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Morphometric Study of the Intervertebral Disc and Intervertebral Foramen of the Cervical Region of the Jordanian Population

Estudio Morfométrico del Disco Intervertebral y el Foramen Intervertebral de la Región Cervical de la Población Jordana

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SUMMARY: Neck pain is a common complaint worldwide. One of its major causes is compression of the spinal nerve. The compression may occur due to intervertebral disc herniation or degenerative changes. These degenerative processes lead to alterations in intervertebral disc morphometry, including reduced disc height and narrowing of the intervertebral foramen This study was conducted to assess the morphometry of the cervical vertebrae; intervertebral foramina and intervertebral disc in the Jordanian population, and to determine the effect of age, sex, body mass index (BMI), occupation, and using the computer, on these measurements. This was a prospective cross-sectional study. The data were collected from the radiology department at The Jordan University Hospital (JUH). One hundred participants (40 males and 60 females) were included in the study that had undergone magnetic resonance imaging (MRI) of the cervical spine. Participants completed a questionnaire that collected information on age, gender, occupation, working posture and daily computer use. Height and weight were measured and body mass index (BMI) was calculated. Intervertebral disc measurements included anterior disc height (IVD-AH), middle disc height (IVD-MH), and posterior disc height (IVD-PH). Intervertebral foramen measurements included foraminal height (IVF-H) and foraminal width (IVF-W) at each cervical level. The results demonstrated that intervertebral disc (IVD) measurements decreased significantly with age and were lower in females ($P < 0.05$). Regarding occupational effects, IVD heights were significantly greater in employed participants. In contrast, age, sex, and occupation had no significant impact on intervertebral foramen (IVF) measurements. Establishing normative morphometric data for cervical intervertebral discs and intervertebral foramina is valuable for radiological assessment, preoperative planning, and the diagnosis of foraminal stenosis.

KEY WORDS: Cervical spine; Intervertebral disc; Intervertebral foramen; Radiological anatomy; MRI.

INTRODUCTION

Neck pain is a prevalent health concern around the world. More than 10 % of adults suffer from frequent episodes of neck pain (Kaiser *et al*., 2026). Its annual prevalence rate of up to 30 % and it is the fourth leading cause of disability worldwide (Cohen, 2015). The source of the pain is postural or mechanical, the mechanical factors are usually related to cervical spondylosis (Binder, 2007), which is one of the most common cervical spine disorders. It is the process of wear and tear that affects parts of the cervical spine over time. Clinically, the most significant changes happen in the intervertebral discs (IVD) and facet joints (Theodore, 2020). Degenerative changes include osteophyte, hypertrophy of facet joint, thickening of ligamentum flavum, (Metzger, 2019), disc desiccation, loss of disc height, displacement, and calcification of the disc (Boutin *et al*., 2000). The most affected segments are C4 - C5, C5- C6, and C6- C7, this can be reasoned by the degree of movements; the extension, and flexion at these levels (Metzger, 2019).

In addition to neck pain, cervical spondylosis is associated with main symptoms including cervical myelopathy and cervical radiculopathy (Shedid & Benzel, 2007). Cervical radiculopathy is compression and consequently inflammation of the cervical nerve roots that exit the cervical intervertebral foraminal (IVF) (Theodore, 2020). The nerve root is compressed or decompressed by

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the movement of the neck that causes dynamic changes in the size of the foramen (Boutin *et al*., 2000)

The association between degenerative changes found on magnetic resonance imaging (MRI) and neck pain is vague. A study has found that the dimensions of the spinal canal in the cervical region are smaller in cases of spondylosis by 3 mm on average and much smaller in cases of congenital stenosis (Shedid & Benzel, 2007). It was confirmed that degenerative changes on MRI in the cervical spine in asymptomatic people depend on age. In general, sex, age, and lifestyle are factors that cause variations in MRI findings between people (Alghamdi & Alqahtani, 2021). Disc desiccation and loss of disc height are the initial and most characteristic manifestations of disc degeneration (Miyazaki *et al*., 2008).

