reported that RD has been observed in 45-63% of systolic HF patients<sup>16</sup>. Baydemir et al showed that 81% of HF patients had moderate RD and 19% had severe RD<sup>17</sup>. However, in a study conducted on 1301 patients registered in a systolic HF disease management program, just 26% were found to have CKD<sup>18, 19</sup>.

RD is common in HF patients and shares the same risk factors. The current study found that older age, history of DM, HTN, and anemia were predictors of RD. Several predictors of RD have been described in the previous studies. Data from the Framingham HF study found that older age, high Body Mass Index (BMI), DM, and smok-

ing were predictors of RD<sup>20</sup>. Data from the national health and nutrition examination surveys suggest that older age<sup>18,22,23</sup>, ethnicity<sup>18,21</sup>, education<sup>18,21</sup>, high BMI<sup>23</sup>, history of DM<sup>15,19,24</sup>, HTN<sup>14,25,26</sup>, and cardiovascular disease<sup>3,28</sup> were associated with RD.

A study done by Tarantini et al showed that moderate to severe RD was diagnosed in 59% of systolic HF patients at hospital admission and these patients were older and had a high prevalence of HTN, DM, and anemia<sup>29</sup>. Another study showed that the age of more than 75 years remained an important risk factor for RD development in HF patients<sup>28</sup>. Older patients have a higher prevalence of DM, HTN, anemia, MI, and HF hospitalization, thus may explain the high prevalence of RD among this group along with age-related changes and decrease in renal function<sup>29</sup>. However, Fox et al showed that age was not associated with RD, demonstrating that age-related systemic effects are not specifically related to the onset of RD<sup>22</sup>.

Among HF patients with RD, the prevalence of DM ranged from 37-55% while the prevalence of HTN ranged from 68-85%. This may be explained by the fact,

that the presence of well-known risk factors of RD like DM and HTN leads to further reduction of eGFR and worsen any pre-existing RD<sup>30</sup>. In univariate analysis, female gender and history of ACS were associated with RD but these links disappeared when the multivariable analysis was conducted. However, McAlister et al showed that HF patients with RD were more likely to be female<sup>30</sup>.

Patients with RD had a significantly higher death rate in contrast to patients without RD. About 86.9% of HF patients who died had RD. RD is related to short and long-term mortality among HF patients<sup>18</sup>. Hillege et al found that the death rate in HF patients was associated with a decline in the eGFR than with a decline in the LVEF%<sup>31</sup>. Löfman et al found that the mortality rate increased from 2% in patients without RD to 30% in those with end-stage renal disease (eGFR <15), and the 5 years probability of death was 60% in those with moderate RD and 80% in patients with severe RD<sup>3</sup>.

In the current study, the total length of stays was higher among patients with RD. But there was no association between RD and the number of hospital admissions. In the Kor-HF registry, length of hospital stays, and the period of intensive care unit stay were prolonged in systolic HF patients with RD and the hospital death rate was 13.2%

<sup>30</sup>. In the candesartan in HF assessment of mortality and morbidity trial, patients with eGFR <60 had increased risk of HF hospitalization and cardiovascular death, and this risk increased with decreasing eGFR<sup>32</sup>. However, Verdiani et al reported that there are no differences in re-hospitalization rates, length of stay, or mortality rate in patients with RD compared with those without RD<sup>20</sup>.

### Conclusion

About 60.9% of systolic HF patients had RD. Older age, history of DM, HTN, and anemia were the independent predictors of RD. Patients with RD had a significantly higher death rate and total length stays.

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Original Article :

## Public Awareness of Audiology and Speech-Language Pathology in Saudi Arabia

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### Abstract

#### Background :

There is a literature gap addressing the Saudi general public's understanding of audiology and speech-language pathology (SLP). This study aimed to examine the public awareness of audiology and SLP professions in Saudi Arabia.

#### Methods:

This was a cross-sectional study design consisted of two parts. The pre-test part aimed to provide content validation for the major questionnaire study. The full-scale study addressed the aim. An electronic questionnaire was prepared and distributed. The questionnaire contained three sections: demographics, experience with hearing and communication disorders, and audiology and SLP knowledge.

#### Results:

A total of 50 and 512 participants completed the questionnaires for both parts, respectively. Most of participants were Saudi citizens (98.8%), aged 18–30 years, and lived in Riyadh. The questions with the most correct response rates were mostly inductive (e.g., workplace), but some audiology and SLP services (e.g., diagnosis and management of tinnitus, vestibular and swallowing disorders) were not well-identified by the participants. Of the total, 78.7% and 87.5% of participants correctly identified that the work of audiologists and speech-language pathologists (SLPs) was not like the work of teachers of deaf and hard of hearing and special education teachers, respectively.

### الملخص

#### الخلفية:

هناك فجوة بحثية بخصوص فهم المجتمع السعودي لتخصص علم أمراض واضطرابات السمع والتخاطب. هدفت هذه الدراسة إلى تحديد مدى وعي المجتمع السعودي لهذا التخصص.

#### طريقة البحث :

تم تصميم دراسة مقطعية وصفية لتحقيق هدف الدراسة. كان الجزء الأول عبارة عن اختبار تجريبي هدف إلى التحقق من صحة المحتوى الذي سوف يستخدم في الدراسة الرئيسية. بينما كان الجزء الثاني عبارة عن الاستبيان الأساسي لتحقيق هدف الدراسة الرئيس. تم قياس مستوى الوعي من خلال إعداد استبيان إلكتروني وتوزيعه حيث احتوى على ثلاثة أقسام: التركيبة السكانية، والخبرة في اضطرابات السمع والتخاطب، والمعرفة بتخصص علم أمراض واضطرابات السمع والتخاطب.

#### النتائج:

أكمل 50 مشاركاً الاختبار التجريبي، بينما أكمل 512 مشاركاً الاستبيان الرئيس. غالبية المشاركين كانوا من المواطنين السعوديين (98,8٪)، الذين تتراوح أعمارهم بين 18-30 سنة، ويعيشون في الرياض. كانت الأسئلة (على سبيل المثال: مكان العمل) ذات معدلات الاستجابة الأكثر دقة، بينما الأسئلة التي كانت تتعلق ببعض الخدمات الصحية في السمع والتخاطب (مثل تشخيص وعلاج طنين الأذن واضطرابات الجهاز الدهليزي والبلع) لم يتم الإجابة عليها بدقة من قبل المشاركين. من مجموع المشاركين، 78,7٪ منهم استطاع التفريق بشكل صحيح بين عمل أخصائيي السمع وعمل معلمي الصم وضعاف السمع، بينما 87,5٪ منهم استطاع التفريق بين عمل أخصائيي أمراض النطق واللغة وعمل معلمي التربية الخاصة.

**Conclusion:**

A reasonable level of public awareness of audiology and SLP in Saudi Arabia was identified. Still, more public awareness campaigns and educational materials about audiology and SLP are needed. Stakeholders are advised to strengthen public awareness efforts at the national level.

**Keywords:**

Audiology; awareness; communication disorders; hearing loss; Saudi Arabia; speech-language pathology.

**الخلاصة:**

بيّنت هذه الدراسة مستوى معقول من وعي المجتمع بتخصص علم أمراض واضطرابات السمع والتخاطب في المملكة العربية السعودية. ومع ذلك، لا تزال هناك حاجة إلى المزيد من حملات التوعية العامة والمواد التعليمية حول هذا التخصص. لذلك يُنصح أصحاب المصلحة بتعزيز جهود التوعية العامة على المستوى الوطني.

**الكلمات المفتاحية:**

علم أمراض واضطرابات السمع والتخاطب، الوعي، اضطرابات التواصل، المملكة العربية السعودية.

**Introduction**

According to Article 19 of the Universal Declaration of Human Rights, it is every human's right to communicate.<sup>1</sup> However, there is a global lack of awareness of the needs of people with communication disorders.<sup>2</sup> Therefore, six international audiology and speech-language pathology (SLP) professional bodies established the "International Communication Project (ICP)" to raise awareness about communication disorders.<sup>3</sup> The ICP focuses on identifying potential opportunities for the acknowledgment of communication disorders by governing bodies and advocate for accessing services.<sup>2</sup> A steppingstone to this acknowledgment and advocacy is assessing the general public's level of knowledge on audiology and SLP.

The professions of audiology and SLP are "inextricably linked".<sup>4</sup> Both professions provide various services to a wide array of individuals from pediatrics to geriatrics.

The following is a list of audiology service delivery areas as per the Saudi Society of Speech-Language Pathology and Audiology (SSSPA): hearing, balance, tinnitus, cognition and auditory processing.<sup>5</sup>

SLP service delivery areas include: speech production, language, fluency, cognition, voice, resonance, feeding and swallowing, auditory habilitation and rehabilitation.<sup>6</sup> However, limited public awareness of hearing and communication disorders remains. For example, according to a survey distributed among American Speech and Hearing Association (ASHA) members, audiologists, and speech-language pathologists (SLPs) indicated that public awareness of the early warning signs of communication disorders is low.<sup>7</sup> Both professions are considered relatively new in Saudi Arabia. Many audiologists mentioned that "Saudi Arabia needs better understanding of the field among other healthcare professionals and in the com-

munity”.<sup>8</sup> SLPs also stated that there needs to be “better recognition of the profession by national authorities”.<sup>8</sup> There is an imbalanced distribution of audiologists and SLPs across Saudi healthcare sectors. A contributing factor to this phenomenon might be the limited public awareness about the professions.<sup>9</sup> Getting an idea of the public’s understanding of the services audiologists and SLPs provide will help identify areas of ambiguity and potentially clarify them. Different studies were carried out pertaining to public awareness of audiology, SLP and hearing and communication disorders in different countries. For example, awareness of dysfluency in Brazil and China,<sup>10,11</sup> awareness of aphasia in England,<sup>12</sup> awareness of audiology, hearing and hearing health in South Africa,<sup>13</sup> and ear and hearing health among mothers of young children in India.<sup>14</sup> Yet, limited research was done on public awareness of audiology and SLP in Arab countries. For example, Mahmoud et al. found that public awareness and knowledge of SLP in Amman, Jordan was limited.<sup>15</sup> Alshehri et al. investigated the public awareness of ear health and hearing loss in Jeddah, Saudi Arabia and found that the overall awareness was fair.<sup>16</sup> They illustrated the need for preparing educational materials for the community including those with hearing loss and their families. There is still a gap

in the literature addressing levels of understanding the Saudi general population has pertaining to audiology and SLP professions and the role of audiologists and SLPs. Addressing this gap will better identify current public awareness levels and serve as a segue to remediate any misunderstandings about both fields.

### Methods

This cross-sectional, descriptive study was designed to examine the public awareness of audiology and SLP professions including their roles in Saudi Arabia.

This study was approved by the Institutional Review Board of King Abdullah International Medical Research Centre (#RC20/031/R). Informed consent was obtained from all voluntarily willing participants. No identifiable or health information was collected. Only the authors had access to the data.

This study was established in Riyadh, Saudi Arabia. The inclusion criteria included all people who lived in Saudi Arabia and who aged  $\geq 18$  years old at the time of completing the questionnaire. Healthcare providers and incomplete questionnaires were excluded. Healthcare providers’ awareness of audiology and SLP in Saudi Arabia will be investigated by the authors in a separate study.

This questionnaire was established and

conducted in two parts. The pre-test part aimed to provide valuable content validation for the major study. The second part, the full-scale study, investigated the awareness level that public has about both professions in Saudi Arabia.

#### *The pre-test part*

A self-administered English questionnaire was developed for data collection after a review of the literature and a focus group of experts in the fields. This questionnaire consisted of 22 questions distributed into three sections: demographics, experience with hearing and communication disorders, and knowledge of audiology and SLP (<https://drive.google.com/file/d/1cjdndIW0nDnHlrwtaOrhgHoCmag5el9q/view?usp=sharing>). In the first section of the questionnaire, participants responded to nine questions related to personal and demographic data: gender, age, nationality, region of residency, education, occupation, place of work, marital status, whether or not they have children, and number of children if applicable. The second section included five questions that invited participants to comment on their experiences with hearing and communication disorders. The third section consisted of eight questions that explored the participants' awareness of audiology and SLP. Because Arabic is the primary language in Saudi Arabia, the authors followed the WHO process of translation and adapta-

tion of instruments.<sup>17</sup> The original English questionnaire was translated into Arabic by two independent bilingual (in English and Arabic) experts. Then, the expert panel identified and resolved any inadequate expressions or concepts of the translation. The Arabic version was then translated back into English by two independent bilingual (in English and Arabic) experts. Later, 50 participants were presented with hard copies of the questionnaire for the pre-test part. Before completing and submitting the questionnaire, the participants had to read and complete the informed consent that included necessary elements, such as the purpose of the research, inclusion criteria, benefits and risks, handling of data, and contact information. Those 50 participants were not included in the sample size of the main study. To ensure no misunderstanding of any question, the participants in the pre-test part were asked about the clarity of all questions. They had correct understanding of the questions, and no comments were received.

The face validity and internal consistency of the final version of questionnaire was established. The data of 50 participants were analysed by using Statistical Package for Social Sciences (SPSS) for Windows v. 25.0 (IBM SPSS Statistics, IBM Corporation, Armonk, NY, USA). Cronbach's  $\alpha$  score was calculated and Principal Com-

ponents Analysis (PCA) was performed for validation of the questionnaire. A Cronbach's  $\alpha$  score of 0.71 was obtained, KMO and Bartlett's test yielded results depicting that variables are significantly correlated on PCA. No changes were done on the translated version which was considered to be the final version of the questionnaire used in the main study.

#### *The full-scale study*

According to the results from the pre-test part, the content of the questionnaire was not modified. A convenience sampling technique was used in this research. The questionnaire was prepared electronically on Google Forms (Google LLC, Mountain View, California, United States) to reach many people all over Saudi Arabia in a time-efficient and cost-effective way. The link to the questionnaire was emailed to a random sample of people and posted on and shared via social media (Twitter, Facebook, LinkedIn, and WhatsApp). An electronic informed consent was obtained in the full-scale study as well. Because the total population in Saudi Arabia is around 33,660,923 excluding approximately 584,708 healthcare providers,[18,19] the sample size was calculated to be 385 participants using Raosoft sample size calculator (Raosoft, Inc., United States) with 5% margin of error, 95% confidence level, and 50% response distribution. The question-

naire link was accessible for five months. Monthly electronic reminders were sent. Participation was voluntary, and answers were anonymous.

#### **Results**

A total of 512 participants were included in the analysis based on the inclusion criteria. Data were analysed using descriptive statistics. Seven uncompleted surveys were excluded. The results were prepared according to the following sections: (a) demographics, (b) experience with hearing and communication disorders, and (c) knowledge of audiology and SLP.

Nine items explained background characteristics of participants. Most of the participants (98.8%) were Saudi citizens, residing in the region of Riyadh. Of the total, 52% participants were male, and the majority aged 18–30 years. Of the participants, 18.9% aged between 31–40 years, 13.3% belonged to the age group of 41–50 years old, 11.3% aged between 51–60 years old, and 8.2% aged between 61–70 years old. Only 0.8% participants were older than 70 years. Regarding education, more than half of the participants had a minimum of a bachelor's degree or higher. The greater proportions of participants were either students or employed individuals. Exactly, 45.7% of participants reported having children. Of the participants who had children, 56% of them had three

to five children. The participants' demographics are summarized in Table 1.

Table 1: Demographics of participants

| Variables          | Answer Options            | Responses <i>n</i> (%) |
|--------------------|---------------------------|------------------------|
| Age Range          | 18–30                     | 243 (47.5)             |
|                    | 31–40                     | 97 (18.9)              |
|                    | 41–50                     | 68 (13.3)              |
|                    | 51–60                     | 58 (11.3)              |
|                    | 61–70                     | 42 (8.2)               |
|                    | 71 and over               | 4 (0.8)                |
| Region             | Riyadh                    | 434 (84.7)             |
|                    | Eastern                   | 38 (7.4)               |
|                    | Makkah                    | 29 (5.6)               |
|                    | Northern Borders          | 5 (1.1%)               |
|                    | Asir                      | 3 (0.6)                |
|                    | Bahah                     | 2 (0.4)                |
|                    | Qassim                    | 1 (0.2)                |
| Educational Level  | Bachelor's degree         | 239 (46.7)             |
|                    | High school or equivalent | 153 (29.9)             |
|                    | Master's degree           | 53 (10.4)              |
|                    | Diploma                   | 35 (6.8)               |
|                    | Doctor of philosophy      | 22 (4.2)               |
|                    | Below high school         | 10 (2)                 |
| Occupation         | Student                   | 198 (38.7)             |
|                    | Employed                  | 170 (33.2)             |
|                    | Retired                   | 71 (13.9)              |
|                    | Unemployed                | 55 (10.7)              |
|                    | Self-employed             | 18 (3.5)               |
| Marital Status     | Married                   | 254 (49.6)             |
|                    | Single                    | 239 (46.7)             |
|                    | Divorced                  | 11 (2.1)               |
|                    | Widow                     | 8 (1.6)                |
| Children           | No                        | 278 (54.3)             |
|                    | Yes                       | 234 (45.7)             |
| Number of children | 3–5 children              | 131 (56)               |
|                    | 6 children or more        | 53 (22.6)              |
|                    | 2 children or less        | 50 (21.4)              |

Of the total, 67% of participants have never personally visited or had one of their family members visit an audiologist or a speech-language pathologist. Of those who had, a bigger portion (18.8%) visited audiologists than SLPs (6.8%), whereas 7.4% participants visited both professionals. Most of participants 87.3% have nev-

er been diagnosed with hearing loss or a communication disorder. Forty-six (9%) participants were diagnosed with hearing loss, 14 (2.7%) with communication disorders, and five (1%) with both.

Over half of the participants (56.6%) knew someone with hearing loss, a communication disorder or both. Those who reported knowing people with hearing loss were more than double those who reported knowing people with communication disorders. Of the total, 47.4% of the participants stated their relationship to individuals with hearing loss or communication disorders. First degree relatives were the biggest portion of responses where 84 participants (34%) had a parent, full sibling or child with hearing loss or a communication disorder. This was followed by friends and acquaintances with 58 responses (24%), then third-degree relatives, such as first cousins, which had a 23% response rate (n=55). Exactly, 36 respondents (15%) had a second degree relative such as aunts, uncles, nieces, nephews, grandchildren, grandparents and half-siblings with hearing loss or a communication disorder. More than half of the participants have never seen, heard, or read anything about hearing and communication disorders. Among those who had, 115 (22.5%) participants encountered information for both hearing and communication disorders, 68 (13.3%)

for hearing disorders only, and 65 (12.7%) for communication disorders only.

Eight items were devoted to establishing the level of awareness of audiology and SLP. Regarding to the type of workplaces for audiologists and SLPs, most of the participants (80.9%) reported hospitals being the main workplace for both professionals, while the least responses (7.2%) were military (Figure 1).

While the majority of participants (n=201; 40.8%) indicated that no referral is needed to see audiologists or SLPs, more than a third of the participants (n=190; 36.9%) did not know if a referral is needed to access services. The remaining participants (n=115; 22.3%) reported that referrals are needed to see audiologists or SLPs. The responses to the age groups that audiologists and SLPs most commonly work with were as follows: toddlers, school-aged children, elderly, teenagers, adults then infants, respectively. Toddlers and school aged children had over 60% response rate for each. This was followed by the elderly, teenagers and adults with over 40% response rate for each. Infants had the least response rate with almost 24%. Surprisingly, 116 of the participants (22.7%) were not sure of the population audiologists and SLPs most commonly work with.

An equal portion of the participants (26.6%) believed that it takes two–three

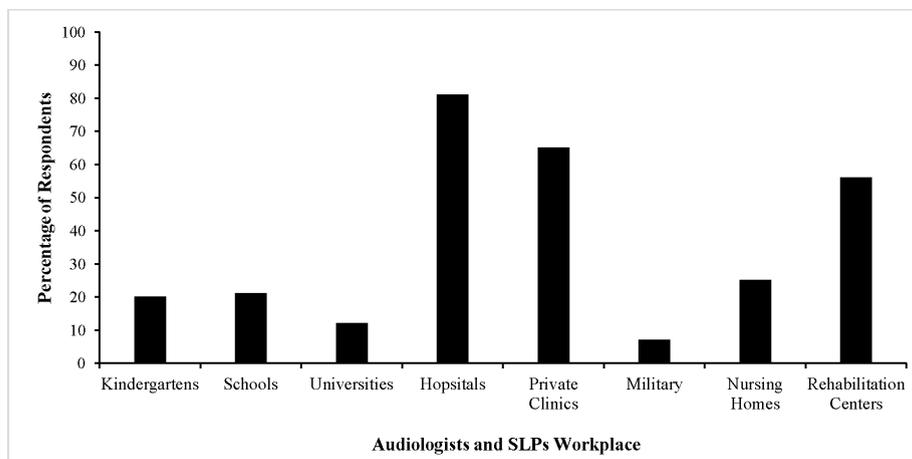


Figure 1. The distribution of potential workplaces for audiologists and speech-language pathologists (SLPs) in Saudi Arabia reported by the participants ( $n= 512$ ). *Note.* The participants stated more than one workplace, so percentages sum to more than 100%.

or four years of study and training after high school to become an audiologist or a speech-language pathologist. Roughly, 30% of the participants indicated that it takes five years of study and training, whereas 53 (10.4%) participants believed it takes more than five years to become a specialist in either field. The remaining participants ( $n=31$ ; 6.1%) thought it took at least a year. While the majority of the participants (78.7%) differentiated between the nature of work that audiologists and teachers of the deaf and hard of hearing do, 109 (21.3%) participants believed that audiologists and teachers of the deaf and hard of hearing do the same work. As for the nature of work that SLPs and special education teachers have, only 64 (12.5%) participants believed that SLPs and special education teachers do the same work. Again, most of the participants (87.5%)

differentiated between the two professions. Most of the participants indicated that diagnosing hearing loss, improving hearing, and prescribing and fitting hearing aids and assistive listening devices were the main services audiologists perform. Less than half of the participants believed that audiologists diagnose and manage tinnitus, whereas only 35.5% of them believed that diagnosing and managing vestibular disorders were within the services that audiologists provide. The majority identified that prescribing medication and surgical intervention were not tasks that audiologists perform. Of the total, 19.7% participants stated that they did not know the job of audiologists (Figure 2).

The most prominent responses about SLP services were all verbal communication skills. Over half the sample believed that improving speech, diagnosing, and man-

aging communication disorders and managing stuttering were within the expertise of SLPs. This was followed by improving receptive language skills and managing

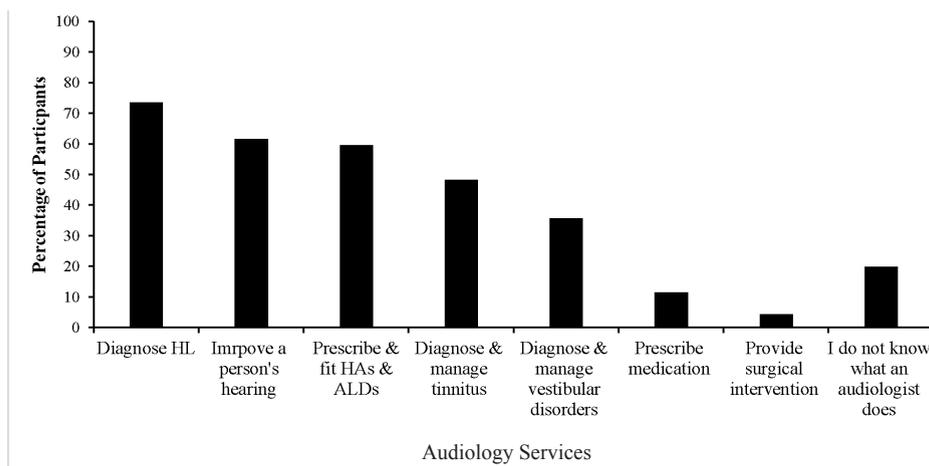


Figure 2. The distribution of the job of audiologists in Saudi Arabia indicated by the participants ( $n= 512$ ). *Note.* The participants reported more than one service, so percentages sum to more than 100%; HL: Hearing loss; HAs: Hearing aids; ALDs: Assistive listening devices.

voice disorders with 41.4% and 40.8% response rates, respectively. Diagnosing and managing swallowing disorders had the least response rate with only 25.6% of participants believing it is within the scope of practice of SLPs. Most participants identified the foil items and did not agree that prescribing medication and surgical inter-

vention were tasks that SLPs perform. Of the total, 18.2% participants reported that they did not know the job of SLPs (Figure 3).

### Discussion

In this study, a questionnaire was administered to study the public awareness of audiology and SLP professions in Saudi

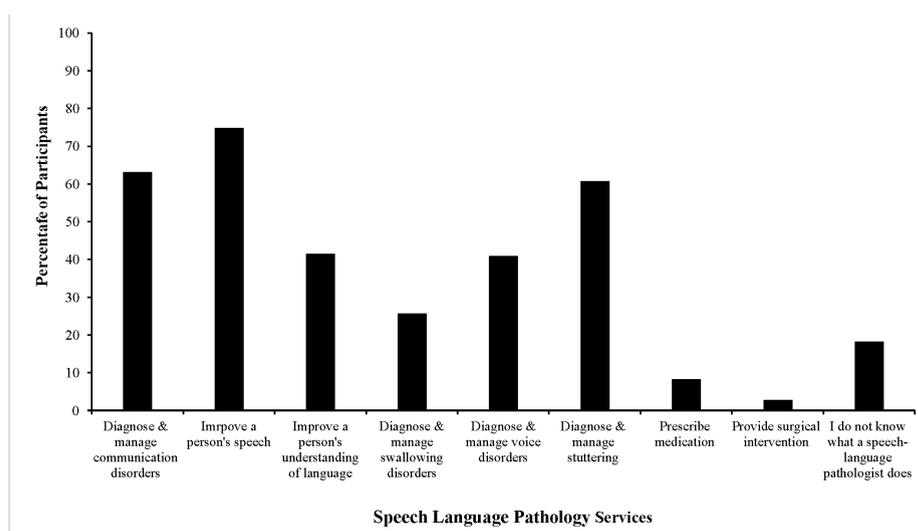


Figure 3. The distribution of the job of speech-language pathologists in Saudi Arabia opted by the participants ( $n= 512$ ). *Note.* The participants reported more than one service, so percentages sum to more than 100%.

Arabia. A total of 512 individuals participated in the main study. Although more than half of them never visited an audiologist or a speech-language pathologist or was diagnosed with hearing loss or communication disorder, our results show an overall reasonable awareness of audiology and SLP. Most of participants were from three large regions: Riyadh, Eastern, and Makkah where audiology and SLP services are well established at different health workplaces (e.g., governmental hospitals and rehabilitation centers). Khojah and Sheeshah reported that most of the SLP services in Saudi Arabia are concentrated in these three regions.<sup>9</sup> Furthermore, the current existing audiology and SLP academic programs are offered by King Saud University, Princes Noura bint Abdulrahman University and Dar AlHekmah University, are located in Riyadh and Jeddah, the two largest cities in Riyadh and Makkah regions.<sup>8</sup> In our study, the majority of the population were highly educated with more than half the participants having a minimum of a bachelor's degree. This indicates an association between level of education and overall awareness of audiology and SLP. All these reasons might explain the level of awareness found in this study.

Only a few participants were diagnosed with hearing loss, a communication dis-

order or both; however, more than half of the participants knew someone with hearing and communication disorders. Most of participants who knew someone with a hearing and/or communication disorder were related in a first degree. The General Authority for Statistics in Saudi Arabia estimated that 1.4% of all citizens have mild, moderate or severe hearing difficulties.<sup>20</sup> Approximately 21.3% of disabilities among Saudi citizens are caused by congenital malformations.<sup>20</sup> Congenital hearing loss has been found in many families because of consanguineous marriage.<sup>21</sup> Interestingly, only 29% (n=149) of the study participants knew a second or third degree relative, friend or acquaintance with a hearing or communication disorder. Given the nature of some auditory and communication disorders, they may be not as visible and noticeable to others. In addition to the possible stigmatization associated with such disorders, some individuals with these disorders might shy away from sharing personal information within their community. That said, it is noteworthy that nearly half of the participants have never seen, heard, or read anything about hearing and communication disorders.

Although there is limited information about audiologists and SLPs employed in Saudi Arabia and their current practices,<sup>8</sup> the participants' awareness of the potential

workplaces for audiologists and SLPs was good. Most of participants correctly identified that hospitals, private clinics, and rehabilitation centres were the most workplaces for audiologists and SLPs. It is estimated that most audiologists and SLPs in Saudi Arabia worked in hospitals.<sup>8</sup>

Regardless the percentage of participants who selected schools and universities as potential workplaces for audiologists and SLPs in Saudi Arabia, there are limited numbers of audiologists and SLPs work in such places. Additionally, many in the educational field strongly agreed to the need of services delivered by both professionals in schools as well.<sup>22</sup> Toddlers and school aged children were selected as the age groups that audiologists and SLPs most commonly work with followed by the elderly, teenagers, and adults. Audiologists and SLPs work with all ages from infancy to adulthood. According to ASHA, SLPs practicing in the United States spent 60% of their clinical services time with adults, 14 % with infants and toddlers, 14% with pre-school children, and 13% with school-age children.<sup>23</sup> In the present study, a few participants might correlate words 'speech' and 'language' with infants and children, so kindergartens were selected as one of the workplaces of audiologists and SLPs in Saudi Arabia. The majority of participants believed a physician's refer-

ral was not required to see an audiologist or a speech-language pathologist, whereas more than a third of the total participants did not know if a referral is needed to access services. Whether the referral is required or not depends on where audiologists and SLPs practice. Since most audiologists and SLPs in Saudi Arabia work in healthcare settings; referrals from physicians are mandatory. However, with a 'direct access' system, patients will be able to see either professionals without a referral from physicians or other healthcare providers.<sup>24</sup>

The fact that 53.2% of participants reported two-four years after high school were required to be an audiologist or a speech-language pathologist is indicative of the community's limited recognition of the services provided by both professionals. In Saudi Arabia, a bachelor's degree is the entry level to work as an audiologist or a speech-language pathologist. The duration of study for this degree is five years including a training year (i.e., internship). It is encouraging evidence that the majority of participants differentiated audiologists from teachers of the deaf and hard of hearing, and SLPs from special education teachers. Only 21.3% of participants believed that audiologists and teachers of the deaf and hard of hearing do the same work, whereas 12.5% of participants be-

lieved that SLPs and special education teachers share similar work responsibilities. Although audiologists, SLPs, teachers of the deaf and hard of hearing, special education teachers are partners in education, their scopes of practice are different. Audiologists and SLPs should continue their efforts to educate the community about the services both professionals provide.

Most of the participants identified diagnosing hearing loss, improving hearing and prescribing and fitting hearing aids and assistive listening devices as the main services audiologists perform. These areas of practice are the main services audiologists practicing in Saudi Arabia provide.<sup>10</sup> Less than half of the participants believed that audiologists diagnose and manage tinnitus and vestibular disorders. Most practicing audiologists in Saudi Arabia did not perform tinnitus and vestibular assessment and rehabilitation.<sup>8</sup> The participants were aware that prescribing medication and surgical intervention were not tasks audiologists perform.

Most of the participants identified that SLPs provide services pertaining to verbal communication skills including improving speech, diagnosing, and managing communication disorders and managing stuttering. All of which are more noticeable disorders given their nature. These areas of practice are the main daily jobs of practicing

SLPs in Saudi Arabia in addition to improving receptive language skills. Also, it is worth noting that the Arabic translation of the term “speech-language pathologist” elicits an understating of professionals dealing with verbal communication disorders, whereas the scope of practice is wider than that.<sup>6</sup> Diagnosing and managing voice had 40.8% response rate. Another study reported similar findings where less participants identified voice and literacy to be within the speech-language pathologist’s scope of practice as well.<sup>22</sup> It is estimated that approximately 32.4% of practicing SLPs in Saudi Arabia work with patients with voice and resonance disorders.<sup>8</sup>

In the current study, 25.6% of the participants believed that SLPs diagnose and manage swallowing disorders. Despite the lower rate of participants that believed swallowing was within the scope of SLPs, it is still a promising percentage as only 4% of registered nurses that participated in a hospital study identified SLPs as the professionals responsible for diagnosing and treating swallowing difficulties (i.e., dysphagia).<sup>25</sup> According to Alanazi, only 27% of SLPs worked with dysphagic patients in Saudi Arabia.<sup>8</sup> The majority of participants were aware that prescribing medication and surgical intervention were not tasks SLPs perform. The response rates of participants who did not know what the job of

audiologists and SLPs were nearly similar. This study calls for collaborative efforts between audiologists and SLPs, SSSPA, audiology and SLP academic programs, and other stakeholders (e.g., Ministry of Health, Ministry of Education) to continuously work together towards improving community awareness about both professionals' roles in addition to hearing and communication disorders at the national level.

### **Limitations**

Although the required sample size was obtained, the sample did not represent all Saudi regions equally. Our questionnaire was designed and professionally reviewed, and was validated through the pre-test part; however, it is a new questionnaire that was not validated in other environments and countries. The correlation of variables, such as educational levels and experience with hearing and communication disorders with the participants' knowledge was not investigated. This an area warrant research attention. Future research will investigate healthcare providers' awareness about audiology and SLP in Saudi Arabia. Further research is also needed to investigate the public's awareness about specific hearing and communication disorders.

### **Conclusion**

The present study investigates the pub-

lic awareness of audiology and SLP professions in Saudi Arabia. Results suggest a reasonable level of public awareness. The main concept of both professions was present, but some audiology and SLP services were not well-identified by the participants. Although professional ethics prevent advertising, there is apparently a need for the public to be informed of the available audiology and SLP services. It is the responsibility of audiologists and SLPs to provide education about such services through media and public educational campaigns. Audiology and SLP services should be extended to reach rural areas in all Saudi regions which will consequently enhance public awareness. The use of tele practice at any time particularly during times, such as the time of Coronavirus disease 2019 (COVID-19) pandemic, is one of the solutions to overcome the shortage of such services in these areas.

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Original Article :

## Prevalence of Impacted Third Molars in AZ-Zulfi Region of Saudi Arabia: A Cross-sectional Study

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### Abstract

#### Background:

This study aims to evaluate the prevalence of the impacted third molars and their associated pathologies in the population of Az Zulfi, Saudi Arabia.

#### Method:

This study was conducted in the clinics of the College of Dentistry, Majmaah University, Saudi Arabia. A total of 1695 orthopantomograms (OPG) from December 2018 and December 2019 were evaluated using the third molar characteristics evaluation form (TMCEF).

#### Results:

Minimum of one impacted third molar had been found in 240 OPG among 1695 studied. Among the gender, males (15.6%) showed more impacted teeth prevalence than females (3.1%). The incidence of mandibular molar impaction (23%) is more when compared to that of the maxilla (14.3%). The mandible shows more prevalence of mesioangular impaction (50.44%) and in the maxilla, it is vertical impaction (49.39%). Depending upon the space available between the second molar distal surface and the mandibular anterior ramus, Class II (51.09%) pattern is

### الملخص

#### الخلفية:

تهدف هذه الدراسة إلى تقييم مدى انتشار الأضراس الثالثة (العقل) المطمورة والأمراض المرتبطة بها في مجتمع الزلفي بالمملكة العربية السعودية.

#### طريقة البحث:

أجريت هذه الدراسة في عيادات كلية طب الأسنان، جامعة المجمعة، المملكة العربية السعودية. تم تقييم ما مجموعه ١٦٩٥ اشعة بانوراما من ديسمبر ٢٠١٨ حتى ديسمبر ٢٠١٩ باستخدام نموذج تقييم الخصائص المولية الثالث.

#### النتائج:

من بين ١٦٩٥ تمت دراستها. بين الجنسين، أظهر الذكور تم العثور على الأقل ضرر ثالث (عقل) مطمور في ٢٤٠ (١٥,٦٪) انتشار أسنان مطمورة أكثر من الإناث (٣,١٪). نسبة حدوث انطمار ضرر عقل في الفك السفلي (٢٣٪) هي أكثر عند مقارنتها بتلك الموجودة في الفك العلوي (١٤,٣٪). يُظهر الفك السفلي انتشارًا أكبر للانطمار المتعلق بالزاوية الأنسية (٥٠,٤٤٪) وفي الفك العلوي هو تأثير عمودي (٤٩,٣٩٪). اعتمادًا على مستوى الانطمار، وجد أن الموضع ب (٤٥,٩٥٪) والموضع ج (٥٩,٨٣٪) أكثر شيوعًا في الفك السفلي والعلوي، على التوالي. من بين الأسنان المطمورة ١٨٧ كان لها بعض الأمراض المرتبطة بها وكان تسوس

found to be more common than the other two Classes. Depending on the level of impaction Position B (45.95%) and Position C (59.83%) were found to be more common in the lower and upper jaw, respectively. More than 66% of maxillary impactions had close approximation to the maxillary sinus floor on both sides. Among the impacted teeth 187 had some associated pathology and dental caries were the most frequent one among all the other pathology reported.

#### Conclusion:

The most common impacted tooth in Az Zulfi, Kingdom of Saudi Arabia is mesioangular and position B in the mandible and vertical and position C in the maxilla.

#### Keywords:

Mandible, Maxilla, Third molar, Tooth, Impacted.

### Introduction:

The functional and topographical position of the third molar had made the prevalence of these teeth more variable and significant when compared to other teeth. Various theories had been put forward to explain the nature of eruption and prevalence of impacted third molar, but none of the theories hold good with all kind of impaction. Third molars were more commonly associated with the development of pathological cyst, TMJ disorders, cheek bite, etc. and hence the prevalence studies on the third molar in the specific region suggest the need for the specific dental care and needs of that region. The erupting pathway and position of the third molar can be related not only to the ethnicity of the population but also to the masticatory efficiency, and hereditary

الأسنان الأكثر شيوعاً بين جميع الأمراض الأخرى التي تم الإبلاغ عنها.

#### الخلاصة:

أكثر الأسنان المتأثرة شيوعاً في الزلفي بالمملكة العربية السعودية هي الأسنان المتعلقة بالزاوية الأنسية والموضع ب في الفك العلوي والموضع ج في الفك السفلي.

influences<sup>1</sup>.

Impacted teeth has been defined as a tooth that doesn't reach the anatomical position because of insufficient space, bony interference, or any trauma leading to deviation in the path of the eruption<sup>2</sup>. In Saudi Arabia, recently more studies have been done on the impacted third molar prevalence, because of its clinical and functional significance. However, there are no such studies found in the literature specific to the Az Zulfi region of Saudi Arabia. The primary objective of this study was to assess the prevalence of impacted third molars and also to evaluate any associated pathology with the impacted third molar among the patients attending the dental clinic, College of Dentistry, Majmaah University in Al-Zulfi region, Kingdom of Saudi

Arabia,

### Materials and methods:

This cross-sectional retrospective radiographic study was done in the clinics of the College of Dentistry, Majmaah University after getting approval from the Deanship of Scientific Research with project number HA-01-R-088. A total of around 1695 orthopantomograms (OPG) of the patients who were reported to the Maxillofacial Department of College of dentistry, Majmaah University from December 2018 and December 2019 were evaluated based on the classifications of Pell & Gregory and Winter. Only those records with panoramic radiographs were selected by simple random sampling method. The medical records of patients who did not have panoramic radiographs and those who did not exhibit complete root formation of the third molars were considered not eligible for the study. The two experts in dental radiology with more than fifteen years of experience were given the third molar characteristics evaluation form (TMCEF) to evaluate all the records included in the study.

(Appendix 1)

The evaluation criteria for typing the impaction in the present study were Pell and Gregory classification<sup>3</sup> and Winter's Classification<sup>4,5</sup>. The earlier classification was based on the occlusal plane level as

A, B, C, where the third molar occlusal plane was at the same level or between the occlusal surface and the cemento-enamel junction of the second molar or the occlusal surface of the third molar was apical to the cemento-enamel junction of the second molar respectively. Based on the space available between the posterior part of the second molar and the anterior border of the ramus, the impaction can be typed as Class I (third molar tooth present in front of the ramus), Class II (ramus have partially embedded teeth) & Class III (fully embedded in the ramus).

Winter's classification of impaction is based on the angle formed by the longitudinal axis of the impacted third molar with the second molar. They are classified as vertical impaction ( $10^{\circ}$  to  $-10^{\circ}$ ), Mesioangular impaction ( $11^{\circ}$  to  $79^{\circ}$ ), Horizontal impaction ( $80^{\circ}$  to  $100^{\circ}$ ), Distoangular impaction ( $-11^{\circ}$  to  $-79^{\circ}$ ), other categories ( $111^{\circ}$  to  $-80^{\circ}$ ), Buccolingual impaction (if in buccolingual direction).

For this study, the proposed null hypothesis was that there exists no difference in the third molar impactions types and the related features (age group, vertical position to the second molar, mandibular canal, and maxillary sinus) in Al Zulfi in comparison to other studies from different locations of the world. The collected data were statistically analyzed using

SPSS version 21(SPSS Inc; Chicago, IL, USA). The prevalence of the third molar impactions and its type, age predilection, and root abnormalities, and its relation to inferior alveolar nerve canal was assessed by percentage and frequency.

### Results:

One thousand six hundred and ninety-five (1695) Orthopantomograms (OPG) of patients ranging in age from 18 to 83 years were evaluated to determine the prevalence of impacted third molars in their population. Among 1695 OPG studied 240 OPGs showed a minimum of one impacted third molar impacted. Among the gen-

der, males (15.6%) showed more impacted teeth prevalence than females (3.1%) (Table 1.A). The impacted mandibular molar prevalence (780, 23%) was more when compared to that of the maxilla (486, 14.3%). The mandible shows more prevalence of mesioangular impaction (50.44%) and in the maxilla, it was vertical impaction (49.39%). The left side of the mandible (23.9%) showed more impaction than the right side (22.1%). But in the maxilla, there is no great difference between the right (14.5%) and left side (14.2%) (Table 1.B).

Table 1

| Gender | Impaction Prevalence |          | Total |
|--------|----------------------|----------|-------|
|        | Maxilla              | Mandible |       |
| Male   | 424                  | 631      | 1055  |
|        | 12.5%                | 18.6%    | 15.6% |
| Female | 62                   | 149      | 211   |
|        | 1.8%                 | 4.4%     | 3.1%  |
| Total  | 486                  | 780      | 1266  |
|        | 14.3%                | 23%      | 18.7% |

|       |       | Distoangular | Horizontal | Mesioangular | Vertical | Buccolingual | Total | Percentage |
|-------|-------|--------------|------------|--------------|----------|--------------|-------|------------|
| UPPER | Right | 83           | 6          | 23           | 120      | 11           | 246   | 14.5       |
|       | Left  | 78           | 9          | 25           | 120      | 8            | 240   | 14.2       |
| LOWER | Right | 17           | 74         | 182          | 101      | 1            | 375   | 22.1       |
|       | Left  | 10           | 80         | 212          | 101      | 2            | 405   | 23.9       |

|       |       | A  | B  | C   | TOTAL |
|-------|-------|----|----|-----|-------|
| UPPER | Right | 15 | 82 | 149 | 246   |
|       | Left  | 15 | 82 | 143 | 240   |

|       |       |     |     |    |     |
|-------|-------|-----|-----|----|-----|
| LOWER | Right | 126 | 184 | 65 | 375 |
|       | Left  | 169 | 174 | 62 | 405 |

Table: 1.D: Prevalence of different classes of impaction in the lower third molar according to Pell &amp; Gregory's Classification

|           | RIGHT     |         | LEFT      |         |
|-----------|-----------|---------|-----------|---------|
|           | Frequency | Percent | Frequency | Percent |
| Class I   | 174       | 42.96   | 158       | 42.02   |
| Class II  | 206       | 50.86   | 193       | 51.33   |
| Class III | 25        | 6.17    | 25        | 6.65    |
| Total     | 405       | 100     | 376       | 100     |

Table: 1.E: Approximation of maxillary sinus in relation to the impacted upper third Molars

| APPROXIMATION TO MAXILLARY SINUS | RIGHT     |         | LEFT      |         |
|----------------------------------|-----------|---------|-----------|---------|
|                                  | Frequency | Percent | Frequency | Percent |
| YES                              | 230       | 67.25   | 223       | 66.77   |
| NO                               | 112       | 32.75   | 111       | 33.23   |
| Total                            | 342       | 100     | 334       | 100     |

There was no significant difference in the status of the molar impaction according to the age of the group (upper left  $P < 0.08$ , lower right  $P < 0.65$ , lower left  $P < 0.36$ ) except the upper right side status of molar

( $P < 0.02$ ) (Table: 2.A, 2.B, 2.C, 2.D) and hence the null hypothesis was rejected as there was a difference in the prevalence of impacted teeth in upper right side impacted teeth.

Table 2

| TYPE OF IMPACTION | Mean age    | SD   | ANOVA                  |         |         |   |                |       |             |   |
|-------------------|-------------|------|------------------------|---------|---------|---|----------------|-------|-------------|---|
|                   |             |      | 95%CONFIDENCE INTERVAL |         |         |   | Sum of Squares | df    | Mean Square | F |
| Lower Bound       | Upper Bound |      |                        |         |         |   |                |       |             |   |
| Distoangular      | 28.1        | 8.9  | 26.1147                | 30.1417 |         |   |                |       |             |   |
| Horizontal        | 32.1        | 10.4 | 24.0452                | 40.177  |         |   |                |       |             |   |
| Mesioangular      | 25.5        | 5.9  | 23.0116                | 27.9484 |         |   |                |       |             |   |
| Vertical          | 25.9        | 7.7  | 24.5282                | 27.3218 | 543.136 | 4 | 135.784        | 2.088 | 0.083       |   |
| Buccoangular      | 25.4        | 6.4  | 19.9581                | 30.7919 |         |   |                |       |             |   |
| Total             | 26.8        | 8.1  | 25.7737                | 27.843  |         |   |                |       |             |   |

|              |      |      |         |         |         |   |        |       |       |  |
|--------------|------|------|---------|---------|---------|---|--------|-------|-------|--|
| Distoangular | 31.5 | 8.80 | 27.0617 | 36.1147 |         |   |        |       |       |  |
| Horizontal   | 28.9 | 7.31 | 27.2513 | 30.6406 | 280.672 | 4 | 70.168 | 1.074 | 0.369 |  |
| Mesioangular | 28.3 | 8.40 | 27.0838 | 29.5425 |         |   |        |       |       |  |

|              |      |      |         |         |  |  |  |  |  |
|--------------|------|------|---------|---------|--|--|--|--|--|
| Vertical     | 27.5 | 7.89 | 25.9563 | 29.0734 |  |  |  |  |  |
| Buccoangular | 26   | .    | .       | .       |  |  |  |  |  |
| Total        | 28.3 | 8.08 | 27.5444 | 29.1863 |  |  |  |  |  |

|              |        |         |         |         |         |   |        |       |       |
|--------------|--------|---------|---------|---------|---------|---|--------|-------|-------|
| Distoangular | 28.9   | 7.35    | 23.63   | 34.161  |         |   |        |       |       |
| Horizontal   | 28.4   | 7.98    | 26.660  | 30.214  |         |   |        |       |       |
| Mesioangular | 28.853 | 7.92873 | 27.7803 | 29.9272 | 171.569 | 4 | 42.892 | 0.608 | 0.657 |
| Vertical     | 27.5   | 9.697   | 25.61   | 29.439  |         |   |        |       |       |
| Buccoangular | 23.5   | 4.94    | 20.971  | 67.971  |         |   |        |       |       |
| Total        | 28.4   | 8.38    | 27.595  | 29.233  |         |   |        |       |       |

|              |      |       |         |         |                |    |             |       |       |
|--------------|------|-------|---------|---------|----------------|----|-------------|-------|-------|
| Distoangular | 29.1 | 8.98  | 27.1587 | 31.0823 | Sum of Squares | df | Mean Square | F     | Sig.  |
| Horizontal   | 27.5 | 7.55  | 19.57   | 35.43   | 866.342        | 5  | 173.268     | 2.699 | 0.022 |
| Mesioangular | 25.3 | 7.31  | 22.1846 | 28.5111 |                |    |             |       |       |
| Vertical     | 25.4 | 7.15  | 24.1646 | 26.752  |                |    |             |       |       |
| Buccoangular | 28   | 9.44  | 21.655  | 34.345  |                |    |             |       |       |
| Total        | 33.6 | 13.05 | 1.2457  | 66.0876 |                |    |             |       |       |

The status of the right side molar influences the status of the left side molar ( $P < 0.00$ ) (Table 3.A, 3.B).

Table 3

|                                   |         | Status of upper right third molar * Status of upper left third molar Cross-tabulation |         |          |        |                    |       |      |      |
|-----------------------------------|---------|---|---------|----------|--------|--------------------|-------|------|------|
|                                   |         | Status of upper left third molar  |         |          |        |                    |       |      |      |
|                                   |         | Missing   | Present | Impacted | Total  | Pearson Chi Square | df    | p    |      |
| Status Of upper right third molar | Missing | Count   | 238     | 103      | 36     | 377                | 9.245 | 4.00 | 0.00 |
|                                   |         | % within Status of upper right third molar  | 63.10%  | 27.30%   | 9.50%  | 100.00%            |       |      |      |
|                                   |         | % within Status of upper left third molar   | 53.70%  | 10.20%   | 15.00% | 22.20%             |       |      |      |
|                                   |         | Present   | Count   | 166      | 855    | 51                 | 1072  |      |      |

|       |          |  |         |         |         |         |  |  |  |
|-------|----------|--|---------|---------|---------|---------|--|--|--|
|       |          | % within Status of upper right third molar | 15.50%  | 79.80%  | 4.80%   | 100.00% |  |  |  |
|       |          | % within Status of upper left third molar  | 37.50%  | 84.50%  | 21.20%  | 63.20%  |  |  |  |
|       | Impacted | Count                                      | 39      | 54      | 153     | 246     |  |  |  |
|       |          | % within Status of upper right third molar | 15.90%  | 22.00%  | 62.20%  | 100.00% |  |  |  |
|       |          | % within Status of upper left third molar  | 8.80%   | 5.30%   | 63.80%  | 14.50%  |  |  |  |
| Total |          | Count                                      | 443     | 1012    | 240     | 1695    |  |  |  |
|       |          | % within Status of upper right third molar | 26.10%  | 59.70%  | 14.20%  | 100.00% |  |  |  |
|       |          |  | 100.00% | 100.00% | 100.00% | 100.00% |  |  |  |

Table:3. B Cross Tabulation with Chi Square test performed to evaluate whether status of lower right-side molar is independent with lower left side molar

| Status of lower left third molar * Status of lower right third molar Crosstabulation |          |  |         |         |          |         |                    |      |      |
|--|----------|--|---------|---------|----------|---------|--------------------|------|------|
|  |          |  | Missing | Present | Impacted | Total   | Pearson Chi-Square | df   | p    |
| Status of lower left third molar   | Missing  | Count                                      | 262     | 109     | 63       | 434     | 1.016E3a           | 4.00 | 0.00 |
|  |          | % within Status of lower left third molar  | 60.40%  | 25.10%  | 14.50%   | 100.00% |                    |      |      |
|  |          | % within Status of lower right third molar | 67.90%  | 12.10%  | 15.60%   | 25.60%  |                    |      |      |
|  | Present  | Count                                      | 88      | 712     | 86       | 886     |                    |      |      |
|  |          | % within Status of lower left third molar  | 9.90%   | 80.40%  | 9.70%    | 100.00% |                    |      |      |
|  |          | % within Status of lower right third molar | 22.80%  | 78.80%  | 21.20%   | 52.30%  |                    |      |      |
|  | Impacted | Count                                      | 36      | 83      | 256      | 375     |                    |      |      |

|       |  |  |         |         |         |         |  |  |  |
|-------|--|--|---------|---------|---------|---------|--|--|--|
|       |  | % within Status of lower left third molar  | 9.60%   | 22.10%  | 68.30%  | 100.00% |  |  |  |
|       |  | % within Status of lower right third molar | 9.30%   | 9.20%   | 63.20%  | 22.10%  |  |  |  |
| Total |  | Count                                      | 386     | 904     | 405     | 1695    |  |  |  |
|       |  | % within Status of lower left third molar  | 22.80%  | 53.30%  | 23.90%  | 100.00% |  |  |  |
|       |  | % within Status of lower right third molar | 100.00% | 100.00% | 100.00% | 100.00% |  |  |  |

The prevalence of impacted third molars according to level of eruption shows that Position B (45.95%) in the mandible and Position C (59.83%) in the maxilla were more common (Table 1.C).