Many studies have been conducted to assess the normal morphometry of IVD or IVF using different image modalities such as radiography, computed tomography scan (CT), MRI, and cadaveric dissections. (Ebraheim *et al*., 1996; Abuzayed *et al*., 2010; Yukawa *et al*., 2012; Al Shammari *et al*., 2020).

This study aimed to use magnetic resonance imaging (MRI) to assess intervertebral disc and intervertebral foramen measurements across all cervical spine levels in the Jordanian population.

MATERIAL AND METHOD

This is a prospective cross-sectional study was conducted at the Department of Anatomy and Histology, The University of Jordan. The data was collected during the period of January to March 2023, from the radiology department at The Jordan University Hospital (JUH). The institutional review board approval at JUH was obtained prior to study initiation.

In this study, 100 participants were included who had MRI scan of the cervical spine. Participants completed a structured questionnaire collecting data on: age, sex, occupation, nature of work (sitting, standing, lifting heavy object), and if they use computer daily. Body weight and height were measured. Body mass index (BMI) was calculated and classified into four weight categories; underweight if BMI was below 18.5, normal weight if BMI was between 18.5-24.9, overweight if BMI was between 25-29.9, and obese if BMI was more than 30 (Weir & Jan, 2019). MRI examinations were performed using Philips Ingenia 1.5T MRI scanner using a spine array coil. Axial and sagittal T2 weighted single spin-echo images with a repetition time (TR) of 3000 milliseconds and echo time (TE) of 100 milliseconds. Slice thickness was 4 mm.

The sample met the inclusion criteria of being Jordanian adults. While the exclusion criteria included history of trauma on the cervical spine, prior cervical spine surgery, and congenital cervical spine deformity or vertebral column diseases. The study sample comprised 60 females and 40 males, with ages ranging from 20 to 80 years.

Disc measurements included intervertebral disc anterior, middle, and posterior disc height at the level of C2-C3, C3-C4, C4-C5, C5-C6, C6-C7, and C7-T1. Foraminal measurements included intervertebral foramen height and intervertebral foramen width at the same cervical levels. The measurements were taken in millimeters by using the SYNAPSE PACS program tools. Intervertebral disc anterior height (IVD-AH) was defined as the distance between the anterior-superior corner of the inferior endplate of the upper vertebra and the anterior-inferior corner of the superior endplate of the lower vertebra at the corresponding intervertebral disc level. Intervertebral disc posterior height (IVD-PH) was measured as the distance between the posterior-superior corner of the upper vertebra and the posterior-inferior corner of the lower vertebra at the same disc level. Intervertebral disc middle height (IVD-MH) was defined as the distance between the midpoint of the inferior endplate of the upper vertebra and the midpoint of the superior endplate of the lower vertebra (Tunset *et al*., 2013; Mirab *et al*., 2018) (Fig. 1).

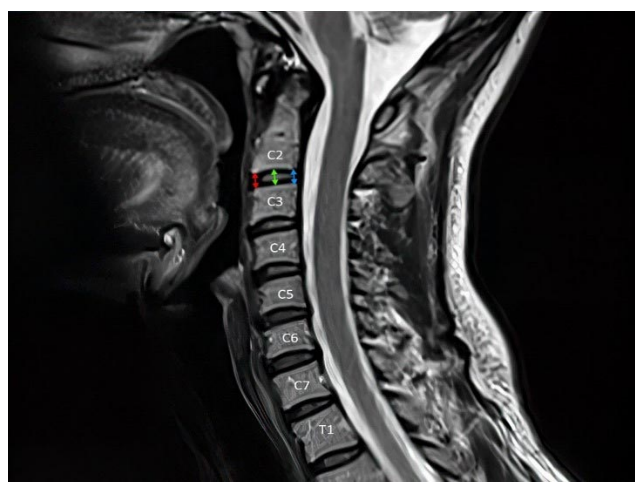

Fig. 1. Sagittal T2- weighted MRI image of the cervical spine. The red arrow represents IVD-AH. The green arrow represents IVD-MH. The blue arrow represents IVD-PH.