The order of occurrence of the level of impaction A, B, C types was analyzed and was found to be C>B>A in the maxilla, and in mandible, it was B>A>C. The Class II (51.09%) pattern is found to be more common than the other two classes (Table 1.D). The less common type of impaction found in the maxilla were horizontal and buccolingual types, whereas in mandible the less commonly found impaction was the buccolingual type (Table 1.B). More than 66% of maxillary impactions had close approximation to the floor of the maxillary sinus on both sides (Table 1.E). Of the impactions, 187 had some pathology associated with the impacted tooth (Ta-

ble 4) and dental caries were found to more common among all the other pathologies.

#### Discussion:

A large number of patients visit dentists seeking treatment for tooth impaction as it is a more common clinical finding in day-to-day practice. The early detection of the impaction and necessary intervention plays an important role to prevent the various harmful consequences of the impacted teeth. Among the radiographic methods available, OPG is commonly preferred to assess the impacted tooth in detail including their angulations, amount of bone covered, and their depth of impaction within the bone, their association with the adjacent normal anatomic structures like maxillary sinus and the mandibular canal and the presence of pathologies associated with them.

In the AZ-Zulfi Region of Saudi Arabia,

mesioangular impacted mandibular molar and vertically impacted maxillary molar were found to be the most common among all the other angulations (Table 2). This result was similar to the study conducted by Syed KB <sup>6</sup>, Hassan AH <sup>7</sup>, Hashemipour MA et al <sup>4</sup>. A study conducted by Kumar Pillai A <sup>8</sup> showed vertical impaction most common in both maxilla and mandible in contrary to this study which had found that the mesioangular type was more common in mandible whereas the vertical type more common in maxilla signifying the region-specific nature of the type of impacted teeth. The maxillary third molar tooth bud normally develops and erupts in the maxillary tuberosity region in the vertical pattern favoring the vertical type of impaction. If the maxillary growth is inadequate, the maxillary third molar gets impacted against the second upper molar <sup>9</sup>. The proximity of 66% impacted maxillary third molar to the floor of maxillary sinus had suggested taking proper surgical care and precaution on attempting the removal of those teeth.

In the Al-Zulfi Region of Saudi Arabia, the prevalence of the impacted teeth was more in mandible which was similar to the results of the study conducted by Hassan AH<sup>7</sup>, Hashemipour MA et al <sup>4</sup>, Kumar Pillai A<sup>8</sup>, and Kamran Bokhari Syed <sup>6</sup>.

Among our study group, the most com-

mon pathology that was seen in association with the impacted tooth was dental caries (75.94%). This result was like the results of the study by Al-Khateeb TH<sup>10</sup>. The second commonly encountered problem was the close association with the inferior alveolar canal. Injury to the Inferior alveolar nerve during impacted third molar removal had been more prevalent <sup>11, 12</sup>. So, all possible care should be taken to prevent any damage to the nerve in all such cases (8.56%). The other problems encountered are caries involving the pulp with or without periapical pathology and pericoronitis like problems. The study results had rejected the proposed null hypothesis as there was a statistically significant difference in the type of impacted teeth and the associated features like age, vertical position to the second molar, mandibular canal, and maxillary sinus position.

### **Conclusion:**

Until now there is no prevalence study done in the region of Az Zulfi, Riyadh Province in Kingdom of Saudi Arabia regarding the third molar impaction status. Understanding the prevalence of impaction among our population helps in the deeper understanding of the incidence of different types of impaction based on different classifications and their association with the pathologies. Methodical and sys-

tematic evaluation of each case in the right way using the radiograph helps in providing the necessary proper intervention when required on a case-by-case basis in the specific region.

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Original Article :

## Movement sequence analysis of cephalocaudal and hip regions during various phases of selected daily activities

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### Abstract

#### Background:

The previous studies conducted that the contribution of lumbar spine segment and hip motion during functional activities of daily livings, however, it is still unknown whether different spinal segment and hip motion occur in a specific sequence during functional tasks. The current study aimed to identify the movement sequence of cephalocaudal and hip regions while performing several dominant daily activities.

#### Methods:

Twelve male participants (mean age =  $29.6 \pm 4.2$  years; weight =  $73.4 \pm 8.4$  kg; height =  $1.76 \pm 0.08$  meters) recruited in this study. Five Tri-axial accelerometer sensors used to collect data of a novel approach to understand the multi-cephalocaudal regions and hip movement sequences when performing several dominant daily activities.

#### Results:

Regional sequences during flexion and extension tasks at starting phase of movement illustrated (92%) of participants move their head cervical region first as well as object lifting (80%). first. Regional sequences during standing-to-sitting task at starting phase of movement found (70%) of participants move their lumbar region first, while (78%) of participants during sitting-to-standing task moved their hip first

#### Conclusion:

This study indicates variations of movement sequence of cephalocaudal and hip regions at different phase. While the head-cervical region moved first in starting phase of flexion, extension, and lifting task, hip region moved first in the end phase of flexion, extension, and standing-to-sitting task.

#### Keywords:

Words, Spine, Hip, Sequence, Movement, Cephalocaudal, Regions, Daily activities

### الملخص

#### الخلفية:

أجريت الدراسات السابقة على مساهمة الجزء السفلي من العمود الفقري وحركة الورك أثناء الأنشطة الوظيفية للحياة اليومية، ومع ذلك، لا يزال من غير المعروف ما إذا كانت حركة العمود الفقري والورك مختلفة من جانب التسلسل في الحركة أثناء المهام الوظيفية. تهدف الدراسة الحالية إلى تحديد تسلسل حركة مناطق الرأس والعمود الفقري والورك أثناء أداء عدد من الأنشطة اليومية المعتادة.

#### طريقة البحث:

أجريت الدراسة على اثني عشر مشاركًا (متوسط العمر =  $29,6 \pm 4,2$  سنة ؛ الوزن =  $73,4 \pm 8,4$  كجم ؛ الطول =  $1,76 \pm 0,08$  متر)، وفي هذه الدراسة استخدمت تقنية جديدة وهي عبارة عن حساسات تقيس الحركة مع الوقت وهي ثلاثية المحاور التي جمع من خلالها بيانات عدد من مناطق الجسم حددت وعددها خمسة وبنهج جديد يقيس حركة المناطق وإيها تحرك قبل الآخر عند أداء العديد من الأنشطة اليومية.

#### النتائج:

تم توضيح التسلسلات الإقليمية أثناء مهام الانثناء للأمام والثني للخلف في مرحلة بدء الحركة وكان (92٪) من المشاركين يحركون منطقة الرأس والرقبة أولاً وكذلك رفع الأشياء، (80٪) من المشاركين تحرك الرأس والعنق أولاً. أثناء مهمة الجلوس في مرحلة بدء الحركة (70٪) من المشاركين قاموا بتحريك منطقة أسفل الظهر أولاً، بينما قام (78٪) من المشاركين أثناء مهمة الوقوف بتحريك الورك أولاً.

#### الخلاصة:

تشير هذه الدراسة إلى اختلافات في تسلسل الحركة لمناطق الرأس والورك في مراحل مختلفة. بينما تحركت منطقة الرأس - والرقبة أولاً في مرحلة البدء لمهمة الانثناء للأمام، وثني الظهر للخلف، والرفع، وتحركت منطقة الورك أولاً في المرحلة النهائية من الثني للأمام، ثني الظهر للخلف، ومهمة الوقوف إلى الجلوس.

## Introduction:

Evaluations of hip and spine mobility is vital for the assessment of low back pain (LBP)<sup>1</sup>. There are various available methods used for the assessment of spinal and hip mobility. For instance, Modified-Schober Test has been validated to assess lumbar mobility during forward bending of spine<sup>2</sup>. Although this test is simple and easy to use, it is unable to detect different motions occurring at multiple spinal segments and hip. Previous studies identified a specific movement patterns at various spinal segments while performing functional and clinical movement<sup>1,3-6</sup>. Additionally, a relationship between specific movement patterns at different spinal segments and functional activities of daily living (ADLs) is not well established[7]. For example, sit-to-stand is a common functional activity that involve a specific movement patterns at hip and spine. Therefore, accurate knowledge of physiological movement of each spinal segment and hip region and the behavior of each regional movement is important.

Various functional tasks including lifting, sit-to-stand, flexion, and extension have been associated with LBP and spinal injury<sup>8,9</sup>. Spine and hip motions are connected during many daily tasks<sup>10,11</sup>, indicating that any limitation in spine or hip motion

will affect the performance of functional ADLs. In particular, sit-to-stand activities are commonest tasks performed daily by working people<sup>12</sup>. Previous studies have reported the quantitative relationship between the lumbar spine and hip motion during daily tasks<sup>13-16</sup>. However, they have considered lumbar spine as a single unit in their measurement. Consequently, other clinicians evaluated the contribution of multisegmented lumbar motion in patient population<sup>17,18</sup> and healthy adults<sup>19,20</sup>.

Although previous studies reported the contribution of lumbar spine segment and hip motion during functional ADLs, it is still unknown whether different spinal segment and hip motion occur in a specific sequence during functional tasks. Therefore, the current study aimed to identify the movement sequence of cephalocaudal and hip regions during several dominant daily activities including flexion, extension, lifting, and standing-to-sitting tasks.

## Methods:

### *Participants*

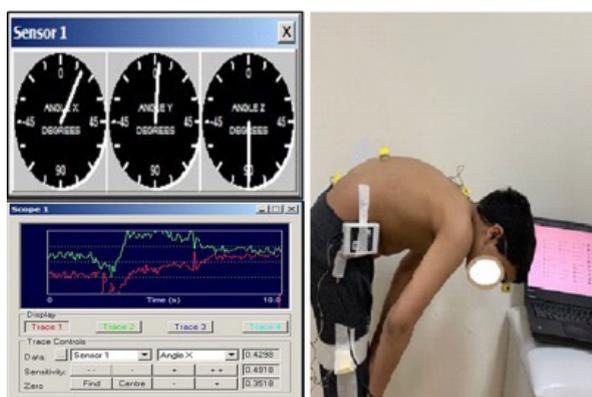
Twelve male participants (mean age = 29.6 ± 4.2 years; weight = 73.4 ± 8.4 kg; height = 1.76 ± 0.08 meters) were recruited. No participant had any history of cervical, thoracic, lumbar pain or not complain of radiated pain to the upper or lower extremities within the last one year. The Ethics

Committee of Najran University approved this study. All participants asked to complete a written informed consent form.

### *Instrumentation*

Five Tri-axial accelerometer sensors used as described in the published study[3] to collect data of a novel approach to understand the multi-cephalocaudal regions and hip movement sequences when performing a number of dominant daily activities.

Figure 1: The dial display for sensor 1 and a "Scope" display showing two data traces on LT and schematic represents the location of three sensors on forehead and spinous processes of T1, T12, and S1 and on the lateral aspect of the thigh midway between the lateral epicondyle and greater trochanter on the iliotibial band (ITB) on RT.



### *Procedures*

When participants attended the laboratory at Physiotherapy Clinic, Applied Medical Science, Collage, Najran University, they returned a signed consent form, which had been provided earlier. The participant should move to a private area to change their clothes and wear shorts. Each participant was instructed to perform forward, backward, rotations, and lateral flexions of head cervical and spine several times be-

fore placing the sensors on the body. The participants were asked to lean forward on the table (waist level) to determine the specific spinous processes. Five sensors were attached using double-sided adhesive tape on different parts of the body (e.g., forehead, spinous processes of first thoracic vertebra (T1), twelfth thoracic vertebra (T12), first sacral vertebra (S1), and middle point at lateral aspect of thigh). Four different anatomical regions of interest were created including Head-cervical (HC), Thoracic (T), Lumbar (L), and Hip (H) to quantify regional movement.

### *Data analysis*

The data was analyzed using SPSS. Regional spinal movement time curves were generated and the values of HC, T, L, and Hip at the beginning, peak, and end movement were calculated. Descriptive statistics were reported. The percentage of participants who performed the task in a specific sequence were calculated: Percentage (%) = (number of participants who achieve task's phase/12 (Total number of subjects)) × 100.

## **RESULTS**

Table1: The movement sequence of cephalocaudal and hip regions during various phases of selected daily activities

| Regional movements   | Subjects' percentage at start of flexion task (%)             | Sequences | Subjects' percentage at peak of flexion task (%)             | Sequences | Subjects' percentage at end of flexion task (%)             | Sequences |
|----------------------|---|-----------|--|-----------|---|-----------|
| Head-cervical region | 92  | 1         | 60   | 1         | 55  | 3         |
| Thoracic region      | 70  | 2         | 60   | 1         | 62  | 2         |
| Lumbar region        | 70  | 2         | 52   | 2         | 72  | 1         |
| Hip region           | 62  | 3         | 52   | 2         | 72  | 1         |
|                      | Subjects' percentage at start of extension task (%)           | Sequences | Subjects' percentage at peak of extension task (%)           | Sequences | Subjects' percentage at end of extension task (%)           | Sequences |
| Head-cervical region | 92  | 1         | 62   | 2         | 45  | 4         |
| Thoracic region      | 60  | 3         | 62   | 2         | 62  | 2         |
| Lumbar region        | 72  | 2         | 75   | 1         | 53  | 3         |
| Hip region           | 60  | 3         | 75   | 1         | 70  | 1         |
|                      | Subjects' percentage at start of object lifting task (%)      | Sequences | Subjects' percentage at peak of object lifting task (%)      | Sequences | Subjects' percentage at end of object lifting task (%)      | Sequences |
| Head-cervical region | 80  | 1         | 60   | 2         | 70  | 1         |
| Thoracic region      | 60  | 2         | 60   | 2         | 70  | 1         |
| Lumbar region        | 50  | 3         | 70   | 1         | 60  | 2         |
| Hip region           | 60  | 2         | 60   | 2         | 60  | 2         |
|                      |   | Sequences |  | Sequences |   | Sequences |
|                      | Subjects' percentage at start of standing-to-sitting task (%) | Sequences | Subjects' percentage at peak of standing to-sitting task (%) | Sequences | Subjects' percentage at end of standing-to-sitting task (%) | Sequences |
| Head-cervical region | 64  | 2         | 60   | 1         | 50  | 2         |
| Thoracic region      | 64  | 2         | 60   | 1         | 60  | 1         |
| Lumbar region        | 70  | 1         | 60   | 1         | 50  | 2         |
| Hip region           | 64  | 2         | 60   | 1         | 60  | 1         |

|                      | Subjects' percentage at start of sitting-to standing task (%) | Sequences | Subjects' percentage at peak of sitting-to standing task (%) | Sequences | Subjects' percentage at end of sitting-to standing task (%) | Sequences |
|----------------------|---|-----------|--|-----------|---|-----------|
| Head-cervical region | 54  | 3         | 70   | 3         | 90  | 1         |
| Thoracic region      | 54  | 3         | 70   | 3         | 67  | 2         |
| Lumbar region        | 65  | 2         | 80   | 2         | 67  | 2         |
| Hip region           | 78  | 1         | 88   | 1         | 67  | 2         |

%= (number of subjects who achieve task's phase/12 (Total number of subjects)) ×100

1= Segment which move firstly, 2= Segment which move secondly, 3= Segment which move thirdly 4= the last segment which move

Table 1 details the results. During flexion task, while the regional sequences at starting phase showed that the most of the participants moved head cervical region (92%) first followed by thoracic and lumbar (70%) together, and hip (62%) regions, the hip and lumbar regions (70% each) moved at the same time followed by

thoracic (62%), and head-cervical (55%) regions at the end phase ((Figure 2, Figure 4). Whereas, the regional sequences at peak phase showed head-cervical and thoracic regions (60%) moved at the same time, followed by lumbar and hip regions (52%), those moved at the same time ((Figure 3).

Figure 2: The movement sequence of cephalocaudal and hip regions by percentage at start of flexion,

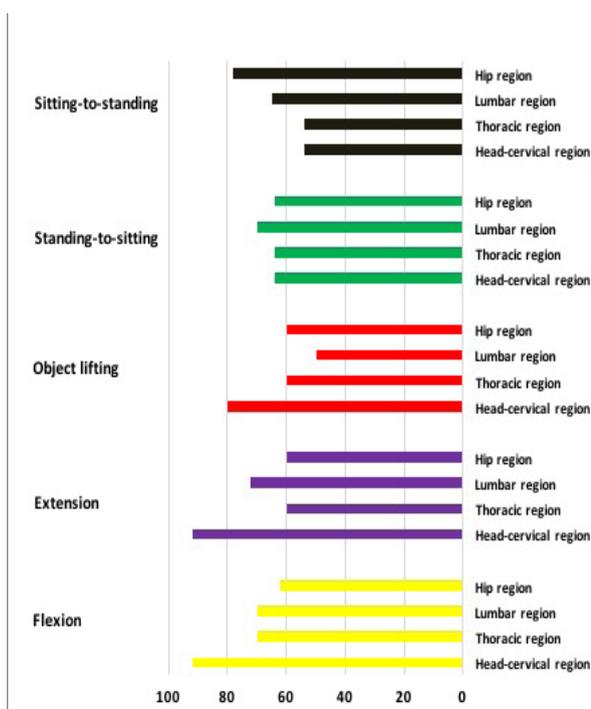


Figure 3: The movement sequence of cephalocaudal and hip regions by percentage at peak of flexion, extension, object lifting, standing to sitting and sitting to standing tasks

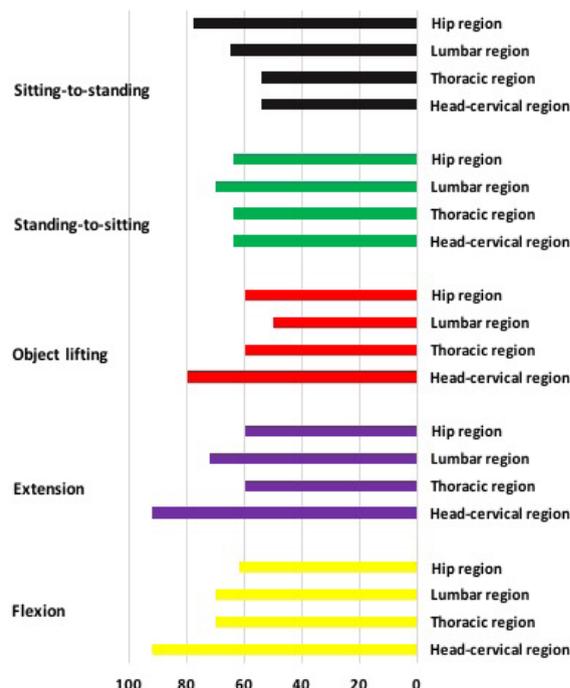
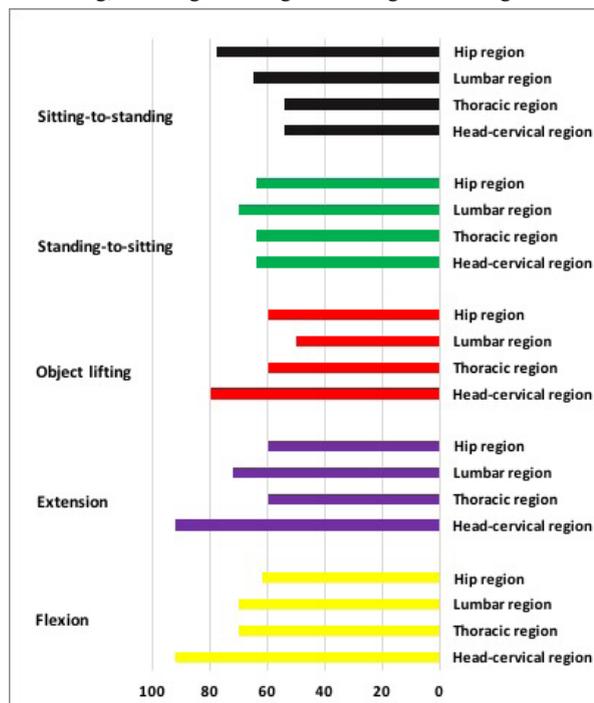


Figure 4: The movement sequence of cephalocaudal and hip regions by percentage at end of flexion, extension, object lifting, standing to sitting and sitting to standing tasks



## Discussion

This study aimed to identify the movement sequence of cephalocaudal and hip regions during several dominant daily activities including flexion, extension, lifting, standing-to-sitting and sitting-to-standing tasks. The results of the current study identify distinguished temporal changes in the movement sequence of cephalocaudal and hip regions during several dominant daily activities. For instance, head-cervical region moved first at the starting phase of flexion, extension, and lifting task. Whereas, the lumbar and hip regions moved first at the starting phase of standing-to-sitting and sitting-to-standing task, respectively. However, in the peak phase, head-cervi-

cal and thoracic regions moved first during flexion task, while lumbar and hip regions moved first during extension task. While lumbar and hip regions moved first at the peak phase of lifting task and sitting-to-standing task, respectively, all the regions moved together at the peak phase of standing-to-sitting- task. In contrast, in the end phase of flexion and extension, hip and lumbar regions and hip region moved first, respectively. Whereas, head-cervical and thoracic regions and hip and thoracic regions moved first in the end phase of lifting and standing-to-sitting task, respectively. The head-cervical region moved first in the end phase of sitting-to-standing task.

Although previous studies were more focused on the assessment of range of motion, LBP may be associated with impaired movement sequence at cephalocaudal and hip regions<sup>21,22</sup>. There were conflicting studies indicating the pattern and contribution of spine and hip motion between healthy adults and LBP patients. For instance, in healthy adults, lumbar spine dominates the movement in initial phase while hip motion dominates peak and terminal phase during spinal flexion motion<sup>13,23,24</sup>. Similarly, in the current study, the head-cervical region dominates the starting phase, while head-cervical and thoracic regions equally dominate the peak phase and hip and lum-

bar region dominates the end phase of spinal flexion. Previous studies also reported greater contribution of spine in the early phase of flexion task while hip region contributed more than spine at the terminal phase of flexion task<sup>13,14</sup>.

However, there are some methodological differences exist in the previous studies in the measurement of movement sequence. While previous studies limited to lumbar and hip motions, the current study included movement sequence of cervical, thoracic, lumbar, and hip regions. In addition, the current study used several dominant daily activities such as flexion, extension, lifting, and standing-to-sitting and sitting-to-standing tasks to measure movement sequence of cephalocaudal and hip regions. No previous studies have investigated the movement sequence of cephalocaudal and hip regions during these tasks.

### **Limitation**

The current study has potential limitations. First, the sample size was small, including only 12 subjects. Second, since all participants were male, the results cannot be generalized to female population. Third, other factors such as spine length, leg length, and pelvic angulation might affect the pattern of movement sequence during these tasks. Furthermore, the study participants were all healthy university staffs and students,

therefore, the sample population may not be truly representative of all groups of young males.

### **Conclusion**

This study indicates variations of movement sequence of cephalocaudal and hip regions at different phases of dominant daily activities. While the head-cervical region moved first in the starting phase of flexion, extension, and lifting task; the hip region moved first in the end phase of flexion, extension, and standing-to-sitting task. Such findings will add new information for clinicians and physiotherapist during spinal assessment.

### **Acknowledgement**

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Original Article :

## Nurses' knowledge about the discharge plan for patients after cardiac surgery at the Sudan Heart Institute

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### Abstract

#### Background & Aims:

Discharged patients from the hospital to home after cardiac surgery require planning, guidance, and recommendations from health care providers that the patient must follow to avoid expected complications. The current study aimed to assess nurses' knowledge about the discharge plan for patients after cardiac surgery at the Sudan Heart Institute.

#### Methods:

This is a descriptive cross-sectional study enrolled 85 nurses and was conducted at the Sudan Heart Institute from January to May 2019. Data were collected using a structured self-designed questionnaire containing different aspects of the discharge plan to assess nurses' knowledge using multiple-choice questions.

#### Results:

The results of this study showed that 70% of the study population were females from 26–30 years old, 83% of the participants were single, and most nurses had a Bachelor's degree (75%). There was a significant difference between the participants' experience and the nurses' knowledge level about the discharge plan ( $p=0.01$ ). Overall, the nurses' knowledge about the discharge plan was good at 78%.