Intervertebral foramen height (IVF-H) is defined as the maximum distance between the inferior margin of the pedicle of the superior vertebra and the superior margin of the pedicle of the inferior vertebra (Humphreys *et al*., 1998; Momani *et al*., 2022) (Fig. 2).

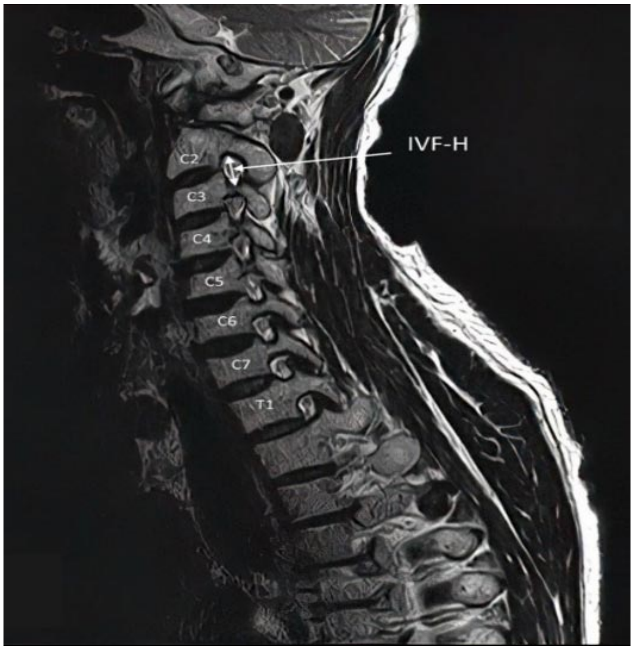

Fig. 2. Parasagittal T2- weighted MRI image of the cervical spine showing IVF-H.

Intervertebral foramen width (IVF-W) was measured on axial sections and is defined as the shortest horizontal distance from the posterior edge of the vertebral body to the corresponding articular process at the level of the cranial or caudal surface of the vertebral body (Rühli *et al*., 2006). Axial T2-weighted images provide a more accurate estimation of neural foraminal stenosis than sagittal images (Park *et al*., 2015; Winegar *et al*., 2020) as the IVF is oriented at a 45° angle to the coronal plane (Tanaka *et al*., 2000) (Fig. 3).

Data entry, preparation, and analysis were performed using the 26th version of the Statistical Package for the Social Sciences (IBM, 2019). Sample characteristics were described using counts, percentages, means, and standard deviations. Associations between variables were examined

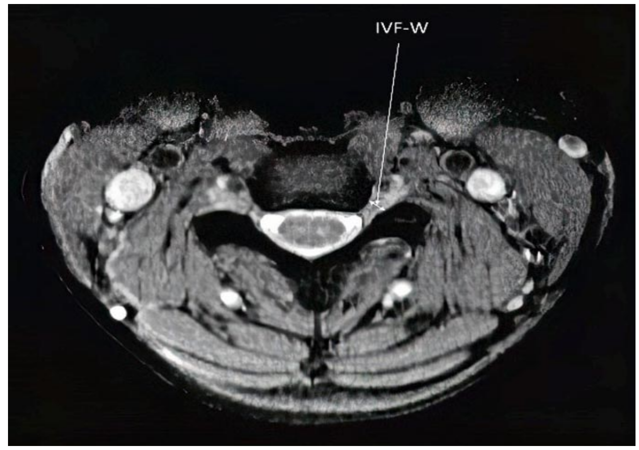

Fig. 3. Axial T2- weighted MRI image of the cervical spine showing IVF-W.

using parametric inferential tests, including independent-sample t-tests, One-Way ANOVA, and Pearson's correlation coefficient (r), depending on the nature of the variables. For all inferential tests, statistical significance was considered at a two-tailed p-value < 0.05.

RESULTS

A total of 100 MRI scans were included in the study. The mean age of participants was 51.7 years (range: 20–80 years). The sample comprised 40 males (40 %) and 60 females (60 %). The mean BMI was 28.6 ± 5.16, ranging from 16 to 46.8. Based on BMI categories, 38 % of participants were obese, 38 % overweight, 22 % normal weight, and 2 % underweight. Regarding employment status, 56 % were employed, 38 % were housewives, 4 % were students, and 2 % were retired.