#### Conclusion:

This study showed the participants had good knowledge of the discharge plan programs for patients after cardiac surgery.

#### Keywords:

nurses, knowledge, discharge plan, cardiac surgery

### المخلص

#### الخلفية والاهداف:

خطة الخروج هو عملية يتم فيها تحديد احتياجات المرضى ، وخطة يتم تشكيلها لنقل المريض من مكان إلى آخر. تهدف الدراسة الحالية إلى تقييم معرفة الممرضين حول خطة الخروج من المستشفى بعد جراحة القلب المفتوح في مستشفى جراحة القلب، السودان

#### طريقة البحث:

أجريت هذه الدراسة الوصفية المستندة إلى المستشفى ، وتم جمع البيانات عن طريق الاستبيانات. وتم تحليلها باستخدام الحزمة الإحصائية للعلوم الاجتماعية (الإصدار ٢٣) ، تم استخدام (اختبار-ت) في اختبارات الدلالة عند مستوى (٠.٠٥) . تم العر بواسطة الجداول، صمم الباحث الاستبيان ليشمل (٢٣) سؤالاً موزعة في قسمين رئيسيين ، وزعت على (٨٥) من الممرضين يعملون في مستشفى جراحة القلب عبر تقنية أخذ العينات العشوائية.

#### النتائج:

أظهرت نتائج هذه الدراسة المعرفة العامة للممرضات على خطط الخروج من المرضى بعد جراحة القلب المفتوح تظهر إحصائيات مهمة (قيمة ب = ٠.٥) . الذين شاركوا في الدراسة كان لديهم معرفة كافية ببرامج خطة الخروج ، تكشف الدراسة الحالية أن أكثر من نصف عينة الدراسة (٧٠٪) كانت من الإناث ، ومتوسط عمر المشاركين بين (٢٠ - ٢٥) ، أظهرت الدراسة أيضا أن الغالبية عدد الممرضين الحاصلات على البكالوريوس (٧٥٪)

#### الخلاصة:

أظهرت نتائج الدراسة الحالية أن الممرضين الذين شاركوا في الدراسة لديهم معرفة كافية ببرامج خطة الخروج للمرضى بعد جراحة القلب المفتوح.

#### الكلمات المفتاحية:

معرفة، الممرضين، خطة الخروج

## Introduction

Open heart surgery is required to treat congenital or acquired heart diseases. Heart surgery is performed to treat coronary artery blockage. Valve repair or replacement is performed in patients with the valvular disorders, and other types of cardiac surgery correct cardiac diseases<sup>1</sup>. Cardiac surgery is a significant event in a patient's life. For revascularization surgery, patients have the chance for a successful surgery, but they also have fears about discomfort and surgical pain and concerns about fatigue and sleep disorders, loss of appetite, return to normal life and activities post-surgery, drug addiction, cardiac monitoring, duration of hospital stay, and hospitalization costs<sup>2</sup>.

Discharge planning is a key element in patient care. It involves outlining the routine and health needs that should be expected upon exit from the facility, which is a link between functioning in the community and hospitalization<sup>3</sup>. Ideally, discharge planning occurs when patients are admitted for cardiac surgery. Discharge instructions after cardiac surgery include instructions about taking medications, activity restrictions, healthy diet and nutrition, wound care (including bandages, if appropriate, suture removal, bathing), and follow-up appointments (cardiologist, pri-

mary health care provider)<sup>4</sup>. This planning helps patients to communicate with health care professionals and primary care providers about the best way to manage their chronic needs after leaving the hospital<sup>5</sup>. The discharge instructions for cardiac surgery patients include monitoring for signs of swelling, checking the sleeping conditions, and observing the patient's appetite. The discharge instructions also educate the patient and urge them to pay attention to the following points: patients' activities post-cardiac surgery, nutrition, complication post-cardiac surgery, methods of preventing infection, and outpatient follow-up<sup>6</sup>. Discharge planning is determined as a part of all patients' management. All patients should be referred to their cardiologist with an appointment about 1 month after surgery. They should return to see the primary surgeon within 1 week. Patients should be instructed on wound care, which includes daily bathing with antibacterial soap and water. Application of ointments, salves, or lotions is to be avoided. Patients should walk as much as tolerated, and they can go up and down steps as tolerated<sup>7</sup>. Educating the patient and family is the responsibility of the nursing staff, and it is an important aspect of patient preparation for discharge that should take place during the hospital stay rather than waiting until the patient is being discharged. Every day,

patients must be educated about drugs, including pain medication, predictions about activity levels, diet, sternal precautions, care of incisions, signs, and symptoms of infection. Patients should be involved in their care as much as possible. Families should participate when possible, particularly family members who will take care of patient at home<sup>8</sup>.

## Methods

### *Study design*

This is a descriptive cross-sectional study. It was conducted to assess nurses' knowledge about discharge plans for patients after cardiac surgery at the Sudan Heart Institute in Khartoum state from January to May 2019.

### *Study area*

The study was performed at the Sudan Heart Institute in Khartoum State. This hospital provides outpatient and inpatient services for people living in this area, and it is open all the day and receives patients from different settings in Sudan.

### *Study population*

The study population is nurses work at Sudan Heart Institute Hospital. The sample of registered nurses for this study was randomly selected from lists of the nurses based on the inclusion and exclusion criteria.

### *Inclusion criteria*

The inclusion criteria were as follows: nurses from different surgical sections in the hospital (included nurses working in the operating room, cardiac catheters, and intensive care unit); and male or female staff nurses who were 20 years to 40 years of age with at least 1 year of job experience.

### *Exclusion criteria*

The exclusion criteria were as follows: head nurses, student nurses, or staff nurses who were less than 20 years or over 40 years of age with less than 1 year of experience.

### *Sample size and sampling technique*

Random sampling was used in this study, and the sample size was calculated according to the following equation:  $n = N/1+N(d^2)$

where  $n$  = sample size,  $N$  = population size,  $d$  = degree of accuracy desired (the accepted margin of error was 0.05).

$$n = 120/1+120(0.05)^2 = 120/1.3 = 92$$

Thus, the sample size should be 92 nurses, but there were 85 nurses who completed the questionnaire.

### *Methods of data collection*

A self-administered questionnaire was used for data collection. The questionnaire was designed according to [9], which assessed nurses' attitudes towards patient perceptions of hospital discharge, to deter-

mine their level of knowledge. The questionnaire was also shared with two professors who specialized in nursing from Al Baha University and Taibah University in Saudi Arabia to express their opinion on the content. A pilot study was conducted, and it was performed with 15 nurses at the Sudan Heart Institute hospital. The participants provided their opinions about the results of the pilot study using a questionnaire, and the final questionnaire was prepared by the author. Participants in the pilot study were excluded from the main study. The first part of the questionnaire included the participant's demographic characteristics and the second part included 16 questions about their knowledge of the discharge plan.

#### *Score grading*

A common grading method was used for each variable in the questionnaire, as follows: one point for the correct option, and zero points for the incorrect answer in the knowledge section. The scoring range for the questionnaire was 0 to 16 (lowest to highest score). For knowledge about the

discharge plan, a score of < 8 was considered to be poor, 8–12 was considered to be average, and 13–16 was considered to be adequate. The total nurses' knowledge scores about the discharge plan were calculated.

#### **Statistical analysis**

The data were analyzed using the Statistical Package for Social Sciences (SPSS, version 21). Descriptive statistics were used, and the data were presented as the frequencies and percentages. Data were analyzed using the Chi-square test, and presented by cross-tabulation.  $P < 0.05$  was considered to be statistically significant.

#### *Ethics approval statement*

The study was approved by the Sudan Heart Institute in Khartoum, Sudan. Participants who were willing to participate received a letter explaining the purpose and outcome of the study, and they were assured that their participation was voluntary.

#### **Results**

Table1. Shows the demographic character-

Table 1: Interpretation of score according to the knowledge level (maximum score = 16)

|   | Knowledge level | Score | Range (%) |
|---|-----------------|-------|-----------|
| 1 | Excellent       | 14–16 | 82–100    |
| 2 | Good            | 11–13 | 64–81     |
| 3 | Average         | 8–10  | 45–63     |
| 4 | Below average   | 4–7   | 20–44     |
| 5 | Poor            | 0–3   | 0–19      |

Table 2: Distribution of socio-demographic characteristics (N = 85)

|   |                    | Frequency (n) | Percentage (%) |
|---|--------------------|---------------|----------------|
| Gender                                    | Male               | 25            | 30             |
|   | Female             | 60            | 70             |
| Age category                              | 20–25 years        | 13            | 15             |
|   | 26–30 years        | 62            | 73             |
|   | 30 years and over  | 10            | 12             |
| Marital status                            | Single             | 70            | 83             |
|   | Married            | 13            | 15             |
|   | Divorce            | 2             | 2              |
| Qualification                             | PhD                | 0             | 0              |
|   | BSc                | 64            | 75             |
|   | Diploma            | 21            | 25             |
| Experience in the cardiac surgery section | Less than 5 years  | 55            | 65             |
|   | 5–10 years         | 20            | 23             |
|   | More than 10 years | 10            | 12             |
| Training course                           | Yes                | 53            | 62             |
|   | No                 | 32            | 38             |

istics of the participants. Most of the subjects (73%) were 26–30 years old. The majority of subjects (70%) were female, most of participants regarding qualification are

They had a Bachelor's degree (75%). Regarding marital status most of the subjects were single (83%)

Table 3: Distribution of correct and incorrect answers by nurses regarding knowledge about the discharge plan, Sudan Heart Institute hospital (N = 85)

|  | Correct<br>N % | Incorrect<br>N % |
|--|----------------|------------------|
| Nurses' knowledge regarding a patient's activities post-cardiac surgery      | 75 (88)        | 10 (12)          |
| Nurses' knowledge regarding nutrition  | 59 (69)        | 26 (31)          |
| Nurses' knowledge regarding indications for cardiac surgery                  | 52 (61)        | 33 (39)          |
| Nurses' knowledge regarding different types of cardiac surgery               | 66 (78)        | 19 (22)          |
| Nurses' knowledge regarding important complications post-cardiac surgery     | 65 (77)        | 20 (23)          |
| Nurses' knowledge regarding the methods of preventing infection              | 75 (88)        | 10 (12)          |
| Nurses' knowledge regarding outpatient follow-up                             | 77 (91)        | 8 (9)            |
| Nurses' knowledge regarding the importance of exercise after cardiac surgery | 59 (69)        | 26 (31)          |
| Total nurses' knowledge about the discharge plan                             | 66 (78)        | 19 (22)          |

Table 3. illustrates the nurses' knowledge of discharge plan. 88% know about knowledge regarding a patient's activities post-cardiac surgery. The participants of the study were asked about knowledge regarding nutrition for which 69% of the participants their correct answers. The majority of the nurses has a good knowledge of

knowledge regarding outpatient follow-up 91% their correct answers.

Table 4: Association between demographic characteristics and nurses' knowledge level about the discharge plan, cross-tabulation (N = 85)

|                    | Knowledge level |      |         |               |      | Total | Chi-Square         | P value |
|--------------------|-----------------|------|---------|---------------|------|-------|--------------------|---------|
|                    | Excellent       | Good | Average | Below Average | Poor |       |                    |         |
| Gender             |                 |      |         |               |      |       |                    |         |
| Male               | 3               | 6    | 6       | 3             | 7    | 25    | 03.08 <sup>a</sup> | 0.55    |
| Female             | 6               | 24   | 10      | 3             | 17   | 60    |                    |         |
| Total              | 9               | 30   | 16      | 6             | 24   | 85    |                    |         |
| Age category       |                 |      |         |               |      |       |                    |         |
| 20–25 years        | 1               | 4    | 3       | 1             | 4    | 13    | 13.25 <sup>a</sup> | 0.10    |
| 26–30 years        | 7               | 33   | 10      | 3             | 9    | 62    |                    |         |
| 30 years and over  | 0               | 2    | 1       | 2             | 5    | 10    |                    |         |
| Total              | 8               | 39   | 14      | 6             | 18   | 85    |                    |         |
| Qualification      |                 |      |         |               |      |       |                    |         |
| PhD                | 0               | 0    | 0       | 0             | 0    | 0     | 08.16 <sup>a</sup> | 0.09    |
| BSc                | 5               | 34   | 11      | 3             | 11   | 64    |                    |         |
| Diploma            | 2               | 5    | 3       | 2             | 9    | 21    |                    |         |
| Total              | 7               | 39   | 14      | 5             | 20   | 85    |                    |         |
| Experience         |                 |      |         |               |      |       |                    |         |
| Less than 5 years  | 1               | 7    | 4       | 7             | 36   | 55    | 23.10 <sup>a</sup> | 0.01    |
| 5–10 years         | 3               | 7    | 5       | 1             | 4    | 20    |                    |         |
| More than 10 years | 1               | 3    | 3       | 1             | 2    | 10    |                    |         |
| Total              | 5               | 17   | 12      | 9             | 42   | 85    |                    |         |
| Training course    |                 |      |         |               |      |       |                    |         |
| Yes                | 2               | 26   | 20      | 1             | 4    | 52    | 06.83 <sup>a</sup> | 0.15    |
| No                 | 4               | 15   | 6       | 2             | 5    | 32    |                    |         |
| Total              | 6               | 41   | 26      | 3             | 9    | 85    |                    |         |

Table 4. showed the statistical Differences between Nurses Knowledge and their socio-demographic characteristics. The results of study showed there was high significant relationship between nurses level of knowledge and level of experience of nurses at  $P = P \leq 0.05$  level.

### Discussion

In the current study, the socio-demographic characteristics indicated that most of the

participants were female (70%). This result was consistent with another study that found that 81% of the participants were female [10]. In our study, participants were mostly 26–30 years of age (73% of participants), which was consistent with another study that found that the largest age group in the study sample was less than 30 years of age <sup>11</sup>.

For marital status, 83% of participants

were single. This result varies compared with another study which found that most of the nurses were married <sup>12</sup>.

Regarding the nurses' qualification level, more than half (75%) of the nurses in the sample had a Bachelor's degree. This finding is consistent with another study that found that most nurses in their study held a Bachelor's degree <sup>13</sup>.

For the nurses' experience in the cardiac surgical unit, we found that 65% of the nurses had less than 5 years of experience. This result was consistent with a study that found that the performance of newer graduates was more effective than that of others with more experience <sup>14</sup>.

We found that 62% of the participants attended training courses. This result agrees with the results of another study that found that most of the nurses (88%) had attended a training course about the discharge plan<sup>15</sup>.

For the nurses' knowledge about the methods of preventing infection, the results showed that 88% of the study sample knew about infection control. This result was consistent with another study that found that most of the nurses were knowledgeable about infection control methods <sup>16</sup>.

We found that 91% of nurses had knowledge about the importance of outpatient follow-up after discharge. This result was different from that of another study that

was conducted at an Iraqi center hospital, which showed that only a small proportion of nurses (36%) had this knowledge <sup>17</sup>.

Nurses' knowledge about routine activity post-cardiac surgery was shown to be 88%. This finding in the present study was consistent with evidence from another study that showed that the level of this knowledge level was high <sup>17</sup>.

Nurses' knowledge regarding nutrition was 69%. This result was supported by a study that was conducted at an Iraqi hospital, which found that the nurses had good knowledge of the nutrition system after discharge from the hospital <sup>17</sup>.

Information that was given to the patients before discharge included signs and symptoms of complications and nutrition. The results showed that the participants had knowledge about these areas (69%, 77%, and 69% respectively). This result agrees with a study that found that nurses' knowledge about providing discharge information for the patient following cardiac surgery, including information on the discharge plan, was good <sup>18</sup>.

There were no differences between demographic characteristics and the knowledge level of nurses about the discharge plan in the current study for gender, age category, qualification, and training courses. These results are consistent with other studies that also did not show a significant differ-

ence between the nurses' age or gender and their practices <sup>19, 20</sup>.

#### Study limitations and strength

The limitations of the study are the small sample size. The strength of this study is that it is the first study in Sudan on the discharge plan for a patient's post-cardiac surgery. The study was widely accepted and the study participants' responses were good.

#### Conclusions

The results of this study showed that most of the participants had 5 years of experience in the cardiac surgical section. The only domain that had an average rate of correct answers of 61% was the nurse's knowledge regarding indications for cardiac surgery. The study participants had good knowledge of all sections and aspects of the discharge plan for patients who underwent cardiac surgery.

The study recommends holding courses and educational sessions for nurses who are working in cardiac surgery to increase their knowledge, and educational leaflets should be provided to the patients after cardiac surgery. A special unit that is responsible for the patient's discharge plan and providing adequate information and knowledge should be created.

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Original Article :

## Prevalence of common work-related musculoskeletal disorders among population of Najran University, Saudi Arabia

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### Abstract

#### Background:

Work related musculoskeletal disorders are the most common occupational problems, which mostly affect the neck, upper and lower back. The objective of this study was to identify the musculoskeletal disorders among the employees of Najran University, KSA.

#### Methods:

This cross-sectional study was conducted among the two sixty nine employees of Najran University during the period of January 2019 to September 2019. Data were collected by using a self-administered questionnaire and a standardized Nordic questionnaire.

#### Results:

269 employees of Najran University participated in this study; the mean age of participants was  $39.35 \pm 7.2$ . Most of participants 56.1% were overweight. The mean value of working experience was  $6.8 \pm 3.0$ , mean value of pain in off days past three year was  $2.06 \pm 8.7$ . Working hour was counted with mean value  $7.13 \pm 1.80$ . Mean value of walking activity was  $33.45 \pm 32.07$  and exercise was  $10.07 \pm 21.4$ . Mean value of daily uses of computer was  $5.01 \pm 2.2$  and cellphone was  $4.65 \pm 3.0$ , Upper and lower extremity multiple problem was found significant with qualification of participants.

#### Conclusion:

Most of the participants have musculoskeletal pain/discomfort. The most affected region identified was low back and participants reported pain in this region. Few participants complained of neck pain. However, the other regions such as shoulder, wrist/ forearm, upper back, knee and ankle were found to be minimally affected. Association was found in personal and working place characteristics in different region of pain.

### المخلص

#### الخلفية:

الاضطرابات العضلية الهيكلية المرتبطة بالعمل هي أكثر المشاكل المهنية شيوعاً، والتي تؤثر في الغالب على الرقبة وأعلى الظهر وأسفل الظهر. الهدف من هذه الدراسة هو التعرف على آلام / اضطرابات العضلات والعظام بين العاملين في جامعة نجران بالمملكة العربية السعودية

#### طريقة البحث:

أجريت هذه الدراسة المسحية بين اثنين وستون من موظفي جامعة نجران خلال الفترة من يناير 2019 إلى سبتمبر 2019. تم جمع جميع البيانات باستخدام استبيان النوردك الذي يستخدم لمعرفة أعراض الاضطرابات العضلية الهيكلية

#### النتائج:

كان متوسط عمر المشاركين 39,3 عاماً، الانحراف المعياري 7,3، مؤشر كتلة الجسم للمشاركين 26,8% أقل من الوزن الطبيعي، 56,1% من المشاركين يعانون من زيادة الوزن، 16,4% يعانون من السمنة المفرطة. من بين اثنين وستين مشاركاً يعانون من اضطرابات مختلفة مثل آلام أسفل الظهر 32,3%، آلام الرقبة 13%، آلام مفصل الركبة 8,2%، آلام الكتف 7,8%، مشاكل متعددة في الأطراف العلوية 7,1%، مشاكل متعددة في الأطراف السفلية 5,6%، آلام الظهر العلوية 3,7%، آلام الاقدام 1,9%، آلام المعصم 0,7%، ألم مفصل الكاحل 0,7%، ألم اليد 0,4%.

#### الخلاصة:

استنتج من الدراسة أن غالبية المشاركين وجد أنهم يعانون من زيادة في الوزن، ولهذا السبب وجد أنهم يعانون من آلام العضلات والعظام. وكانت المنطقة الأكثر تضرراً التي تم تحديدها هي منطقة أسفل الظهر. عدد قليل من المشاركين اشتكوا أيضاً من آلام الرقبة، ومع

**Key words:**

Work related musculoskeletal disorders, chronic pain, occupational problem

ذلك، تم العثور على مناطق أخرى من الجسم مثل الكتف والمعصم والساعد وأعلى الظهر والركبة والكاحل حيث كانت متأثرة بشكل طفيف.

**Introduction**

Work-related musculoskeletal disorder is defined as damage to the musculoskeletal system resulting from work-related events, and it is one of the most general causes of chronic pain and physical disorders occurring among modern workers. Health systems are immensely affected because of work-related musculoskeletal disorders among the working population <sup>1</sup>. About 2/3 of the working time of these population remain in a sitting posture, and their sitting sessions typically lasts at least 30 minutes <sup>2, 3</sup>.

Inactive behavior has been well-defined as when a person uses their energy expenditure while in a reclining or sitting posture of  $\leq 1.5$  METs while in a sitting or reclining posture<sup>4</sup>. In office workplaces increase the risk of type 2 diabetes, cardio-metabolic disease obesity, musculoskeletal disorders, coronary artery disease, different kinds of cancer, and early death. <sup>5-7</sup> Musculoskeletal discomfort or pain is a huge burden nowadays and mostly population are facing the difficulties in their jobs or tasks of daily routine.

The purpose of this study was to identify the prevalence of common work-related

musculoskeletal disorders among population of Najran University

**Methods**

This cross-sectional study was conducted among the employees of Najran University to assess musculoskeletal disorders. A Standardized Nordic questionnaire and self-administered questionnaires were distributed among the employees of Najran University.

Self-administered questionnaire had 15 questions to ask about the personal data of the participants such as height, weight (BMI), qualification, experience, working hours, about walk, heavy exercises, about diabetes and hypertension or any other health problems, use of computers and cell phones.

Standardized Nordic questionnaires, which is very authentic and common questionnaire about the symptoms of WMSD's. This questionnaire covered the areas of body causing WMSD's: neck, shoulder, elbow, wrist/forearm, hand, upper back, lower back, hips, knees, ankle, and foot. This questionnaire contains 5 questions in each section and last question of each section has further three separate parts about the degree of pain or discomfort interfered

with your work, your life outside of work, your sleep, and how many days in the past years did participants stop the activities.

All participants were male. The participants of this study were working in different sections of Najran University, like administration, dentistry, pharmacy, physiotherapy, nursing, computer, Engineering, English department, accounts, sharia, and medicine. The teaching staff and employees who work in the offices Najran University were included.

The employees of Najran University, who don't work in the offices like security guards and cleaners, were excluded. All participants read the information sheet and signed the consents form. Statistical analysis was performed with the SPSS (version-24), Descriptive summary statistics including mean, frequencies, and percentages. The Ethics committee of Najran University granted the ethics approval and all data will be kept confidential.

## Results

300 questionnaires were randomly distributed among the population of Najran University, 269(89.6%) participants responded to the questionnaire. Table -1 shows the descriptive statistics of participants in which Mean age of participants was  $39.35 \pm 7.2$ . Most of participants 56.1% were overweight and 93.3% have not any

diabetic/hypertensive problem but 16.4% were found obese.

Table 1: Personal Characteristics

| Personal Characteristics n=269 | Mean±std      |
|--------------------------------|---------------|
| Age of participants            | 39.35±7.2     |
| BMI                            | Frequency (%) |
| Underweight                    | 2(0.7)        |
| Healthy weight                 | 72(26.8)      |
| Overweight                     | 151(56.1)     |
| Obese                          | 44(16.4)      |
| <b>Qualification</b>           |               |
| Matric                         | 6(2.2)        |
| Higher Secondary               | 28(10.4)      |
| Graduation                     | 72(26.8)      |
| Masters                        | 97(26.8)      |
| PhD                            | 66(24.5)      |
| <b>Diabetic/Hypertensive</b>   |               |
| No Problem                     | 251(93.3)     |
| Diabetic                       | 15(5.6)       |
| Hypertensive                   | 1(0.4)        |
| Other Problems                 | 2(0.7)        |

The mean value of working experience was  $6.8 \pm 3.0$ , mean value of pain in off days past three year was  $2.06 \pm 8.7$ . Working hour was counted with mean value  $7.13 \pm 1.80$ . Mean value of walking activity was  $33.45 \pm 32.07$  and exercise was  $10.07 \pm 21.4$ . Mean value of daily uses of computer was  $5.01 \pm 2.2$  and cellphone was  $4.65 \pm 3.0$ , (table2).

Table 2: Workplace characteristics

| Workplace characteristics n=269                       | Mean±std    |
|---|-------------|
| Working experience                                    | 6.8±3.0     |
| How many days off in the past 3 years because of pain | 2.06±8.7    |
| Working hours   | 7.13±1.08   |
| Walking activity                                      | 33.45±32.07 |

| Workplace characteristics n=269 | Mean±std   |
|---------------------------------|------------|
| Exercise                        | 10.07±21.4 |
| Daily uses of computer          | 5.01±2.2   |
| Daily uses of cellphone         | 4.65±3.0   |

Out 269 most of participants (87) had pain in lower back, 35 had in neck region, 22 were reported in knee, 19 were in upper extremity multiple problem 15 had in lower extremity in multiple problem and rest of participants in different regions but no

one reported in shoulder and elbow region, (shown in Table. 3).

Upper and lower extremity multiple problem was found significant with qualification of participants <0.001 and <0.017 respectively. Upper extremity multiple problem also found significant with BMI in p value <0.001 and Diabetic/ Hypertensive found significant with neck pain with value 0.002, (shown in table 4).