The mean measurements of IVD-AH, IVD-MH, IVD-PH, IVF-H, and IVF-W were 4.76, 5.78, 4.06, 11.21, and 6.56 mm, respectively. The highest IVD-AH and IVD-MH values were observed at the C6–C7 level, while the

Table I. Measurements, mean, and standard deviation (SD) of IVD-AH, IVD-MH, IVD-PH, IVF-H, and IVF-W at each cervical level.

Average Disc Measurement	C2 – C3	C3 – C4	C4 – C5	C5 – C6	C6 – C7	C7 – T1	Mean (SD)
Anterior Height of Intervertebral Disc (IVD-AH)	4.74	4.64	4.85	4.62	5.02	4.68	4.76 (.66)
Middle Height of Intervertebral Disc (IVD-MH)	5.90	5.89	5.72	5.49	5.92	5.76	5.78 (.69)
Posterior Height of Intervertebral Disc (IVD-PH)	4.29	4.14	4.38	3.85	3.84	3.85	4.06 (.63)
Intervertebral Foramen Height (IVF-H)	11.40	11.06	11.05	11.27	11.24	11.25	11.21 (1.03)
Intervertebral Foramen Width (IVF-W)	6.59	6.33	6.37	6.60	6.56	6.94	6.56 (.61)

* statistically significant; p < .05

lowest were at C5–C6. The maximum IVD-PH was recorded at C4–C5, and the minimum at C6–C7. For the intervertebral foramen, the maximum IVF-H occurred at C2–C3, and the minimum at C4–C5. The maximum IVF-W was observed at C7–T1, while the minimum was at C3–C4 (Table I; Figs. 4 and 5).

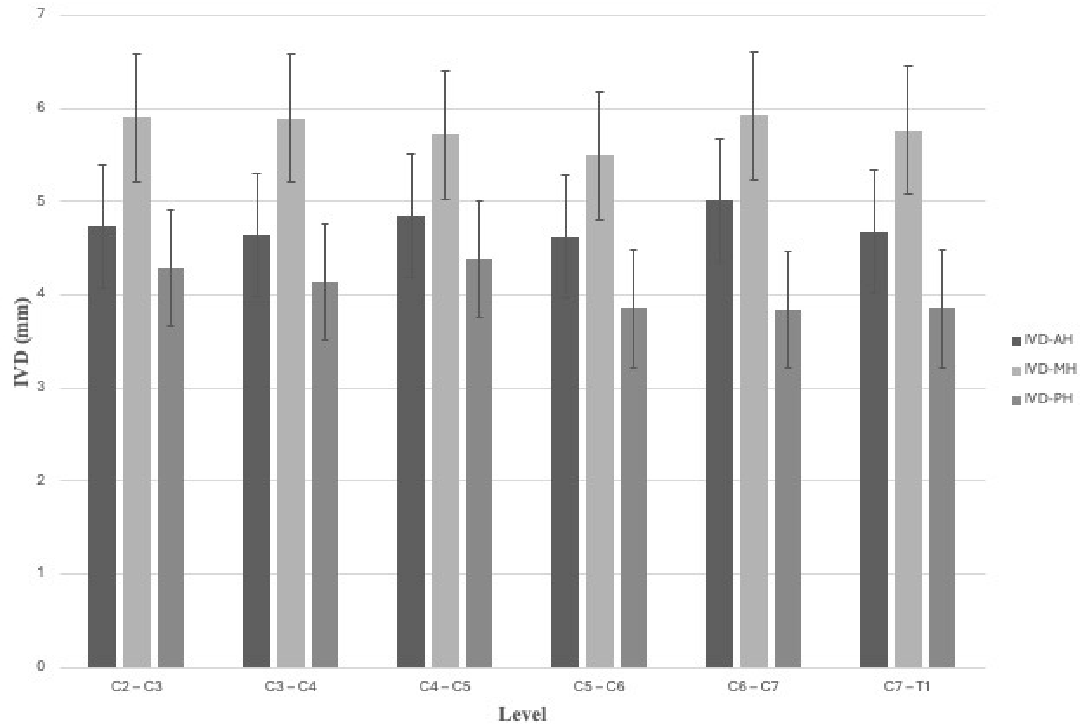

Fig. 4. shows the mean anterior height of the intervertebral disc IVD-AH, IVD-MH, and IVD-PH at each cervical level.

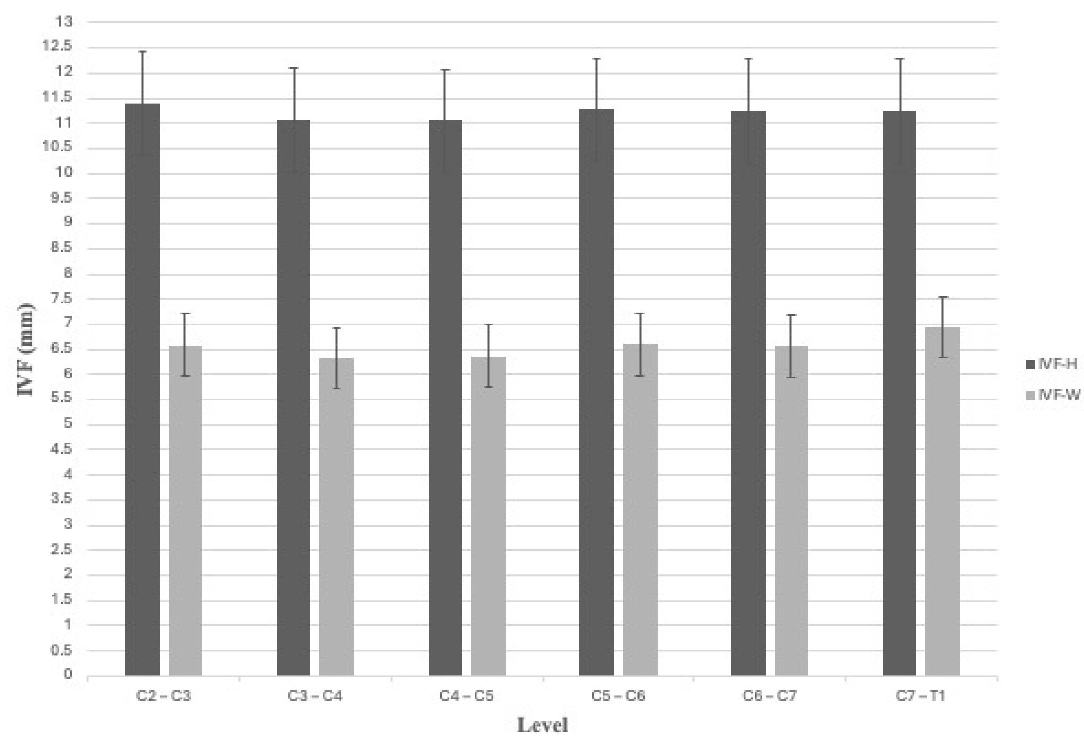

Fig. 5. shows the mean anterior height of the intervertebral disc IVF-H, and IVF-W at each cervical level.

All measurements were higher in males except for IVF-W. The mean IVD-AH, IVD-MH, IVD-PH, IVF-H, and IVF-W in males were 5.10, 6.05, 4.34, 11.38, and 6.52 mm, respectively, compared to 4.53, 5.60, 3.87, 11.10, and 6.59 mm in females. Independent-sample t-tests showed that sex had a significant effect on IVD measurements but not on IVF measurements (Table II; Fig. 6).

Age had a significant effect on IVD-AH and IVD-PH, with both measurements decreasing as age increased. However, age did not significantly affect IVD-MH, IVF-H, or IVF-W. Table III presents the correlations between the five measurements and age using Pearson's correlation coefficient (r).