Table 3: common work-related musculoskeletal disorders (n=269)

| MSDs                             | frequency of affected person |
|----------------------------------|------------------------------|
| Pain in lower back               | 87                           |
| Pain in neck                     | 35                           |
| Pain in knee                     | 22                           |
| Upper extremity multiple problem | 19                           |
| Lower extremity multiple problem | 15                           |
| Pain in upper back               | 10                           |
| Pain in foot                     | 5                            |
| Pain in wrist                    | 2                            |
| Pain in ankle                    | 2                            |
| Pain in hand                     | 1                            |

Table 4: Association between personal characteristics with Prevalence of MSD's

| personal characteristics n=269 | Pain in neck |       | Pain in lower back |       | Pain in knee |      | Pain in ankle |      | Upper extremity multiple problem |        | Lower extremity multiple problem |       |
|--------------------------------|--------------|-------|--------------------|-------|--------------|------|---------------|------|----------------------------------|--------|----------------------------------|-------|
|                                | No. (%)      | p     | No. (%)            | p     | No. (%)      | p    | No. (%)       | p    | No. (%)                          | p      | No. (%)                          | p     |
| Qualification                  |              |       |                    |       |              |      |               |      |                                  |        |                                  |       |
| Matric                         | 0(0.0)       | 0.599 | 2(0.7)             | 0.455 | 0(0.0)       | 0.35 | 0(0)          | 0.47 | 2(7)                             | <0.001 | 0(0)                             | 0.017 |
| Higher 2ry                     | 3(1.1)       |       | 5(1.9)             |       | 2(7)         |      | 0(0)          |      | 9(3.3)                           |        | 5(1.9)                           |       |
| Graduate                       | 11(4.1)      |       | 24(8.9)            |       | 7(2.6)       |      | 0(0)          |      | 4(1.5)                           |        | 2(0.7)                           |       |
| Master                         | 10 (3.7)     |       | 31(31)             |       | 11(4.1)      |      | 2(7)          |      | 4(1.5)                           |        | 7(2.6)                           |       |
| PhD                            | 11(4.1)      |       | 25(9.3)            |       | 2(7)         |      | 0(0)          |      | 0(0.0)                           |        | 1(0.4)                           |       |

| personal characteristics<br>n=269 | Pain in neck |       | Pain in lower back |       | Pain in knee |       | Pain in ankle |       | Upper extremity multiple problem |        | Lower extremity multiple problem |       |
|-----------------------------------|--------------|-------|--------------------|-------|--------------|-------|---------------|-------|----------------------------------|--------|----------------------------------|-------|
|                                   | No. (%)      | p     | No. (%)            | p     | No. (%)      | p     | No. (%)       | p     | No. (%)                          | p      | No. (%)                          | p     |
| BMI                               |              |       |                    |       |              |       |               |       |                                  |        |                                  |       |
| Underweight                       | 0(0.0)       | 0.305 | 0(0)               | 0.08  | 0(0.0)       | 0.407 | 0(0.0)        | 0.4   | 2(0.7)                           | <0.001 | 0(0)                             | 0.695 |
| Healthy weight                    | 5(1.9)       |       | 23(8.6)            |       | 9(3.3)       |       | 1(0.4)        |       | 6(2.2)                           |        | 3(1.1)                           |       |
| Overweight                        | 23(8.6)      |       | 43(16)             |       | 11(4.1)      |       | 0(0.0)        |       | 11(4.1)                          |        | 8(3)                             |       |
| Obese                             | 7(2.6)       |       | 21(7.8)            |       | 2(0.7)       |       | 1(0.4)        |       | 0(0)                             |        | 4(1.5)                           |       |
| Diabetes/Hypertension             |              |       |                    |       |              |       |               |       |                                  |        |                                  |       |
| No                                | 30(11.2)     | 0.002 | 81(30.1)           | 0.607 | 21(7.8)      | 0.995 | 2(0.7)        | 0.986 | 19(7.1)                          | 0.690  | 14(5.2)                          | 0.976 |
| Diabetes                          | 3(1.1)       |       | 6(2.2)             |       | 1(0.4)       |       | 0(0)          |       | 0(0)                             |        | 1(0.4)                           |       |
| Hypertension                      | 0(0.0)       |       | 0(0.0)             |       | 0(0.0)       |       | 0(0)          |       | 0(0)                             |        | 0(0)                             |       |
| Others                            | 2(7)         |       | 0(0.0)             |       | 0(0.0)       |       | 0(0)          |       | 0(0)                             |        | 0(0)                             |       |

Lower extremity multiple was found significant with walking activity with p value 0.021, association was found in pain in upper back with age of participants, off days in past three year because of pain and working hours with p value 0.07, 0.006, and 0.009 respectively. Association was found of knee pain with working hours,

daily uses of computer and exercise with p value 0.00, 0.45 and 0.006 respectively. And association of upper extremity multiple problem was found with age of participants, walking activity and exercise with p value 0.00, 0.007 and 0.037 respectively, (Table. 5)

Table 5: Association between workplace characteristics and MSDs, n=256

| characteristics | Pain in lower back |      | Lower extremity multiple problem |      | Pain in upper back |      | Pain in neck |      | Pain in knee |      | Upper extremity multiple problem |      |
|-----------------|--------------------|------|----------------------------------|------|--------------------|------|--------------|------|--------------|------|----------------------------------|------|
|                 | Mean ±SD           | P    | Mean ±SD                         | P    | Mean ±SD           | P    | Mean ±SD     | P    | Mean ±SD     | P    | Mean ±SD                         | P    |
| Age             |                    |      |                                  |      |                    |      |              |      |              |      |                                  |      |
| yes             | 40.31 ±7.03        | .137 | 38.5 ±8.7                        | .653 | 33.3 ±2.63         | .007 | 40.11 ±7.3   | .510 | 41.09 ±7.0   | .244 | 33 ±3.1                          | .000 |
| No              | 38.91 ±7.36        |      | 39.4 ±7.2                        |      | 39.59 ±7.3         |      | 39.2 ±7.3    |      | 39.20 ±7.3   |      | 39.8 ±7.3                        |      |

| characteristics                                       | Pain in lower back |      | Lower extremity multiple problem |      | Pain in upper back |      | Pain in neck   |      | Pain in knee   |      | Upper extremity multiple problem |      |
|---|--------------------|------|----------------------------------|------|--------------------|------|----------------|------|----------------|------|----------------------------------|------|
|   | Mean ±SD           | P    | Mean ±SD                         | P    | Mean ±SD           | P    | Mean ±SD       | P    | Mean ±SD       | P    | Mean ±SD                         | P    |
| Working experience of participants                    |                    |      |                                  |      |                    |      |                |      |                |      |                                  |      |
| yes   | 6.80<br>±3.18      | .994 | 6.0<br>±2.7                      | .285 | 6.5<br>±1.71       | .743 | 6.97<br>±2.4   | .728 | 6.86<br>±3.2   | .926 | 6.9<br>±3.0                      | .833 |
| No  | 6.80<br>±2.91      |      | 6.8<br>±3.0                      |      | 6.81<br>±3.04      |      | 6.7<br>±3.1    |      | 6.8<br>±3.0    |      | 6.8<br>±3.0                      |      |
| How many days off in the past 3 years because of pain |                    |      |                                  |      |                    |      |                |      |                |      |                                  |      |
| yes   | 2.86<br>±9.0       | .294 | 1.8<br>±2.6                      | .905 | 9.4<br>±18.7       | .006 | 1.11<br>±3.3   | .490 | 1.81<br>±5.8   | .892 | 1.9<br>±2.6                      | .953 |
| No  | 1.67<br>±8.5       |      | 2.0<br>±9.0                      |      | 1.77<br>±18.69     |      | 2.2<br>±9.1    |      | 2.08<br>±8.8   |      | 2.1<br>±8.9                      |      |
| Working hours   |                    |      |                                  |      |                    |      |                |      |                |      |                                  |      |
| yes   | 7.09<br>±1.06      | .689 | 7.4<br>±0.6                      | .320 | 8<br>±1.24         | .009 | 7.34<br>±0.5   | .212 | 6.36<br>±1.2   | .000 | 7.1<br>±0.5                      | .917 |
| No  | 7.14<br>±1.09      |      | 7.1<br>±1.1                      |      | 7.1<br>±1.1        |      | 7.1<br>±1.1    |      | 7.19<br>±1.0   |      | 7.1<br>±1.1                      |      |
| Walking activity                                      |                    |      |                                  |      |                    |      |                |      |                |      |                                  |      |
| yes   | 30.86<br>±31.04    | .361 | 52<br>±33.0                      | .021 | 18<br>±21.0        | .121 | 41<br>±41.7    | .136 | 36.36<br>±25.1 | .658 | 52.3<br>±37.3                    | .007 |
| No  | 34.69<br>±32.56    |      | 32.3<br>±31.7                    |      | 34.05<br>±32.3     |      | 32.3<br>±30.3  |      | 33.19<br>±32.6 |      | 32.0<br>±31.3                    |      |
| Daily uses of cellphone                               |                    |      |                                  |      |                    |      |                |      |                |      |                                  |      |
| yes   | 5.04<br>±3.02      | .141 | 6<br>±11.0                       | .450 | 5.6<br>±3.20       | .313 | 5.7<br>±3.3    | .022 | 12.2<br>±20.2  | .616 | 4.2<br>±10.1                     | .217 |
| No  | 4.46<br>±3.0       |      | 10.3<br>±21.9                    |      | 4.61<br>±3.0       |      | 4.4<br>±2.9    |      | 9.87<br>±21.5  |      | 10.5<br>±22.0                    |      |
| Daily uses of computer                                |                    |      |                                  |      |                    |      |                |      |                |      |                                  |      |
| yes   | 4.93<br>±2.33      | .674 | 4<br>±2.5                        | .073 | 6<br>±1.56         | .160 | 5.37<br>±2.2   | .317 | 4.1<br>±1.2    | .045 | 4.31<br>±2.6                     | .162 |
| No  | 5.05<br>±2.22      |      | 5.0<br>±2.2                      |      | 4.98<br>±2.27      |      | 4.9<br>±2.2    |      | 5.1<br>±2.3    |      | 5.0<br>±2.2                      |      |
| Exercise  |                    |      |                                  |      |                    |      |                |      |                |      |                                  |      |
| yes   | 8.39<br>±19.07     | .374 | 3.6<br>±2.6                      | .192 | 14<br>±20.7        | .556 | 10<br>±20.5    | .982 | 3.0<br>±1.2    | .006 | 3.2<br>±2.7                      | .037 |
| No  | 10.88<br>±22.47    |      | 4.7<br>±3.0                      |      | 9.92<br>±21.48     |      | 10.08<br>±21.6 |      | 4.8<br>±3.1    |      | 4.7<br>±3.0                      |      |

## Discussion

Many studies showed that increase in the sitting time ultimately increases the chances of obesity and diabetes by 5% and 7 %<sup>8</sup>, whereas musculoskeletal disorders particularly low back pain was also found to be increased with extended sitting time <sup>9</sup>. Most studies had also shown that musculoskeletal problems are also common in office workers especially in the low back, upper limb, shoulder, and neck <sup>10</sup>. And the prevalence of musculoskeletal disorders ranged 40- 80% in office workers <sup>11</sup>.

Similar results were observed in our study. The most affected region identified was low back, upper back, knee pain, lower and upper extremity found associated with characteristics of working place. Participants reported pain in these regions.

Findings of the Sherise Epstein conducted a study on the incidence of work-related musculoskeletal disorders among Interventionists and surgeons. Results showed that 17% of the population suffered from cervical spine disorders, 18% tend to have rotator cuff problems, 19% is suffering from lumbar spine diseases and 9% population is suffering from carpal tunnel syndrome <sup>12</sup>. Another study conducted by Meisha DE et al who studied the prevalence of work-related musculoskeletal disorders among dentists and found 70% of the population were affected by WMSDs.

The most region affected was lower back (85%), 84.6% of them reported neck was the commonest affected region. Female population was found to be more affected as compared to males because of the lack of physical activity or exercise. Carpal Tunnel Syndrome was also identified in 9% of the population working in private sectors and its chances increases with age. Whereas the least reported work-related musculoskeletal disorders were found in orthodontists maxillofacial surgeons <sup>13</sup>. However, in our study few of the participants also complained about the neck pain. However, the other regions such as shoulder, wrist/ forearm, upper back, knee, and ankle were found to be minimally affected. Another study by Liping Li showed that prevalence of work-related musculoskeletal disorders was found to be common among teachers. The regions mostly affected are shoulder, low back, elbow, wrist/ hand <sup>14</sup>.

A study by Ashiyat K.Akodu showed that lower back pain was found to be the most prevalent work-related musculoskeletal disorder among the respondents <sup>15</sup>.

A study was conducted in Saudi Arabia to find the patterns of MSD patterns and its associated factor of risk among the higher education academicians MSDs found lower among the occupations of higher academic. However, neck, knee pain and back

found common and also highlighted that it was significant association with these regions of body <sup>16</sup>.

Another study was conducted on the faculty members of Majmaah University, to find the prevalence of WMSDs. Most of participated were found affected with WMSDs, the neck was found mostly affected of WMSD. There was lack of training of ergonomic and using computer associated with WMSDs in most of body regions <sup>17</sup>. Whereas in our study the findings revealed that majority of the participants have musculoskeletal pain/discomfort whereas only few numbers of participants are suffering from this condition. The most affected region identified was low back and participants reported pain in this region.

### Conclusion

It has been concluded from the study that majority of participants have musculoskeletal pain/discomfort. The most affected region identified was low back and participants reported pain in this region. Few of the participants also complained about neck pain. However, the other regions such as shoulder, wrist/ forearm, upper back, knee, and ankle were found to be minimally affected. Association was found in personal and working place characteristics in different region of pain.

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Original Article :

## Antagonistic Activity and Probiotic Potential of *Lactobacillus* sp. isolated from fermented dairy products from Majmaah

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### Abstract

#### Background And Aims:

In much scientific research, it has been found that antagonistic activity is one of the important properties of a probiotic bacterium to attach in the intestine to reduce attachment of pathogenic bacteria in the intestine. *Lactobacillus* sp., isolated from fermented dairy products, shows a positive impact on human health.

This study was designed to study *Lactobacillus* sp. isolated from fermented dairy products for their antagonistic activity and probiotic potential.

#### Methods:

In this study, we used the *Lactobacilli* strain isolated from yogurt samples by a dilution plating method and were screened for their antagonistic activities and potential probiotics. The isolates were tested for their growth in the presence of 0.3% bile salt and pH 2.0 and 3.0.

#### Result:

Out of the 52 strains, 30 strains (60%) had survival rates above 90% after 2 h of incubation at pH values of 2.0 or 3.0. Further screening was performed for their growth at 0.3% bile salt. From 30 strains, only ten strains showed tolerance to 0.3% bile salt. Two *Lactobacilli* strains exhibited antagonistic activity. Moreover, all eight strains were found suitable for the potential probiotic activity, included *Lactobacillus casei* MU01, MU02, *Lactobacillus reuteri* MU 113, *Bifidobacterium lactis* MU85, *Lactobacillus salivarius* MU18, MU31, *Lactobacillus plantarum* MU211 3032, and *Lactobacillus buchneri* MU37.

#### Conclusion:

This study suggests that eight strains showed good antagonistic activity and probiotic potential, which can be used as supplements for good human health.

### المخلص

#### خلفية والاهداف:

في الكثير من الأبحاث العلمية، وجد أن النشاط العدائي «المضاد» هو أحد الخصائص المهمة لبكتيريا البروبيوتيك «المعززات الحيوية»؛ حيث أن التصاقها في الأمعاء يقلل من تعلق البكتيريا المسببة للأمراض في الأمعاء. حيث أظهرت بكتيريا اللاكتوباسيلس المعزولة من منتجات الألبان المخمرة؛ تأثير إيجابي على صحة الإنسان.

تم تصميم هذه الدراسة لدراسة بكتيريا اللاكتوباسيلس المعزولة من منتجات الألبان المخمرة؛ لنشاطها العدائي المضاد وإمكانية البروبيوتيك.

#### طريقة البحث:

في هذه الدراسة تم استخدام سلالة اللاكتوباسيلس المعزولة من عينات الزبادي بطريقة التصفية المخفف وتم فحصها بحثاً عن أنشطتها العدائية والبروبيوتيك المحتملة. ومن ثم اختبار نمو البكتيريا المعزولة في وجود 0.3% ملح الصفراء ودرجة الحموضة 2.0 و 3.0.

#### النتيجة:

من أصل 52 سلالة، كان لدى ثلاثين سلالة أي (60%) معدلات بقاء فوق 90% بعد ساعتين من الحضارة عند قيم الأس الهيدروجيني 2.0 أو 3.0 للمحوضة. ثم تم إجراء المزيد من الفحوصات لاختبار نموها عند 0.3% من ملح الصفراء. من بين الثلاثين سلالة أظهرت عشرة سلالات فقط قدرة تحمل الملح الصفراوي بنسبة 0.3%. و أظهرت سلالتين من اللاكتوباسيلس نشاط عدائي مضاد. علاوة على ذلك، تم العثور على ثمانية سلالات مناسبة لنشاط بروبيوتيك محتمل، بما في ذلك:

*Lactobacillus casei* MU01, MU02, *Lactobacillus reuteri* MU 113, *Bifidobacterium lactis* MU85, *Lac-*

**Key Words:**

Lactobacilli, Probiotic Potential, Antagonistic activity, Lactobacillus buchneri, acid-tolerant

*tobacillus salivarius* MU18, MU31, *Lactobacillus plantarum* MU211 3032 and *Lactobacillus buchneri* MU37

**الخلاصة:**

تشير هذه الدراسة إلى أن ثمانية سلالات أظهرت نشاطًا عدائيًا جيدًا وإمكانية البروبيوتيك، والتي يمكن استخدامها كمكملات جيدة لصحة الإنسان.

**Introduction**

Lactobacilli (the species of the genus *Lactobacillus*) are the major residents of the vertebrate intestine, including humans. They were found in the fermentation of various food products made from dairy and plants. Microorganisms that are safe and beneficial for health are characterized as probiotics<sup>1</sup>. Other than *Lactobacillus*, probiotic strains that are considered beneficial include *Pediococcus*, *Bifidobacterium*, and *Enterococcus*<sup>2</sup>. Probiotics are defined as living microorganisms that have beneficial effects on the host and can adjust the host micro-ecological balance, improve intestinal function, and stimulate digestion and immune function. *Lactobacillus* was the earliest discovered probiotic of the three types of probiotics, which also include *Bifidobacterium* and Gram-positive cocci<sup>3</sup>. Use of probiotics dates back from the time human civilization eating fermented food, milk, and other products from plants and animals, but their use for health benefits is more in use from the last century, due to growing awareness about the health ben-

efits of probiotic bacteria<sup>4</sup>. These bacteria not only help to maintain the gut ecosystem balanced but also help in controlling many disease conditions like inflammatory bowel disease and inflammatory bowel syndrome<sup>1</sup>.

The antagonistic property of probiotic bacteria is an important attribute property to be evaluated as it helps in the identification of bacterial species that can adhere to the intestine walls, reduce adhesion of pathogenic bacteria. Previous research shows the number of Lactobacilli, which originate from dairy fermented products, show the antagonistic property, but not all of them are able to grow at high acidic conditions, similar to the one found in the human stomach and at low pH like 2.0<sup>5</sup>. To consider any probiotic bacteria for human consumption, it must be able to withstand different pH and acidic conditions found in the human gut; also, it can attach to intestine walls and reduce the attachment of other food or waterborne pathogens<sup>6</sup>.

Thus, the study was designed to identify the best potential probiotic *Lactobacillus*

isolates from fermented dairy products. The in vitro probiotic properties like bile tolerance, acid tolerance, antagonistic activity, and auto and co-aggregation property of the selected strains were studied

## Material and Method

### *Sampling*

Fifty-two different fermented dairy products were collected from different local markets. Isolation was done on MRS (Man-Rogosa-Sharp) agar as per Ananthanarayan, R<sup>7</sup> method and incubated at 37°C for 24 to 48 hours to apply the phenotypic and genotypic identification<sup>8</sup>.

### *Acid tolerance*

Acid tolerance was studied as per the method by Chung et al.<sup>8</sup>. All isolates were taken in a concentration of 10 µL, incubated overnight in MRS broth into 1 mL of pH 2.0, 3.0, and 6.4 (control) MRS broths.

### *Culture Characters:*

The streak plate method was performed to record the culture characters, and morphology was carried out according to Banson, H.J.<sup>9</sup>. The colonies grown on MRS agar plates were carefully studied concerning size, color, opacity, form rise, and margin.

### *Test for Bile Toleration (pH-6.1)*

For a potential probiotic bacterium, tolerance to bile concentration is an essential probiotic property. Only a few bacterial strains can resist strong bile acid, which is

one of the challenges encountered by probiotics<sup>10</sup>.

### *Medium:*

LS broth with 0.4%- 1% bile salt (Sodium taurocholate)

### *Procedure:*

Sodium taurocholate mixed with LS broth in different proportions of 0.4%, 0.6%, 0.8%, and 1% dispensed in test tubes. Using the loop inoculation process, the tubes were inoculated and incubated at 37 °C for 24 hours, along with a control. The result was recorded after 24 hours using the spectrophotometry method at 600 nm.

### *Antagonistic Activities:*

To study antagonistic activity, the lactobacillus strains showing good activity for bile were grown in MRS broth at 37 °C for 24 hours, and cell-free supernatants were collected. Strains of *E. coli*, *Salmonella Enteritidis*, and *Salmonella Typhimurium* isolated from food were incubated in nutrient broth for 24 hours and then diluted to 0.06 at 600 nm equivalent to McFarland standard 0.5, and to microtiter plates. An equal amount of CFS of LAB cultures was added and incubated at 37 °C for 24 hours. The growth of pathogenic bacteria was determined using a spectrophotometer at 600 nm<sup>11</sup>.

### *Autoaggregation and Coaggregation:*

Activities of Auto and co-aggregation were measured using the method of Jena et al.

(2013)<sup>11</sup>. For auto-aggregative ability assays, LAB strains cultured overnight, harvested, washed, and re-suspended in PBS. OD (optical density) of each strain was recorded at 600 nm. The selected strains were incubated at 37 °C without agitation, and OD readings were recorded at different time intervals (3 and 24 hours).

The formula for calculating the percentage of aggregation:

$$A\% = 100 \times \left(1 - \frac{A1}{A0}\right)$$

$$A\% = 100 \times (1 - A_t/A_0)$$

where A0 refers to the OD 600 values at 0 hours and At refers to OD 600 values at the indicated time points

Coaggregation assay was done by taking equal volumes of the LAB strains with pathogenic bacteria isolated from food, mixed, and OD reading was taken at 600 nm. The mixed bacterial suspensions were incubated at 37 °C, and OD values were measured at 3 and 24 hours (12).

#### Statistical analysis

Statistical analyses were performed using SPSS 14.0 software (SPSS Inc.; Chicago, IL, USA). Significant differences among

treatments were tested by ANOVA developed by Ronald Fisher in 1923 with a level of significance at  $\alpha = 0.05$ . Data were expressed as Mean Values  $\pm$  Standard Deviation (SD). All experiments were performed in duplicate and repeated three times.

#### Result

##### *Morphological and colony characteristics*

Morphological and colony characteristics of the isolated bacterial culture from fermented milk products samples were carried out. Five types of different bacterial colonies with distinct morphological characters were isolated.

##### *Identification by molecular biology method*

Out of 52 strains, 38 were Gram-positive, rod-shaped, and catalase-negative using the conventional method of identification, whereas, by using molecular biology technique, isolated strains were found to be *Lactobacillus casei*, *Lactobacillus salivarius*, *Lactobacillus plantarum*, and *Lactobacillus buchneri*, *Bifidobacterium lactis*, *Lactobacillus salivarius* and *Lactobacillus reuteri*.

Table 1: Strains showing the highest viability (log CFU/mL) at different pH, survival percentage, and Agitation at 600 nm of strains with a high survival rate.