Using One-Way ANOVA, BMI categories (Underweight, Normal weight, Overweight, and obese) showed no significant effect on IVD and IVF measurements. However, the mean IVD-AH measurement was the highest among overweight participants and lowest among underweight participants. The mean IVD-MH and IVD-PH were greatest in normal weight group. The highest IVF-H was observed in underweight participants, while the lowest IVD-MH, IVD-PH, and IVF-H were in obese participants. The widest IVF-W was found in obese participants, while the narrowest was observed in underweight group.

In our sample, 56 % (n= 56) of the participants were employed. Among them 63 % (n=35) of them spend most of their working time in a sitting position; 30 % (n=17) in a standing position, and 7 % (n=4) alternated between sitting and standing positions and none of the participants reported lifting heavy objects at work. The mean duration of employment was 18 years ±9.45, ranging from 2 to 40 years. The mean daily working hours was 8.23 hours ±1.82 with a maximum of 12 hours and a minimum of 4 hours.

Table II. Means and standard deviation (SD) of IVD-AH, IVD-MH, IVD-PH, IVF-H, and IVF-W with sex.

Average Disc Measurement	Sex					
	Male		Female		*t*	*p*
	mean	SD	mean	SD		
Anterior Height of Intervertebral Disc (IVD-AH)	5.10	.65	4.53	.45	4.761	.000*
Middle Height of Intervertebral Disc (IVD-MH)	6.05	.62	5.60	.68	3.339	.001*
Posterior Height of Intervertebral Disc (IVD-PH)	4.34	.72	3.87	.48	3.685	.000*
Intervertebral Foramen Height (IVF-H)	11.38	.96	11.10	1.07	1.311	.193
Intervertebral Foramen Width (IVF-W)	6.52	.64	6.59	.59	-.509	.612

* statistically significant; p < .05

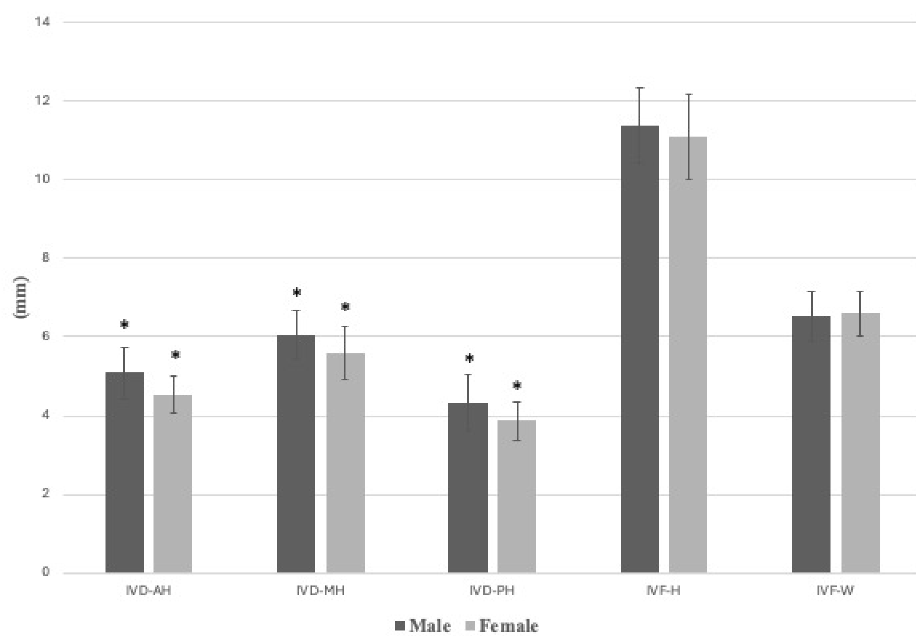

Fig. 6. shows the mean IVD-AH, IVD-MH, IVD-PH, IVF-H, and IVF-W with sex. The blue bars show IVD measurements in males. The orange bars show IVD measurements in females.
* statistically significant; p < .05

Table III. Shows the correlation between IVD-AH, IVD-MH, IVD-PH, IVF-H, and IVF-W with age.

Average Disc Measurement	**Age**	
	r	***p***
Anterior Height of Intervertebral Disc (IVD-AH)	-.223	.026*
Middle Height of Intervertebral Disc (IVD-MH)	-.149	.140
Posterior Height of Intervertebral Disc (IVD-PH)	-.377	.000*
Intervertebral Foramen Height (IVF-H)	-.142	.159
Intervertebral Foramen Width (IVF-W)	-.37	.717

* statistically significant; p < .05

Independent-sample t-tests showed that working status had a significant effect on IVD measurements. The mean IVD-AH, IVD-MH, and IVD-PH values were higher in employed participants compared with those who were not employed. In contrast, working status had no significant effect on IVF measurements (Table IV; Fig. 7).

The association between IVD and IVF measurements and the nature of participants' work (sitting only, standing only, or alternating between sitting and standing) was analyzed using One-Way ANOVA. This factor was found to have no significant effect on any of the measured parameters. Among the 56 employed participants, 27 (48 %) reported daily computer use, with a mean duration of 2.11 ± 2.96 hours (range: 0–10 hours). Pearson's correlation analysis showed that computer use had no significant effect on either IVD or IVF measurements.

Table IV. Shows the mean measurements and standard deviation (SD) of IVD-AH, IVD-MH, IVD-PH, IVF-H, and IVF-W with working status.

Average Disc Measurement	**Working Status**					
	Works		**Doesn't Work**		***t***	***p***
	mean	**SD**	**mean**	**SD**		
Anterior Height of Intervertebral Disc (IVD-AH)	4.94	.64	4.53	.60	3.294	.001*
Middle Height of Intervertebral Disc (IVD-MH)	5.91	.60	5.61	.77	2.205	.030*
Posterior Height of Intervertebral Disc (IVD-PH)	4.17	.68	3.91	.53	2.067	.041*
Intervertebral Foramen Height (IVF-H)	11.17	.97	11.27	1.11	-.451	.653
Intervertebral Foramen Width (IVF-W)	6.49	.66	6.66	.54	-1.35	.180

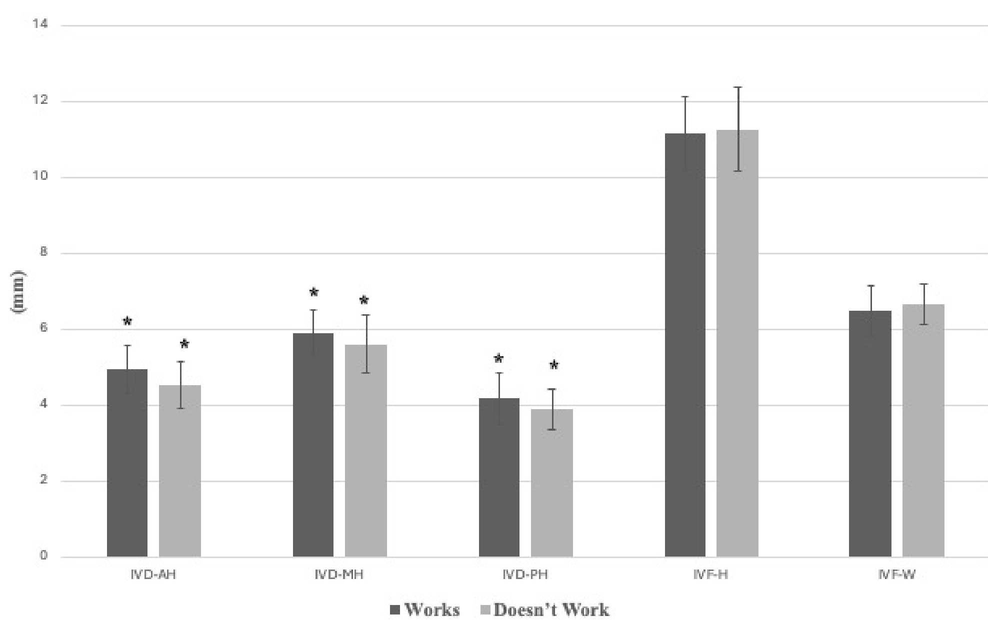

Fig. 7. shows the mean measurements of IVD-AH, IVD-MH, IVD-PH, IVF-H, and IVF-W with working status. The blue bars show IVD measurements in worker participants. The orange bars show IVD measurement in participants who don't work. * statistically significant; p < .05

DISCUSSION

This study was conducted to assess the morphometry of the intervertebral disc and intervertebral foramen in the cervical region among the Jordanian population and to evaluate the effect of age, sex, BMI, occupation, and computer use on these measurements.