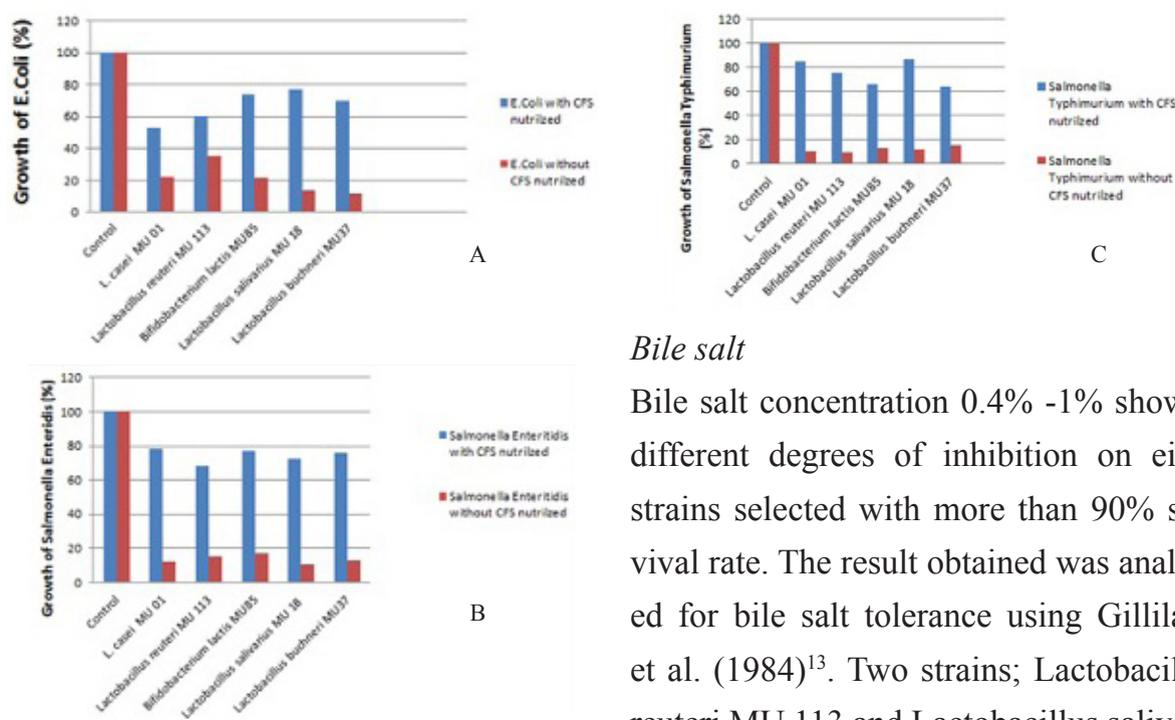
| Isolates       | Absorption at 600 nm (without agitation) | Absorption at 600 nm (with agitation) | pH 6.2* Viable count (log CFU/mL) | pH 3.0 Viable count (log CFU/mL) | Percentage survival (%) | pH 2.0 Viable count (log CFU/mL) | Percentage survival (%) |
|----------------|--|---------------------------------------|-----------------------------------|----------------------------------|-------------------------|----------------------------------|-------------------------|
| L. casei MU 01 | 0.055                                    | 0.032                                 | 6.17+0.01                         | 5.33+0.04                        | 90                      | 5.70+0.02                        | 95                      |
| L. casei MU 02 | 0.058                                    | 0.044                                 | 7.98+0.08                         | 6.51+0.10                        | 85                      | 6.14+0.07                        | 90                      |

| Isolates                       | Absorption at 600 nm (without agitation) | Absorption at 600 nm (with agitation) | pH 6.2* Viable count (log CFU/mL) | pH 3.0 Viable count (log CFU/mL) | Percentage survival (%) | pH 2.0 Viable count (log CFU/mL) | Percentage survival (%) |
|--------------------------------|--|---------------------------------------|-----------------------------------|----------------------------------|-------------------------|----------------------------------|-------------------------|
| Lactobacillus reuteri MU 113   | 0.088                                    | 0.078                                 | 9.08+0.01                         | 7.80+0.01                        | 97                      | 7.89+0.26                        | 95                      |
| Bifidobacterium lactis MU85    | 0.097                                    | 0.076                                 | 8.97+0.01                         | 8.07+0.02                        | 92                      | 8.99+0.21                        | 95                      |
| Lactobacillus salivarius MU 18 | 0.059                                    | 0.023                                 | 9.07+0.31                         | 8.77+0.21                        | 96                      | 8.47+0.09                        | 92                      |
| Lactobacillus salivarius MU 31 | 0.087                                    | 0.061                                 | 7.46+0.04                         | 6.26+0.14                        | 84                      | 5.96+0.21                        | 78                      |
| Lactobacillus plantarum MU 211 | 0.066                                    | 0.041                                 | 8.90+0.29                         | 7.70+0.20                        | 86                      | 7.20+0.11                        | 80                      |
| Lactobacillus buchneri MU37    | 0.037                                    | 0.024                                 | 7.26+0.02                         | 6.96+0.12                        | 94                      | 5.96+0.07                        | 81                      |

*Antagonistic Effect of Strains on Food-borne pathogens in the presence of CFS*  
 Antagonistic activity of strains having survival rate higher than 90 % was measured in the presence of CFS with neutralization

using 1M HCl in Figure 1A E. coli, 1B for Salmonella Enteritidis, and 1C for Salmonella Typhimurium with and without neutralization was studied.

Figure 1: Inhibition of foodborne pathogens in the presence of CFS with and without neutralization using different LAB strains isolated from fermented milk products. A) E.coli B) Salmonella Enteritidis , and C) Salmonella Typhimurium.

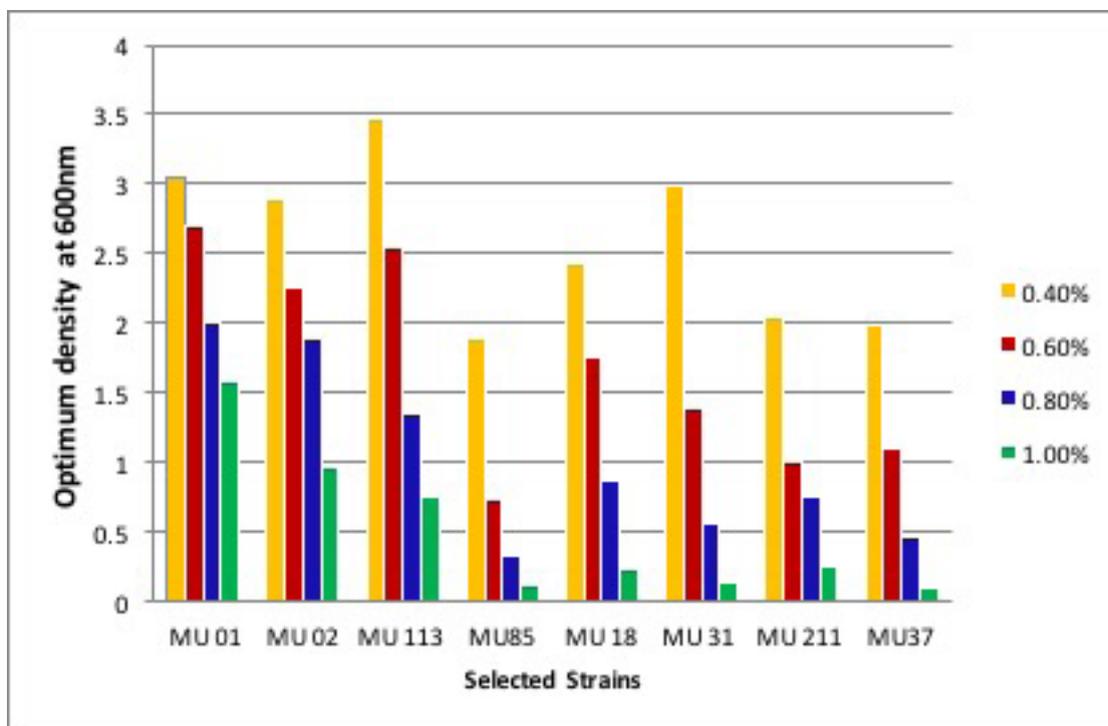


*Bile salt*

Bile salt concentration 0.4% -1% showed different degrees of inhibition on eight strains selected with more than 90% survival rate. The result obtained was analyzed for bile salt tolerance using Gilliland et al. (1984)<sup>13</sup>. Two strains; Lactobacillus reuteri MU 113 and Lactobacillus salivari-

us MU 31, were considered to be resistant ( $d \leq 15$  min): Out of 8 strains, four strains were found to be tolerant strains (MU01, MU02, MU113, MU31;  $15 < d \leq 40$  min); other four strains ( MU18, MU85, MU37 and MU211;  $40 < d < 60$ ) were found to be weakly tolerant strains as shown in Figure 2.

Figure 2: Bile acid tolerance (0.4% to 1.0%) of different strains at an optimum density of 600 nm.



### *Autoaggregation and Coaggregation activity:*

To measure co-aggregation activity, the strains showing the best activity in other parameters are selected. The co-aggrega-

tion property of these strains with food-borne pathogens was determined at 37 °C at a time interval of 3 and 24 hours (Table 2).

Figure 2: Bile acid tolerance (0.4% to 1.0%) of different strains at an optimum density of 600 nm.

| Strains | Co-aggregation activity (%) |           |                        |          |                        |          |
|---------|-----------------------------|-----------|------------------------|----------|------------------------|----------|
|         | E. coli                     |           | Salmonella Enteritidis |          | Salmonella Typhimurium |          |
|         | 3 hour                      | 24 hour   | 3 hour                 | 24 hour  | 3 hour                 | 24 hour  |
| MU 01   | 13.6±0.4                    | 42.6± 0.2 | 11.7±0.8               | 53.4±0.7 | 16.3±0.3               | 40.5±0.2 |
| MU 02   | 7.5±0.4                     | 30.1±0.5  | 10.6±0.4               | 44.6±0.3 | 11.5±0.2               | 33.6±0.1 |
| MU 113  | 15.7±0.6                    | 60.4±0.8  | 12.3±0.2               | 56.9±0.6 | 13.1±0.3               | 48.9±0.3 |
| MU 31   | 11.4 ±0.5                   | 46.7±0.2  | 13.2±0.4               | 44.6±0.3 | 12.6±0.5               | 38.7±0.6 |

### **Discussion**

The bacterial species isolated from fer-

mented milk products were subjected to general bacteriological isolation tech-

niques. Among the biochemical test, the important results showed by the isolates were catalase-negative, lactic acid production from glucose, and heavy growth on Tomato juice agar<sup>14</sup>. All the isolates showed pigmentation on Tomato juice agar, which ranges from orange to brown color. The growth of isolates on MRS agar plates at pH 6.5 confirmed the lactobacillus sp.<sup>15</sup>. For a probiotic bacterium to work efficiently, it must have the capacity to survive in the gastrointestinal tract.

In many studies, the acid resistance for Lactobacillus at pH 2.0 and 3.0 was studied with MRS broth. In a study on 52 strains of lactobacilli, a favorable resistance at pH 2.0 was observed among 72% of isolate<sup>16</sup>. In the present study, more than 60% of strains showed the survival rate of  $\geq 90\%$  at pH 3.0, whereas 62.5% of the strains showed the survival rate of  $\geq 90\%$  at pH 2 (Table 1). Antagonistic activity of different LAB strains isolated from plant and animal products showed CFS to be a complete inhibitor without neutralization against many foodborne pathogens<sup>17, 18</sup>. In our study, it was found that the MU18 strain inhibited more than 60% growth of all three foodborne pathogens with CFS without neutralization.

In the human gut, NaCl is an inhibitory substance that can inhibit the growth of the microbe, so; the isolates were grown in a

medium with NaCl concentration ranging between 0.4-1% bile concentrations<sup>5, 19</sup>. It was found that all 30 strains were able to survive at 0.5% bile salt, but only eight were found to be tolerant to all concentrations between 0.4-1.0 percent, whereas the rest were found to be weakly tolerant (figure 2). The highest optimum density was shown by MU113, whereas the least OD was recorded by MU 85.

The co-aggregation properties are another important factor in selecting a probiotic strain<sup>20</sup>. Most LAB strains exhibited significant co-aggregation activity with foodborne pathogens after 24 hours of incubation. As per the results of the present study (Table 2), MU113 displayed the highest co-aggregation E.coli after 24 hours of incubation, which was similar in the study by Zhang et al.<sup>21, 22</sup>.

### Conclusion

In conclusion, out of 52 strains, 30 strains were selected as appropriate probiotic potential strains, out of which eight were found suitable for promoting hosts' intestinal health and to maintaining healthy natural micro-flora during antibiotic treatment. Also, there is a need for an in vivo study to verify the effectiveness of selected strains.

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Original Article :

## Wet cupping (Hijama) positively and significantly impacted multiple hematological parameters

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### Abstract

#### Background and Aim:

Wet cupping, known as Hijama, is considered one of the main types of traditional (alternative) medicine around the world. The practice of cupping helps in treating many health problems and many studies have shown its effectiveness. The study target is to figure out if the hematological parameters are affected by wet cupping or not, and to determine the risk of anemia caused by wet cupping.

#### Methods:

The data were collected from 17 participants who participate in the study. The cupping was performed at cupping centers in Madinah, and the samples were processed in the research laboratory at Taibah University. The analysis of hematological parameters was done by comparing the samples of each participant before wet cupping, one week and two weeks after it.

#### Results:

The results of the study show that the wet cupping causes an increase, that were statistically significant, in many hematological parameters such as white blood cells count and hemoglobin level after performing wet cupping.

#### Conclusion:

Several hematological parameters were influenced after performing wet cupping while others did not. Wet cupping is generally safe, as it does not cause anemia, and it is recommended to be performed appropriately due to its health benefits.

#### Key words:

Wet cupping, Hijama, alternative medicine, hematological parameters, anemia.

### المخلص

#### الخلفية والأهداف:

تعتبر الحجامه الرطبه أحد أهم أنواع الطب التقليدي (البديل) حول العالم. تساعد ممارسة الحجامه في علاج العديد من المشاكل الصحية وقد أظهرت العديد من الدراسات فعاليتها. تستهدف الدراسة معرفة تأثير الحجامه الرطبه على مؤشرات الدم ، وقياس خطر فقر الدم الناجم عن الحجامه الرطبه.

#### طريقة البحث:

تم جمع البيانات من ١٧ مشاركاً شاركوا في الدراسة. تم إجراء الحجامه في مراكز الحجامه بالمدينه المنوره وتمت معالجتها وفحصها في معمل الأبحاث بجامعة طيبه. تم إجراء الدراسة بمقارنة مؤشرات الدم المفحوصه من عينات كل مشارك قبل الحجامه الرطبه ، بعد أسبوع وبعد أسبوعين من الحجامه.

#### النتائج:

أظهرت نتائج الدراسة أن الحجامه الرطبه لها تأثير بزيادة بعض مؤشرات الدم مثل كريات الدم البيضاء وخضاب الدم (الهيموجلوبين) بعد إجراء الحجامه الرطبه.

#### الخلاصة:

تأثرت بعض مؤشرات الدم بعد إجراء الحجامه الرطبه والبعض الآخر لم يتأثر. الحجامه الرطبه آمنه بشكل عام ولا تسبب فقر الدم ويوصى بإجرائها بالطريقة الصحيحه نظراً لفوائدها الصحيه.

#### الكلمات المفتاحية:

الحجامه الرطبه، الحجامه، الطب البديل، مؤشرات الدم، فقر الدم

## 1.Introduction

Cupping (Arabic term: Hijama), is known as the process of applying cups on different parts of the body to draw blood by making an incision (of wet cupping) or without incision (other types of cupping) <sup>1</sup>. It is considered as one of the traditional (alternative) medicine types around the world <sup>2</sup>. Cupping has an extended history along different centuries in different cultures, from East to West. Cupping in ancient times is different from the current time in the ways of its application and the instruments used. The practice of cupping was shown to help in treating many health problems and some studies have shown their effectiveness<sup>3</sup>. Methodologies of traditional cupping have been passed along the centuries by its practitioners <sup>4</sup>. Dry, wet, and massage are the three known cupping types <sup>5</sup>. In Saudi Arabia, wet cupping is the most common type that has been used until now. The Middle East, including Saudi Arabia, uses different wet cupping techniques from the one that is used in China, Korea and Germany <sup>6</sup>. Middle East technique usually utilize three order of steps which are cupping, puncturing, and then cupping again after making incision by a sharp surgical blade. On the other hand, Germany, China, and Korea use two steps procedure by using an auto-lancet for the puncturing. The two

steps are puncturing and cupping <sup>7,8</sup>.

Cupping cups can be placed on many places in the human body including the back, neck, area of sacral, thigh and shoulders to relieve symptoms of many health problems such as arthritis and diabetes <sup>9</sup>. Based on the National Institute of Health (NIH) in the United States, cupping shows its effects in various symptoms such as chemotherapy, nausea and vomiting <sup>3</sup>. Cupping is mainly suggested as a complementary therapy in some conditions such as knee pain, sports injuries and performance, muscle pain and soreness, back pain, neck and shoulder pain, headache or migraine <sup>10</sup>. Cupping usually is safe when a professional person performs it on healthy people <sup>2</sup>. However, cupping is not recommended for people with some health problems due to its side effect. Also, cupping might cause pain and bruise. According to the National Center for Complementary and Integrative Health (NCCIH) in the United States, many side effects may result from cupping including hematoma (blood accumulated outside the blood vessels), persistent skin discoloration that leads to irregular patches areas where there are changes in skin color, scars (fibrous tissue that replaces normal skin after an injury), burns, bleeding which may occur with people who lacks the essential clotting factors such as factor VIII, or psoriasis (an autoimmune

disease characterized by patches of abnormal skin these skin patches are typically red), or purple on some people with darker skin, dry, itchy, and scaly<sup>11</sup>. Several contraindications prevent people from doing wet cupping which includes pregnancy, swelling, dry or cracked skin, hypotension, open wounds, and high fever. Even though some people believe that wet cupping can cause anemia, cupping is safe for anemic patients and does not cause anemia according to some studies<sup>12</sup>.

Wet cupping has been used as a treatment for many years. In 2008, one study showed a relationship between cupping and Iron deficiency<sup>10</sup>. This study contradicts newer studies that show no effect of wet cupping on hemoglobin levels<sup>12, 13</sup>. Thus, there are limited studies available regarding cupping's effect on hematological parameters. Here, we asked whether the wet cupping has a significant influence on the hematological parameters or not. Our investigation will be comparing the samples of each participant before wet cupping, one-week after wet cupping and two weeks after wet cupping.

## 2. Materials and Methods

### 2.1 Study design and sampling method:

The design of this study is an experimental cohort prospective study. It is the most suitable design of the study since it re-

quires a follow up with the participant to investigate the effect of wet cupping on the blood parameters. Also, to answer the question regarding the differences of the hematological parameters among people who do cupping.

### 2.2 Location of the study:

The cupping was performed at cupping centers in Madinah, Saudi Arabia. The cupping centers mainly provide wet cupping therapy for individuals who ask for it for different reasons.

### 2.3 Procedure of the study:

The data was collected from 17 volunteers who participated in the study. The blood sample was collected in Ethylene Diamine Tetra Acetate (EDTA) tube (the sample volume is about 3ml). The sample was collected immediately from the participant before cupping, one week and two weeks after cupping to compare the hematological parameters of each participant before and after cupping. To minimize physiological variations, the collection time of venous blood was performed from 10:00 AM to 2:00 PM and after 30 minutes from eating a mild meal. The total blood cells that include Red Blood Cell (RBC), White Blood Cell (WBC) and Platelet (PLT) were measured by using the automated method, Beckman machine (Atlanta Georgia, United States), that measure the complete blood count (CBC). The other

measured parameters include hemoglobin (HB), hematocrit (HCT), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), red cell distribution width (RDW), platelet distribution width (PDW), mean platelet volume (MPV) and Plateletcrit (PCT).

#### *2.4 Inclusion criteria:*

The study focused on healthy male individuals in Madinah, who should be clear from any health concerns, and the age of volunteers ranged between 18-42.

#### *2.5 Exclusion criteria:*

We exclude all individuals who suffer from any health concerns such as hypertension or diabetes.

#### *2.6 Ethical approval:*

Ethical approval was obtained for the study from the research ethics committee of the College of Applied Medical Sciences at Taibah University via letter number SREC/AMS 2019/44/CLD dated: 18/11/2019. All participants who received wet cupping signed a form of consent indicating that their data would be used in this study and they have the right to withdraw anytime during the study and there is no personal information will be shared with others.

#### *2.7 Cupping procedure:*

The tools used in the cupping procedure including plastic cups, blades, and suction devices. The procedure of cupping usually

involves cleaning the target area with an alcohol swab and placing the cup over a specific area and start suctioning. The cup is then gently removed, and three to four fine superficial incisions were made [the size of incisions is about 0.3 cm to 0.7 cm in length and 0.2 mm in depth parallel to each other]. After creating the incisions, the cup is placed again over the same area, and the suctioning is repeated. This procedure is performed on all or most of the cupping targets at the same time. The amount of blood removed in cupping is about 50-60 ml of blood and a maximum of 100 ml.

**2.8 Statistical analysis:** The statistical tests such as mean, standard deviation, student's t-test (dependent t-test), and p value are performed using statistical package for social science (SPSS) program. Differences were considered significant when the  $p < 0.05$ .

### **3.Results**

The age of our participants in this study was ranged from 18 to 42 years. All the participants were males. The mean values of the participants WBC, RBC, HB, HCT, MCV, MCH, MCHC, RDW, PLT, MPV, PCT, and PDW were all written in (Table 1). All the participants had 5 cups of wet cupping, in which two cups in the shoulders and three cups in the back.

Several comparisons were obtained from

the participant's results to demonstrate the variation between their blood results before wet cupping and one week after wet cupping, then before wet cupping and two weeks after wet cupping (detailed in the next sections).

Table 1. Baseline characteristics of participants before wet cupping.

| Baseline characteristic | Results ( $\pm$ SD)   | Range     | Reference Range*              |
|-------------------------|-----------------------|-----------|-------------------------------|
| Mean age                | 24.17 ( $\pm$ 5.67)   | 18-42     | 18-60                         |
| Mean WBC count          | 6.34 ( $\pm$ 2.04)    | 3.4-10.6  | 4-11 X 10 <sup>9</sup> /L     |
| Mean RBC count          | 4.91 ( $\pm$ 0.41)    | 3.94-5.76 | 4.5-6.5 X 10 <sup>12</sup> /L |
| Mean HB level           | 12.82 ( $\pm$ 1.14)   | 10.7-14.8 | 13-18 g/dl                    |
| Mean HCT                | 40.94 ( $\pm$ 3.24)   | 32.3-47.4 | 40-52%                        |
| Mean MCV                | 83.71 ( $\pm$ 6.90)   | 64.8-93.5 | 80-100 fl                     |
| Mean MCH                | 26.25 ( $\pm$ 2.88)   | 19.1-30.1 | 26-32 pg                      |
| Mean MCHC               | 31.27 ( $\pm$ 1.34)   | 29.4-34.2 | 32-36 g/dl                    |
| Mean RDW                | 13.50 ( $\pm$ 1.63)   | 12.2-19   | 11.5-14.5%                    |
| Mean PLT                | 210.82 ( $\pm$ 59.39) | 124-322   | 150-450 X 10 <sup>9</sup> /L  |
| Mean MPV                | 8.82 ( $\pm$ 1.18)    | 6.8-11.5  | 9.4-12.3 fl                   |
| Mean PCT                | 0.19 ( $\pm$ 0.05)    | 0.11-0.20 | $\leq$ 0.15%                  |
| Mean PDW                | 16.21 ( $\pm$ 0.99)   | 13.1-17.5 | 10.0 - 17.9%                  |

\*Obtained from the World Health Organization (WHO).

### 3.1 Effect of wet cupping on White Blood Cells (WBCs) indices

#### 3.1.1 Total White Blood Cells (WBCs) count:

We looked into the WBCs count. The mean before wet cupping was 6.34 ( $\pm$  2) X 10<sup>9</sup>/L (Table 1). This number increased to 7.5 ( $\pm$  1.8) X 10<sup>9</sup>/L after wet cupping by one week. Then, the mean decreased to 6.9 ( $\pm$  1.6) X 10<sup>9</sup>/L after two weeks of wet cupping (Table 2). The result shows

that the WBCs count increased after one week of wet cupping but decreased after two weeks of wet cupping. Interestingly, a comparison of WBCs counts between before wet cupping and after one week of wet cupping showed a statistically significant difference ( $p=$  0.02). However, a comparison of WBCs counts between before wet cupping and after two weeks of wet cupping showed no statistical significance ( $p=$  0.33) (Table 2).

Table 2. Comparison between the WBCs counts before wet cupping, one week after wet cupping and two weeks after wet cupping.

| Comparisons                        | Comparison between baseline and results one week after wet cupping | Comparison between baseline and results two weeks after wet cupping |
|------------------------------------|--|---|
| Mean after wet cupping ( $\pm$ SD) | 7.5 ( $\pm$ 1.8) X 10 <sup>9</sup> /L                              | 6.9 ( $\pm$ 1.6) X 10 <sup>9</sup> /L                               |
| P value                            | 0.02*  | 0.33  |

\*Statistically significant at  $<$  0.05

### 3.2 Effect of wet cupping on Red Blood Cells (RBCs) indices:

#### 3.2.1 Total Red Blood Cells (RBCs) count:

We moved to look at the RBCs count. The mean before wet cupping was  $4.91 (\pm 0.41) \times 10^{12}/L$  (Table 1), then it decreased to  $4.89 (\pm 0.5) \times 10^{12}/L$  after one week of wet cupping. Then it raised to  $4.93 (\pm 0.5) \times 10^{12}/L$  after two weeks

of wet cupping (Table 3). The result shows that the RBC count decreased after performing wet cupping. However, the RBC count reversibly increased after two weeks of wet cupping. The comparison of RBCs counts between before and after wet cupping showed non-statistically significant results (Table 3).

Table 3. Comparison between the RBCs indices before wet cupping, one week after wet cupping and two weeks after wet cupping.

| Comparisons   | Comparison between baseline and results one week after wet cupping | Comparison between baseline and results two weeks after wet cupping |
|---|--|---|
| <b>Total Red Blood Cell (RBC)</b>                       |  |   |
| Mean after wet cupping ( $\pm$ SD)                      | $4.89 (\pm 0.5) \times 10^{12}/L$                                  | $4.93 (\pm 0.5) \times 10^{12}/L$                                   |
| P value   | 0.84   | 0.87  |
| <b>Hemoglobin (Hb)</b>                                  |  |   |
| Mean after wet cupping ( $\pm$ SD)                      | $13.74 (\pm 1) \text{ g/dl}$                                       | $13.5 (\pm 0.94) \text{ g/dl}$                                      |
| P value   | 0.003*   | 0.03*   |
| <b>Hematocrit (HCT)</b>                                 |  |   |
| Mean after wet cupping ( $\pm$ SD)                      | $42.2 (\pm 3.17)\%$  | $41.58 (\pm 2.14)\%$  |
| P value   | 0.18   | 0.49  |
| <b>Mean Corpuscular volume (MCV)</b>                    |  |   |
| Mean after wet cupping ( $\pm$ SD)                      | $86.77 (\pm 6.41) \text{ fl}$                                      | $85.29 (\pm 6.36) \text{ fl}$                                       |
| P value   | $< 0.001^*$  | $0.01^*$  |
| <b>Mean corpuscular hemoglobin (MCH)</b>                |  |   |
| Mean after wet cupping ( $\pm$ SD)                      | $28.31 (\pm 2.55) \text{ pg}$                                      | $27.28 (\pm 2.61) \text{ pg}$                                       |
| P value   | $< 0.001^*$  | $< 0.001^*$   |
| <b>Mean corpuscular hemoglobin concentration (MCHC)</b> |  |   |
| Mean after wet cupping ( $\pm$ SD)                      | $32.59 (\pm 1.18) \text{ g/dl}$                                    | $33.17 (\pm 2.17) \text{ g/dl}$                                     |
| P value   | $< 0.001^*$  | $0.006^*$   |
| <b>Red cell Distribution width (RDW)</b>                |  |   |
| Mean after wet cupping ( $\pm$ SD)                      | $14.34 (\pm 1.75)\%$   | $13.82 (\pm 1.98)\%$  |
| P value   | $0.004^*$  | 0.4   |

\*Statistically significant at  $< 0.05$

#### 3.2.2 Hemoglobin (Hb):

We analyzed the Hb level, the mean before wet cupping was  $12.82 (\pm 1.14) \text{ g/dl}$  (Table

1). In the first week after wet cupping, the Hb level showed an increase in the mean value  $13.74 (\pm 1) \text{ g/dl}$ . Later (i.e. after two

weeks), the Hb level showed a slight decrease of  $13.5 (\pm 0.94)$  g/dl (Table 3). Interestingly, these results were statistically significant in both comparisons, ( $p= 0.003$ ) in the first comparison between before wet cupping and one week after and ( $p= 0.03$ ) same with the second comparison between before wet cupping and two weeks after (Table 3).

### 3.2.3 Hematocrit (HCT):

In the analysis of HCT, the mean before wet cupping was  $40.94 (\pm 3.24)\%$  (Table 1), it increased in one week after wet cupping to  $42.2 (\pm 3.17)\%$ , then slightly decreased in two weeks after wet cupping  $41.58 (\pm 2.14)\%$  (Table 3). We observed non-statistically significant results in both comparisons.

### 3.2.4 Mean corpuscular volume (MCV):

We looked at the MCV level. The mean before wet cupping was  $83.71 (\pm 6.9)$  fl (Table 1), it increased in one week after wet cupping  $86.77 (\pm 6.41)$  fl and decreased in two weeks after wet cupping  $85.29 (\pm 6.36)$  fl (Table 3). This result shows that the MCV level increased after one week of wet cupping but decreased after two weeks of wet cupping. The results show significant differences between the groups in both comparisons; ( $p< 0.001$ ) in the first comparison between before wet cupping and one week after and ( $p= 0.01$ ) in the second comparison between before

wet cupping and two weeks after (Table 3).

### 3.2.5 Mean corpuscular hemoglobin (MCH):

We looked at the MCH level. The mean before wet cupping was  $26.25 (\pm 2.88)$  pg (Table 1), it increased in one week after wet cupping  $28.31 (\pm 2.55)$  pg, and decreased in two weeks after wet cupping  $27.28 (\pm 2.61)$  pg (Table 3). These results show that the MCH level increased after one week of wet cupping but decreased after two weeks of wet cupping. The results show significant differences between the group in both comparisons; ( $p< 0.001$ ) in the first comparison between before wet cupping and one week after and ( $p< 0.001$ ) in the second comparison between before wet cupping and two weeks after (Table 3).

### 3.2.6 Mean corpuscular hemoglobin concentration (MCHC):

We analyzed the MCHC level, before wet cupping the mean was  $31.27 (\pm 1.34)$  g/dl (Table 1), in the first week after wet cupping it showed an increase in the mean value  $32.59 (\pm 1.18)$  g/dl, and then it also increased after two weeks of wet cupping  $33.17 (\pm 2.17)$  g/dl. These results were statistically significant in both comparisons; ( $p< 0.001$ ) in the first comparison between before wet cupping and one week after and ( $p= 0.006$ ) in the second comparison between before wet cupping and two weeks after (Table 3).

**3.2.7 Red cell distribution width (RDW):** We investigated the RDW ratio. The mean before wet cupping was 13.5 ( $\pm 1.63$ )% (Table 1). This number increased to 14.34 ( $\pm 1.75$ )% after wet cupping by one week. Then, the mean decreased to 13.82 ( $\pm 1.98$ )% after two weeks of wet cupping. This result shows that the RDW ratio increased after one week of wet cupping and decreased after two weeks of wet cupping. Interestingly, the comparison of the RDW ratio between before wet cupping and after one week of wet cupping shows a statistically significant difference ( $p= 0.004$ ) (Table 3). However, a comparison of the RDW ratio between before and after two weeks of wet cupping shows non-statistical significance.

### 3.3 Effect of wet cupping on Platelets (PLTs) indices:

#### 3.3.1 Platelets (PLT) count:

In the analysis of PLT, the mean before wet cupping was 210.8 ( $\pm 59.4$ ) X 10<sup>9</sup>/L

(Table 1), it decreased after one week of wet cupping 208.1 ( $\pm 56.1$ ) X 10<sup>9</sup>/L, and increased after two weeks of wet cupping 209.8 ( $\pm 51.06$ ) X 10<sup>9</sup>/L (Table 4). We observed a non-statistically significant result in both comparisons.

#### 3.3.2 Mean platelet volume (MPV):

We investigated the MPV level. The mean before wet cupping was 8.82 ( $\pm 1.18$ ) fl (Table 1). This number increased to 9.94 ( $\pm 1.75$ ) fl after one week of wet cupping. Then, the mean decreased to 8.74 ( $\pm 1.18$ ) fl after two weeks of wet cupping (Table 4). The result shows that the MPV level increased after one week of wet cupping and decreased after two weeks of wet cupping. Comparison of MPV level between before wet cupping and after one week of wet cupping shows a statistically significant difference ( $p= 0.03$ ). However, a comparison of MPV level between before wet cupping and after two weeks of wet cupping shows a non-statistical significance ( $p= 0.81$ ).

Table 4. Comparison between the PLT indices before wet cupping, one week after wet cupping, and two weeks after wet cupping.

| Comparisons                        | Comparison between baseline and results one week after wet cupping | Comparison between baseline and results two weeks after wet cupping |
|------------------------------------|--|---|
| Platelets count (PLT)              |  |   |
| Mean after wet cupping ( $\pm$ SD) | 208 ( $\pm 56.1$ ) X 10 <sup>9</sup> /L                            | 209.8 ( $\pm 51.06$ ) X 10 <sup>9</sup> /L                          |
| P value                            | 0.89   | 0.94  |
| Mean Platelet Volume (MPV)         |  |   |
| Mean after wet cupping ( $\pm$ SD) | 9.94 ( $\pm 1.75$ ) fl   | 8.74 ( $\pm 1.18$ ) fl  |
| P value                            | 0.03*  | 0.81  |

| Comparisons                        | Comparison between baseline and results one week after wet cupping | Comparison between baseline and results two weeks after wet cupping |
|------------------------------------|--|---|
| Plateletcrit (PCT)                 |  |   |
| Mean after wet cupping ( $\pm$ SD) | 0.20 ( $\pm$ 0.03)%  | 0.18 ( $\pm$ 0.04)%   |
| P value                            | 0.22   | 0.71  |
| Platelet Distribution Width (PDW)  |  |   |
| Mean after wet cupping ( $\pm$ SD) | 15.7 ( $\pm$ 1.5)%   | 16.14 ( $\pm$ 0.9)%   |
| P value                            | 0.09   | 0.8   |

\*Statistically significant at  $< 0.05$

### 3.3.3 Plateletcrit (PCT):

For PCT, the mean before wet cupping was 0.19 ( $\pm$  0.05)% (Table 1), it increased after one week of wet cupping 0.20 ( $\pm$  0.03)% and decreased after two weeks of wet cupping 0.18 ( $\pm$  0.04)% (Table 4). In the analysis of PCT, we observed a non-statistically significant result in both comparisons.

### 3.3.4 Platelet distribution width (PDW):

We moved to look at the PDW ratio. The mean before wet cupping was 16.21 ( $\pm$  0.99)% (Table 1), it decreased to 15.7 ( $\pm$  1.5)% after one week of wet cupping. Then it raised to 16.14 ( $\pm$  0.9)% after two weeks of wet cupping (Table 4). The comparison of PDW between before and after wet cupping showed non-statistically significant results.

## 4. Discussion:

In this study, we show that wet cupping has a significant impact on several hematological parameters such as WBCs, Hb, MCV, MCH, MCHC, RDW and MPV. Although other parameters were still affected by wet cupping, it was not statistically significant.

### 4.1 Effect of wet cupping on total WBCs count:

White Blood Cells (WBCs) play a crucial role in the immune system by protecting the body from infectious disease and foreign substances<sup>14</sup>. The results of our study show that wet cupping influences the total WBCs count after one week, where the increase was statistically significant. In contrast after two weeks, it was not statistically significant. Measuring WBCs count is considered as one way for assessing the stimulation of the immune system. It has been known that the immune system could be enhanced by wet cupping<sup>5</sup>. Our result confirms the previous statement in which we observed a significant increase in the WBCs count after one week from performing wet cupping. However, when we measure the WBCs count after two weeks from performing wet cupping, we did not observe this significant increase. This observation is consistent with another study that shows no significant difference between WBCs count before wet cupping and two

weeks after wet cupping<sup>1</sup>. So, our study added additional evidence for the transient enhancement of the immune system upon wet cupping, and this observation triggers further investigation to understand the significance of this phenomenon. One of the main limitations of this study is that we did not compare the clinical conditions of participants, whether are they infected during the study duration. Besides, the variation of the results might be due to the cupping methodology that we and others applied.

#### *4.2 Effect of wet cupping on RBCs indices:*

**4.2.1 Effect of wet cupping on RBCs count:** Red Blood Cells (RBCs) are responsible for delivering oxygen to the cells and tissues in which oxygen is carried by the hemoglobin, which is a constituent part of RBCs<sup>15</sup>. Counting the RBCs is considered as one way of assessing anemia<sup>12</sup>. The results of our study show that the wet cupping has no or minimal effect on the total RBCs count after one and two weeks of wet cupping. There were inconsistent results about the effect of wet cupping on RBCs count. Our results are consistent with the studies that show a minimal difference in the total RBCs count when it is measured before and after the wet cupping<sup>11, 16</sup>. On the other hand, there is one study that shows a statistically significant decrease ( $p= 0.04$  in a cohort of 48 participants) of the total RBCs count when it is measured after two

weeks of the wet cupping<sup>1</sup>. It is essential to mention that the decreased RBCs count reported in our study was not clinically significant (i.e. it did not cause anemia).

One of the main arguments against wet cupping is the possibility of wet cupping causing anemia. Our results showed that RBCs count is not significantly decreased after the wet cupping procedure. This is also observed in many other studies<sup>1, 12</sup>. It is important to mention that these results are based on following standard wet cupping protocols that prohibit frequent wet cupping procedures and a high number of incisions<sup>6, 17-20</sup>.

#### *4.2.2 Effect of wet cupping on Hb level:*

Hemoglobin (Hb) is an RBCs that contained a protein, that has a function in oxygen delivery<sup>21-23</sup>. Measuring Hb level is considered as one way of assessing polycythemia (the increase in RBCs hematocrit or hemoglobin level when measuring in CBC as compared to reference range)<sup>24</sup>. The results of our study show that wet cupping has a significant effect on Hb level after one and two weeks. There were inconsistent results on the impact of wet cupping on the Hb level. For instance, some studies show that there is a minimal difference in the Hb level when it is measured before and after the wet cupping<sup>12, 17</sup>. Other studies, which are consistent with our results, showed that there was a sta-

tistically significant difference in the Hb level when it is measured before and after wet cupping<sup>1,5</sup>. Again, we did not observe anemia upon wet cupping. Therefore, our study is confirming the safety of wet cupping as it will not cause anemia if it is performed properly.

#### 4.2.3 Effect of wet cupping on HCT level:

The term Hematocrit (HCT) is known as the measuring of the volume of packed RBCs relative to whole blood. It is also known as packed cell volume (PCV). It is a simple test used to recognize a condition such as anemia and polycythemia. This test is also used for monitoring drug response<sup>18</sup>. The results of our study show that the wet cupping has no or minimal effect on the HCT level after one and two weeks of wet cupping. Our results are consistent with previous reports that show no significant difference in hematocrit level when it is measured before and after wet cupping<sup>16, 17</sup>.

#### 4.2.4 Effect of wet cupping on MCV:

Mean Corpuscular Volume (MCV) is a laboratory measurement that determines the average size and volume of RBCs. It is useful and helpful in determining the cause of anemia<sup>19</sup>. The results of our study show that the wet cupping has a noticeable effect on the MCV level after one and two weeks of wet cupping. There were inconsistent results on the impact of wet cupping on the

MCV level. These reports show that there is a minimal difference in the MCV level before and after the wet cupping<sup>1,12</sup>. On the other hand, our result was consistent with one study that showed a significant difference in MCV level when measured before and after wet cupping<sup>25</sup>.

#### 4.2.5 Effect of wet cupping on MCH:

Mean Corpuscular Hemoglobin (MCH) is the average amount of hemoglobin per single RBC in a blood sample. It is a useful tool that helps in determining hypochromic anemia<sup>20</sup>. The results of our study show that the wet cupping has a significant effect on MCH level after one and two weeks of wet cupping. There were inconsistent results about the effect of wet cupping on the MCH level show that there is a minimal difference<sup>1,12</sup>. There is a study, which is consistent with our results, show that there is a significant difference in MCH level when it is measured before and after the wet cupping<sup>25</sup>.

#### 4.2.6 Effect of wet cupping on MCHC:

Mean Corpuscular Hemoglobin concentration (MCHC) is known as the measuring concentration of hemoglobin in a specific blood sample. It is a useful tool in determining iron deficiency<sup>26</sup>. The results of our study show that the wet cupping has a significant effect on the MCHC level after one and two weeks of wet cupping. There were inconsistent results on the impact of

wet cupping on the MCHC level showed that there is a minimal difference<sup>1</sup>. Some studies, which are consistent with our results show that there was a significant difference in the MCHC level when it is measured before and after wet cupping<sup>17,25</sup>.

#### 4.2.7 Effect of wet cupping on RDW:

Red Cell Distribution Width (RDW) is a simple and cheap parameter that shows the degree of heterogeneity of erythrocyte volume. It is useful in the differential diagnosis of anemia<sup>8, 27</sup>. The results of our study show that the wet cupping influences RDW after one week, where the increase was statistically significant. However, RDW is not statistically significantly different after two weeks.

#### 4.3 Effect of wet cupping on PLT indices:

##### 4.3.1 Effect of wet cupping on PLT count:

Platelets (PLTs) also called thrombocytes are tiny cells that are important for normal blood clotting<sup>21</sup>. Measuring PLT count is considered an essential way in the assessment of bleeding disorder, or excessive clotting disorder<sup>22</sup>. The results of our study show that wet cupping has no or minimal effect on the total PLT count after one week and after two weeks of wet cupping. There was an inconsistent study about the impact of wet cupping on PLT count<sup>1</sup>. There is a study, which is consistent with our result, show that there was minimal difference in the total PLT count when it measured be-

fore and after wet cupping<sup>16</sup>.

##### 4.3.2 Effect of wet cupping on MPV:

Mean Platelet Volume (MPV) is a laboratory test associated with platelet function and activity; it is considered an important indicator for the thromboembolic disease<sup>23</sup>. The results of our study show that the wet cupping influences the MPV after one week, where the increase was statistically significant. On the other hand, the MPV was not statistically significant after two weeks. Our result is aligned with the previous statement in which we observed a significant increase in the MPV after one week. However, when we measure MPV after two weeks from performing the wet cupping, we did not observe a significant increase.

##### 4.3.3 Effect of wet cupping on PCT:

Plateletcrit (PCT) Is the measurement of total platelet mass<sup>24</sup>. The results of our study showed that wet cupping has no or minimal effect on PCT after one and two weeks of wet cupping.

##### 4.3.4 Effect of wet cupping on PDW:

Platelet distribution width (PDW) is the calculation of platelet anisocytosis that is measured from the distribution of person platelet volume<sup>25</sup>. The results of our study show that wet cupping has no or minimal effect on PDW after one and two weeks of wet cupping.

### 5. Conclusion:

Wet cupping has a significant effect on hematological parameters, and it is also safe when it is performed by trained people in the right way. Based on our findings, we are suggesting studying the effect of wet cupping on hematological parameters in a larger cohort. Furthermore, it is worthwhile to study the significance of the transient elevation of WBCs count and its correlation with different WBC cells as well as other immunological biomarkers.

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Review Article :

## Lumbar Segmental Instability Classification: Functional, Structural and Multiple Instability

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**Abstract**

Low back pain (LBP) is a widespread condition. One of the common cause of LBP is lumbar segmental instability (LSI). The understanding of LSI can be improved by dividing cases into three subcategories: functional instability; if neuromuscular system is dysfunctional, structural instability; if osseoligamentous structure is disrupted, and multiple instability; if both subcategories are existed. Elucidating distinctions between sub-classifications might improve common understanding regarding LSI subcategories among physical therapists, radiologists and spinal physicians. The purpose of this review is to highlight the distinctions among the three LSI subcategories, which includes their definitions, scientific evidence, and clinical tests. This review will help to improve understanding of LSI and guide clinical diagnostic decisions. Additionally, this review might help in future research on LSI into three distinct and clinically meaningful sub-classifications.

**Keywords:**

Low back pain, Lumbar segmental instability, Classification, Functional instability, Structural instability, Multiple instability.

**المخلص**

آلام أسفل الظهر (LBP) هي حالة منتشرة. أحد الأسباب الشائعة لـ LBP هو عدم استقرار أو ثبات الفقرات القطنية (LSI). يمكن تحسين فهم LSI عن طريق تقسيم الحالات المرضية إلى ثلاث فئات فرعية: عدم استقرار الفقرات وظيفياً؛ إذا قلّة كفاءة النظام (العصبي-العضلي). عدم استقرار الفقرات بنائياً؛ إذا قلّة كفاءة النظام (الهيكلية-الرباطية). عدم الاستقرار المضاعف؛ إذا تأثر كلا النظامين في آن واحد. قد يؤدي إيضاح الفروق بين التصنيفات الفرعية إلى تحسين الفهم المشترك فيما يتعلق بفئات LSI الفرعية بين أخصائيي العلاج الطبيعي وأطباء الأشعة وأطباء العمود الفقري. الغرض من هذه المراجعة هو تسليط الضوء على الفوارق بين فئات LSI الفرعية الثلاثة، والتي تشمل تعريفاتها، والأدلة العلمية، والاختبارات السريرية. تساعد هذه المراجعة في تحسين فهم LSI وتوجيه قرارات التشخيص السريري. علاوة على ذلك، قد تساعد هذه المراجعة في توجيه الأبحاث المستقبلية حول LSI إلى ثلاثة تصنيفات فرعية مميزة وذات مغزى سريري.

**الكلمات المفتاحية :**

آلام أسفل الظهر، عدم استقرار الفقرات القطنية، التصنيف، عدم الاستقرار الوظيفي، عدم الاستقرار الهيكلية الرباطية، عدم الاستقرار المضاعف.

## INTRODUCTION:

Lumbar segmental instability (LSI) is believed to be a main cause of the high recurrence rates of low back pain (LBP)<sup>1</sup>. However, concept of LSI is different among different specialties<sup>2</sup>. For example, spinal surgeons view LSI as segmental movement that exceeds normal segmental range of motion (ROM), especially at end-ROM<sup>2</sup>. In contrast, physiotherapists view LSI as neuromuscular control error across motion segments, especially at mid-ROM<sup>3</sup>. Both types lead to excessive tissue elongation/compression and thus irritation/injury of the soft tissues of motion segment<sup>4</sup>. Despite unique features, both can exist separately or jointly (multiple instability).

The main aim of this review is to highlight distinctions among LSI sub-classifications: Functional, structural, and multiple instability. Elucidating distinctions between sub-classifications might improve common understanding regarding LSI subcategories among physical therapists, radiologists and spinal physicians<sup>5</sup>. Additionally, this review might help in future research on LSI into three distinct and clinically meaningful sub-classifications.

### Lumbar segmental instability:

In normal tasks of daily living, e.g. bending forward, each spinal segment slide forward and rotate<sup>2</sup>. Therefore, if one seg-

ment suddenly moves beyond its normal range, spinal structures may sustain overstretch/compression injuries/irritation<sup>3,4</sup>. Instability is defined as loss of segmental stiffness or abnormal response to applied loads characterized by movement of motion segments beyond normal constraints<sup>6</sup>. Panjabi proposed a biomechanical model of spinal stabilization system involving three anatomical subsystems: passive, active and neural control subsystems<sup>4</sup> (Figure-1).

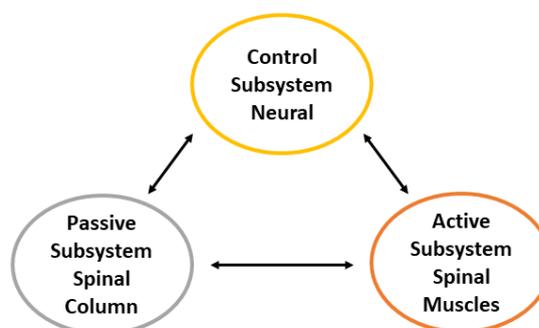


Figure 1. the spinal stability system consists of three subsystems: passive spinal column, active spinal muscles and neural control unit

However, the main function of the neuromuscular control subsystem is to orchestrate adequate and timely orders to ensure appropriate muscular recruitment<sup>7</sup>. This leads LSI classification into: 1) functional instability, if active( neuromuscular) system is dysfunctional; 2) structural instability, if passive (osseoligamentous ) system is disrupted; and 3) multiple instability, if both systems are affected (Figure-2).

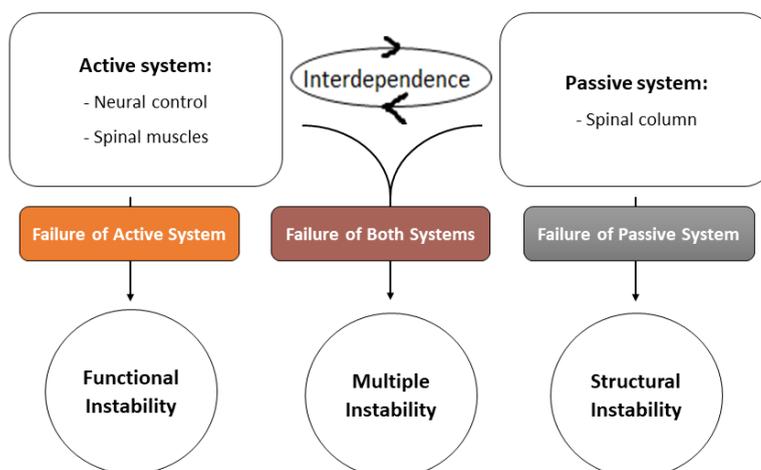


Figure 2. Relationship between the binary stabilization system and the SLI classification

LSI patients have LBP during spinal movement, positioning/sustained postures<sup>8</sup>. The patient report “giving-way”/“slipping” sensation<sup>9</sup>. Symptoms decrease with rest and bracing<sup>10</sup>.

**Functional (patho-mechanical) instability:**

Functional instability refers to “a significant decrease in capacity of active system to maintain the intervertebral neutral zones within physiological limits[expansion of neutral zone] so that there is no neurological dysfunction, no major deformity and no incapacitating pain”<sup>11</sup>. (Figure-3)

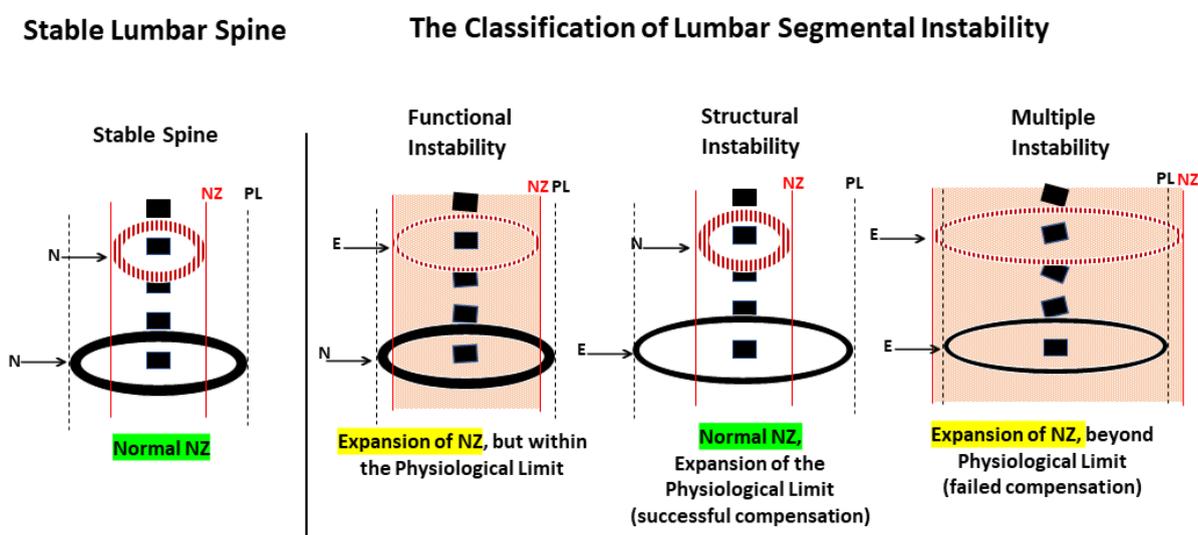


Figure 3: Theoretical interaction between the active system (red circles) and passive system (black circles) and their effects on the size of the neutral zone (NZ) in the stable lumbar spine and instability subcategories. NZ: neutral zone; PL: physiological limit; N: normal; E: expansion.

If spinal segment is unable to support load and maintain a normal pattern of displacement, it is considered unstable, which may generate LBP<sup>12</sup>.

#### **Evidence of Functional Instability:**

Studies have reported abnormal increase in lumbar segmental translation in patients with recurrent LBP<sup>13,14</sup>. Other studies have reported muscular deficits at pain level or increased fatty tissue infiltration leading to acute<sup>15</sup>, chronic and recurrent LBP<sup>16</sup>. Wallwork et al.<sup>17</sup> reported an association in chronic LBP patients between lumbar multifidus muscle(LMM) atrophy and reduced voluntary isometric muscle contraction. Furthermore, Tsao et al. found an association between recurrent LBP and adaptive motor cortex remapping favouring superficial fascicles of the longissimus erector spinae at expense of the deep fibres of the LMM<sup>18</sup>. Lastly, LBP patients demonstrated reduced proprioception, impaired postural control and impaired ability to react to perturbations<sup>19</sup>. All this evidence may indicate a deficit of the active system, which may increase the risk of lumbar spine buckling injuries as a result of delayed and inefficient spinal muscular recruitment.

#### **Functional Instability Tests:**

Hicks et al. proposed four predictors that, together, form the clinical prediction rule

(CPR) for determining which LBP patients will respond to stabilization exercise<sup>20</sup>. CPR involves four variables<sup>21</sup>: age <40 years, positive result for Prone Instability Test (PIT), presence of aberrant lumbar movement during trunk motion testing and a mean straight leg raise (SLR) >91°. If CPR is positive (three of four variables are present), likelihood of stabilization success increases from 33% to 67%. CPR was validated in two treatment-based classification studies<sup>22,23</sup> and reliability ranges from substantial to excellent<sup>21</sup>. Another CPR validity study, Rabin et al.<sup>24</sup> proposed a modified CPR that involves only two items (the presence of aberrant movement and a positive PIT) and had an improved predictive validity for identifying individuals most likely to succeed with stabilization exercise, but this requires further validation.

#### **Structural (Radiographic/Patho-anatomical ) Instability:**

Structural/radiographic instability refers to “disruption of passive stabilizers and decreased structural integrity”<sup>25</sup> due to progressive degenerative changes<sup>4</sup>. The main feature of segmental osseoligamentous structures is passive stability at physiological end-ROM. (Figure-3)

#### **Evidence of Structural Instability:**

Various imaging techniques such as radi-

ography, CT, and MRI are used to visualize structural abnormalities. Carragee et al. found that about 90% of 200 asymptomatic subjects had radiographic signs of abnormality, despite not having LBP. Among asymptomatic subjects, 36% had a herniated disc, 21% had spinal stenosis and >90% had a degenerated disc<sup>26</sup>. More pertinently, LSI radiographic studies have reported high false-positive rates for individuals without LBP<sup>2</sup>.

As the majority of people with static radiographic signs are asymptomatic, it is important to realize that these signs might indicate a previous period of degenerative instability that resulted in re-stabilization<sup>9</sup>. Thus, static radiographic signs of degenerative instability are part of normal ag-

ing and their usefulness depends on establishing a cause-and-effect relationship between them and clinical presentation among LSI patients<sup>2</sup>.

### Structural Instability Tests:

Widely used assessment method is flexion-extension/dynamic radiography, which was first described by Knuttson to identify and quantify abnormal anterior-to-posterior translation of the motion segments at end-ROM<sup>27</sup>. Common criteria for structural instability diagnosis is 3 mm or 9% of vertebral body width on flexion-extension radiograph or 9° of sagittal plane rotation between the L1–L5 motion segments. There are a number of clinical tests that are reported to predict dynamic radiograph findings<sup>28</sup> (Table 1).

Table 1: Clinical tests predicting dynamic radiograph findings

| Author                             | Test                                | Reliability    | Sensitivity (95% CI) | Specificity (95% CI) | +LR (95% CI)      | -LR (95% CI)      |
|------------------------------------|-------------------------------------|----------------|----------------------|----------------------|-------------------|-------------------|
| Kasai et al. <sup>[29]</sup>       | PLET                                | k=0.46 to 0.76 | 84 (68, 93)          | 90 (82, 96)          | 8.8 (4.5, 17.3)   | 0.2 (0.1, 0.4)    |
| Esmailiejah et al. <sup>[30]</sup> | PLET                                | -              | 78.8                 | 94.7                 | 19.44 (2.80, 135) | 0.29 (0.15, 0.55) |
| Abbott et al. <sup>[31]</sup>      | PPIVM (flexion)                     | -              | 5 (1, 22)            | 99.5 (97, 100)       | 8.7 (0.6, 134.7)  | 1.0 (0.9, 1.1)    |
|                                    | PPIVM (extension)                   | -              | 16 (6, 38)           | 98 (94, 99)          | 7.1 (1.7, 29.2)   | 0.9 (0.7, 1.1)    |
| Fritz et al. <sup>[13]</sup>       | Lack of intervertebral hypomobility | k=-0.2 to 0.3  | 43 (0.27, 0.61)      | 95 (0.77, 0.99)      | 9.0 (1.3, 63.9)   | 0.60 (0.43, 0.84) |

k=kappa coefficients; +LR=positive likelihood ratio; -LR=negative likelihood ratio; PPIVM=Passive Physiological Intervertebral Movements; PLET=Passive lumbar extension test.

### Multiple (pathomechanical/pathoanatomical) Instability:

Multiple instability is defined as “expan-

sion of the neutral region that cannot be held at physiological limits when a problem occurs in subsystems that provide sta-

bility in the spine”<sup>32</sup> (Figure-3).

Clinically, multiple instability can be defined as; an expansion of intervertebral motion of the lumbar spine beyond physiological limits that causes chronic intractable LBP (with or without sciatica) due to suboptimal generation of stiffness by both active and passive systems”.

#### **Evidence of Multiple Instability:**

Panjabi hypothesized that sub-failure ligament injuries due to single or cumulative micro-traumas generates corrupted signals to the neuromuscular control unit, which in turn produces a corrupted muscular response. The persistently inaccurate muscular response produces higher stresses and strains on the spinal components, leading to further sub-failure<sup>16</sup>.

Accumulated evidence links spinal osseoligamentous injuries or degeneration to neuromuscular control impairments that indicate multiple instability. For example, experimentally induced intervertebral disk injury causes focal atrophy, as indicated by decreased LMM cross-sectional area at the relevant level in a porcine<sup>33</sup> model and in patients with disk herniation<sup>34,35</sup>. Furthermore, spinal degeneration conditions are associated with decreased density of the paraspinal muscles<sup>36</sup>. More recent, 22 consecutive patients undergoing surgery due to chronic degenerative lumbar spine

pathology were found to have high levels of LMM degeneration<sup>37</sup>. This further confirms relationship between degenerative osseoligamentous structures and dysfunction of active subsystem in LBP patients.

#### **Multiple Instability Tests:**

To categorize a case of LSI as multiple instability, both functional and radiographic instability tests have to be positive.

#### **Conservative treatment of lumbar segmental instability:**

In functional instability, the neutral zone (NZ) expansion can overstretch and/or compress spinal structures beyond their normal NZ limits. However, the expansion does not pass the physiological limits. Therefore, although the flexion-extension radiography results are negative, patient signs and symptoms can indicate functional instability (false-negative). Therefore, historically, functional instability diagnosis has been considered as a diagnosis of exclusion<sup>28</sup>. In contrast, multiple instability affects both the active and passive systems, so the expansion of the NZ passes the physiological limits, which can be observed on flexion-extension radiographs. Contrary, structural instability is a potential rather than an actual instability sub-classification that represents disruption and deterioration of the passive stabilizers, which might be masked (successful com-

pensation) primarily by the active system. However, if the compensation fails, the segmental motions will exceed the physiological limits, causing multiple instability. Based on this model, we can predict that functional and multiple instabilities are reversible (Figure 4).

### Conservative Treatment of Lumbar Segmental Instability

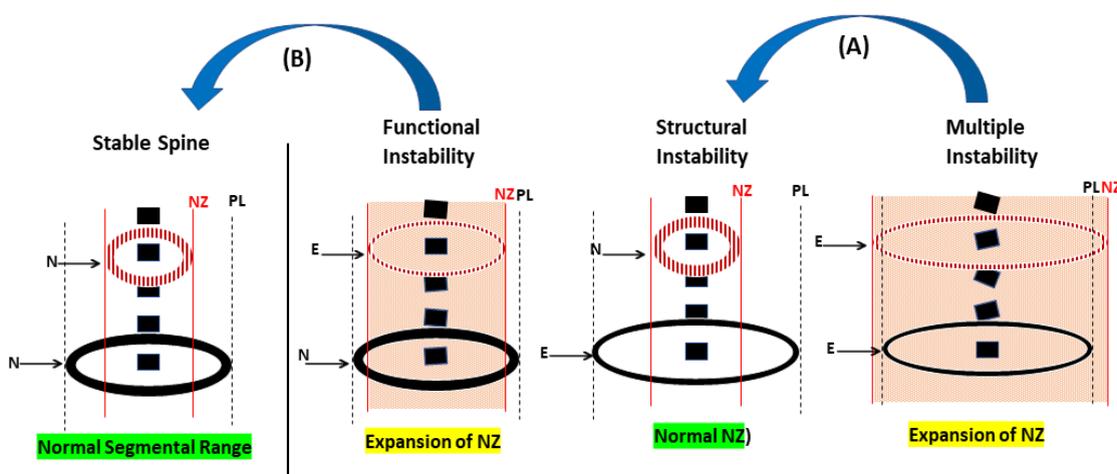


Figure 4: The arrows indicate the translation of patient classification from: (A) the expansion of NZ classifications (multiple instability) to potentially normal NZ classification (structural instability) and (B) the expansion of NZ classifications (functional instability) to normal NZ classification (healthy stable spine).

### CONCLUSIONS:

In this review, we proposed clinical LSI classification system involving functional, structural and multiple instability that are based on reformulation of Panjabi's theory. Two clinical instability sub classifications are caused by expansion of NZ: functional and multiple instability, primarily due to active stabilization system dysfunction. As stabilization exercises can restore functionality of active system, which subsequently restores the normal NZ, multiple instability can be reversed to produce structural instability and functional instability can be reversed to produce a stable

spine.

### SOURCE OF FUNDING

NIL

### CONFLICT OF INTEREST

NIL

### KEY POINTS:

- The understanding of clinical concept of LSI can be improved by dividing LSI individuals into three subcategories: functional, structural and multiple instability.
- Active (neuromuscular) system dysfunctionality may cause LBP due to expansion of NZ.

- The improvement of patients' outcome due to stabilization exercises can be attributed to restoration of active system functionality, thus, restoration of normal NZ.
- Because active stabilization system is trainable, multiple instability and functional instability can be reversed to produce structural instability and stable spine, respectively.

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Case Report :

## Third (Intermediate) head of gastrocnemius muscle; a case report and literature review

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**Abstract**

Anatomical variations of limb musculature are common. During the routine dissection for teaching musculoskeletal course for second year students of Medicine, a third (Intermediate) head of the gastrocnemius muscle was detected in a 70-year-old female cadaver in left lower limb. It was originated from the posterior surface of the distal end of the femur by small tendon and extended as long muscular belly. Throughout its course, this belly crosses superficial to the popliteal fossa beneath the skin on its way to join the medial side of the lateral head of gastrocnemius muscle. Furthermore, the intermediate head takes its innervation from the nerve to the lateral head of gastrocnemius that passes on its deeper aspect. No such variation was found in the right lower limb. Knowledge of these variants is very important in clinical practice.

**Keywords:**

Gastrocnemius, Dissection, Variation, intermediate head and Cadaver.

**الملخص**

تعتبر الاختلافات التشريحية لعضلات الأطراف شائعة. أثناء التشريح الروتيني لتدريس مقرر العضلات والعظام للسنة الثانية لطلاب الطب، تم اكتشاف رأس ثالث (متوسط) لعضلة الساق في جثة أنثى تبلغ من العمر ٧٠ عاماً في الطرف السفلي الأيسر. نشأ من أسطح الخلفي للنهاية البعيدة لعظم الفخذ بواسطة وتر صغير ويمتد مثل البطن العضلي الطويل. خلال مساره يتقاطع هذا البطن سطحياً مع الحفرة المأبضية تحت الجلد في طريقه للانضمام إلى الجانب الإنسي للرأس الجانبي لعضلة الساق. علاوة على ذلك، يأخذ الرأس الوسيط تعصيبه من العصب إلى الرأس الجانبي لعضلة الساق الذي يمر على جانبه الأعمق. لم يتم العثور على مثل هذا الاختلاف في الطرف السفلي الأيمن. معرفة هذه المتغيرات مهمة جداً في الممارسة السريرية.

**Introduction:**

The gastrocnemius muscle is the superficial muscle of the back of the leg. It was a powerful planter flexor of the ankle joint<sup>1</sup>. The gastrocnemius muscle proximally originated by two heads, the medial head

arose from the popliteal surface of the femur superior to the medial condyle and the lateral head arose from lateral aspect of lateral condyle of the femur. Distally it attaches to the posterior surface of calcaneum via Achilles tendon<sup>1</sup>. The gastrocne-

mius muscle take origin from both diaphysis and shaft the lateral head arises by a tendon from the lateral surface of lateral condyle and by few fleshy fibers from the lateral supracondylar ridge. The medial head arises by tendon from the medial supracondylar and by fibrous from the popliteal surface of the femur <sup>2</sup>.

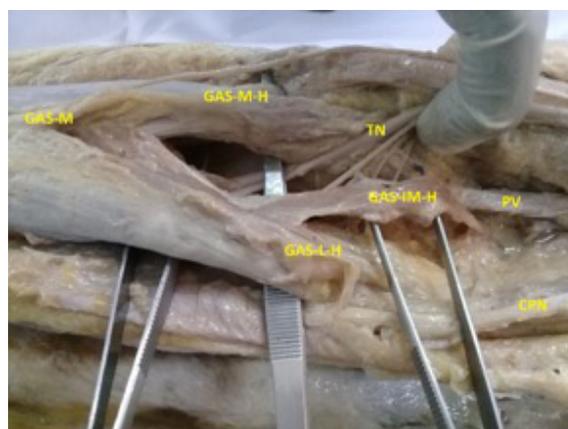
In a case report the gastrocnemius muscle was observed with three heads. Accessory third head was fused with the medial head with sural nerve entrapped between them [3]. Amuscular belly was noted in the middle of the popliteal fossa. It was arising by two tendons from the biceps femoris long head and semitendinosus muscle. It has a tendon courses between the two heads of gastrocnemius muscle and runs on superficial to the tendocalcaneus <sup>4</sup>.

### Case report:

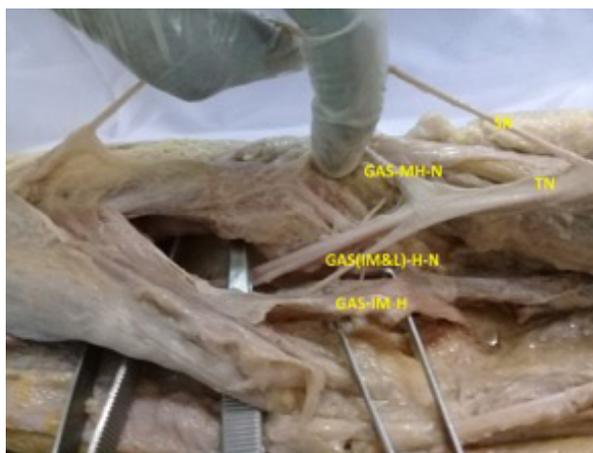
During the routine dissection for second year medical students at the department of Anatomy of Riyadh International College of Medicine for the academic year 2018-2019. A third (Intermediate) head of the gastrocnemius muscle was detected in a 70-year-old female cadaver in left lower limb. The contents of popliteal fossa and the gastrocnemius muscle heads were carefully dissected and cleaned. An intermediate head of the gastrocnemius was observed, it had its origin from the posterior

surface of the distal end of the femur by small tendon about 1 cm just lateral to the popliteal vessels. Further, when followed distally it was extended as long muscle belly running beneath the skin of the popliteal fossa with the tibial nerve and popliteal vessels deeperto it. The intermediate head finally joins the lateral head of gastrocnemius on its medial aspect near its junction with medial head. The intermediate head measured 5.48 cm long. The tibial nerve gives a common branch which passes on the deeper aspect to the intermediate and lateral heads. Then the intermediate and lateral heads were joining the medial head where they constitute gastrocnemius muscle, which was the normal in morphology as demonstrated in Figures 1&2.No other variation or variant was encountered.

"Fig. 1."Showing the third head (intermediate) (GAS-IM-H) of the gastrocnemius muscle(GAS-M) joining the lateral head (GAS-L-H). Also shown in the figure are medial head of gastrocnemius (GAS-M-H), popliteal vein (PV), tibial nerve (TN), and common peroneal nerve (CPN)



“Fig. 2.” Showing the nerve supply to the (GAS-IM&L-H) third head (Intermediate) (GAS-IM-H) and lateral head (GAS-L-H), medial head of gastrocnemius (GAS-M-H) and tibial nerve (TN) and (SN)sural nerve



### Discussion:

Variations of muscles have been usually benign; it occurs due to genetic factors or embryological errors <sup>5</sup>. Anomaly of the gastrocnemius muscle of origins and accessory heads are usually encountered at the popliteal fossa <sup>6</sup>. Additional slips of the gastrocnemius muscle may have different sites of origin <sup>7</sup>. A study of thirty west Nigerian cadavers, the gastrocnemius muscle were found attached by four heads representing 51.7%, followed by two-headed gastrocnemius muscle representing 35% and lastly three-headed muscle in about 13.3% of investigated limbs <sup>8</sup>.

Srinivasa et al reported accessory muscular belly about 4.8 cm long was in the popliteal region. It has a separate branch of the tibial nerve; the belly extends to fuse with the medial head of the gastrocnemius muscle with the popliteal vessels entrapped

between them <sup>9</sup>. A north Indian 70-year-old male cadaver showed additional head for gastrocnemius muscle, it was originating from the supracondylar ridge and lateral condyle of the femur. The three heads united together to form the tendocalcaneus <sup>10</sup>. Yildirim et al describes the third additional head as gastrocnemius tertius which was found on two sides, his case presented also an unilateral accessory soleus muscle. The medial head of the gastrocnemius muscle receives the junction of right gastrocnemius tertius <sup>11</sup>.

In a 54-year-old female the left lower extremity showed a muscular belly representing the third head of the gastrocnemius muscle. This belly was coming proximally from the popliteal surface of the femur shaft, at the lower part of the popliteal fossa, it fused heads of the gastrocnemius muscle <sup>12</sup>. In comparison to previous literature to the current case, the intermediate head of the gastrocnemius muscle measured about 4.48 cm in length, it was arising from the posterior surface of the lower end of the femur and extended straightly to merge with the lateral head near its fusion with the medial head.

20 out of 1,039 investigated knees demonstrated a third head arising from the back of the distal end of the femur and finally fused with the medial aspect of the lateral head of the gastrocnemius. One case

of a third head of the gastrocnemius was seen which joined the medial head of the gastrocnemius. Regarding the relation between the third and the popliteal vessels in 20 presented cases the popliteal vessel gained a lateral position<sup>13</sup>.

In accordance with this case observation there is similarity in the origin, course and termination of the third head of the gastrocnemius muscle of the previous study. Rajan et al named the caput tertium for gastrocnemius third head, it joins the medial head of the gastrocnemius. The third and medial heads seemed to constrict the popliteal vessels<sup>13</sup>. In contrast to the present case the popliteal vessels were crossing medially to the intermediate head, so they were appearing not at danger to be entrapped.

#### **Conclusion:**

A third (Intermediate) head of the gastrocnemius muscle was observed in left lower limb of a female cadaver. Knowledge about such a variant muscle in the popliteal region should be considered in the diagnosis and management of various procedures in the fields of surgery, radiology and physiotherapy.

#### **Conflict of Interests:**

None.

#### **Acknowledgments:**

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- Methods
- Results
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- Three to ten key words at the end of the abstract must be provided.

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- Discussion
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- Figures

Acceptance of original manuscripts will be based upon originality and importance of the investigation. These manuscripts are reviewed by the Editors and, in the majority of cases, by two experts in the field. Manuscripts requiring extensive revision will be at a disadvantage for publication and will be rejected. Authors shall be responsible for the quality of language and style and are strongly advised against submitting a manuscript which is not written in grammatically correct English. The Editors reserve the right to reject poorly written manuscripts even if their scientific content is qualitatively suitable for publication. Manuscripts are submitted with the understanding that they are original contributions and do not contain data that have been published elsewhere or are under consideration by another journal.

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"HVPG was measured by hepatic vein catheterization using a balloon catheter according to a procedure described elsewhere [14, 15] and used as an index of portal hypertension [16]."

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[14] Merkel C, Bolognesi M, Bellon S, Zuin R, Noventa F, Finucci G, et al. Prognostic usefulness of hepatic vein catheterization in patients with cirrhosis and esophageal varices. *Gastroenterology* 1992;102:973-979.

[15] Groszmann RJ, Wongcharatrawee S. The hepatic venous pressure gradient: anything worth doing should be done right. *Hepatology* 2004;39:280-282.

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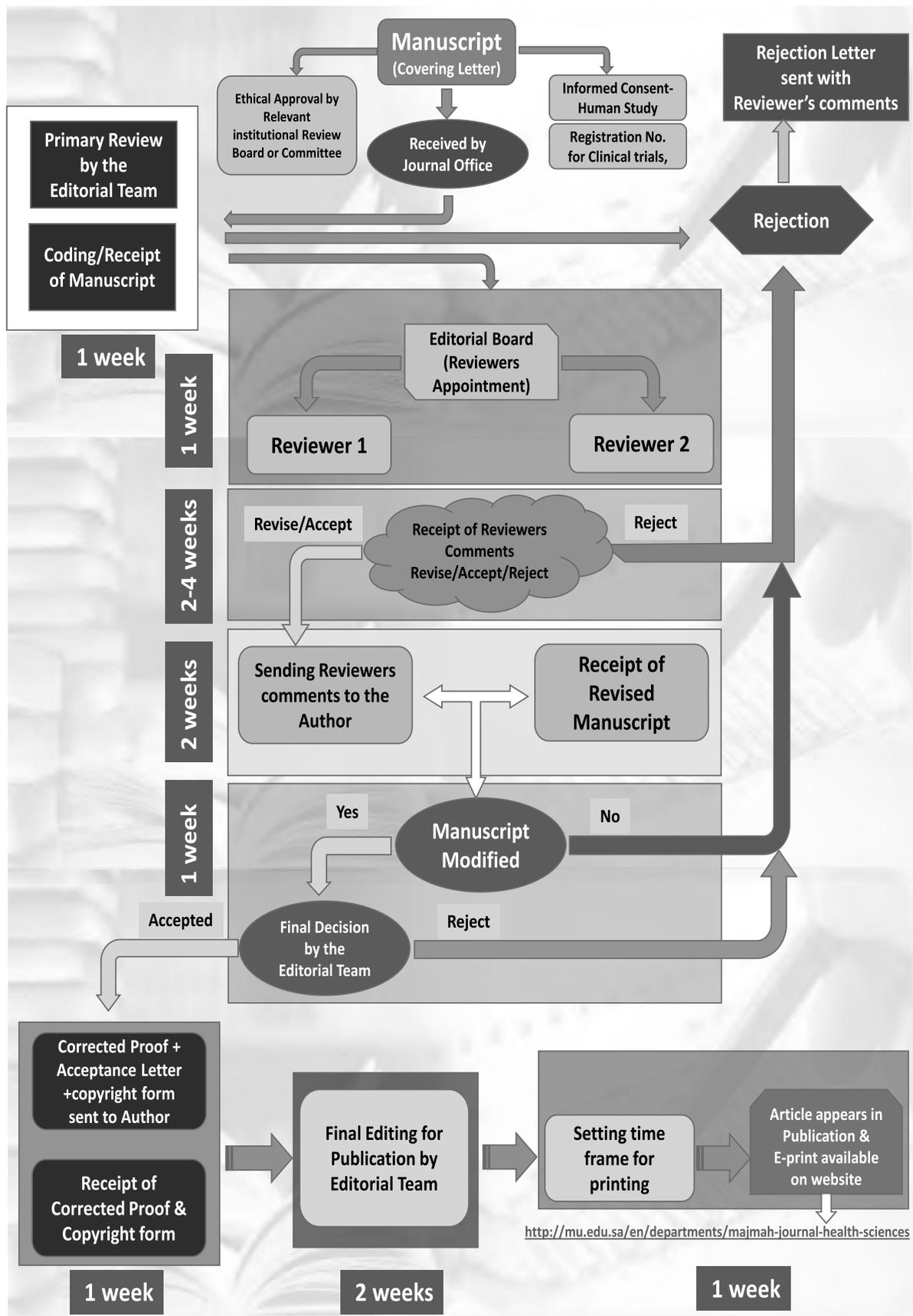
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