Our findings provide valuable data on the normal values of cervical IVD and IVF dimensions in the Jordanian population. This information is essential in cervical spine surgeries as laminectomy and discectomy, as knowing the normal anatomical measurements helps surgeons in selecting appropriately sized surgical tools and equipment, thereby reducing the risk of intraoperative injuries and postoperative complications.

Furthermore, this study addresses the importance of identifying and highlighting factors that may influence IVD and IVF measurements, especially those related to work environment and occupational posture. Moreover, understanding IVF dimensions contributes to the accurate diagnosis of foraminal stenosis and radiculopathy.

In our study, the highest IVD-AH and IVD-MH values were observed at the C6-C7 levels, while the lowest were recorded at C5-C6 .The maximum IVD-PH was found at C4-C5, whereas the minimum occurred at C6-C7. The highest IVF-H was observed at C2-C3, while the least at C4-C5. The widest IVF-W was recorded at C7-T1, while the narrowest was at C3-C4.

Using radiography, a Japanese study found that the highest IVD-MH was at C6-C7, and the lowest at C5-C6 which is consistent with our finding. However, their overall measurements were higher than those observed in our study (Yukawa *et al*., 2012). In a study on Turkish population, Abuzayed *et al*. (2010), used CT scan and found the maximum IVD-AH and IVD-MH at C6-C7, while the minimum IVD-AH was at C4-C5, however, they found the measurements of IVD-MH were remained relatively constant at the other cervical levels (Abuzayed *et al*., 2010). In contrast a Korean study, used lateral X-ray and found the maximum IVD-MH at C4-5 (Lee *et al*., 2004).

Two studies investigated IVD measurement using cadavers, one study was done in the United States of America (USA), and the other in South Korea; both studies reported generally lower values than those found in our study (Lu *et al*., 2000; Sohn *et al*., 2004). An Egyptian study found that the highest IVF-H occurred at C6-C7, while the lowest was found at C3-C4 in both cadaveric and radiographic samples. In the same study the widest IVF-W in the radiographic sample was at C6-C7, and the narrowest IVF-W was at C4-C5 (Ahmed *et al*., 2014). Furthermore, in another a study conducted in USA, Lentell *et al*. (2002), using MRI found that the highest IVF-H and the widest IVF-W was at C2-C3, while the smallest IVF-H was at C3-C4, and the narrowest IVF-W at C7-T1.

In a cadaveric study, Sohn *et al*. (2004) found the highest IVF-H and the widest IVF-W were observed at C2-C3. The least IVF-H was found at C4-C5 on the left side, while the narrowest IVF-W was at C5-C6. In another Jordanian study, Momani *et al*. (2022) used CT imaging and found that the highest IVF-H was at C2-C3 and the lowest at C7-T1, whilst the widest IVF-W was recorded at C7-T1 and the narrowest at C3-C4. They explained the large dimension of C2-C3 by the presence of anterior epidural venous plexus which is a prominent anterolateral structure at that level. Also, they noted that the brachial plexus roots and prominent vessels within the lower cervical intervertebral foramina require a wider IVF-W at these levels (Momani *et al*., 2022). In another cadaveric study, Ebraheim *et al*. (1996) reported that the measurements increasing progressively from cephalad to caudal except at C2-C3 which is consistent with our findings. In general, the differences in measurements may be due to variation measurement techniques, the mean age of the subjects and the inter-population differences.

Czervionke *et al*. (1988) reported that the cervical IVF is oval in shape, with the width approximately half of its height. This finding is consistent with our results where the mean IVF-H was 11.21 ±1.03 mm and the mean IVF-W was 6.56 ±0.61 mm.

Our results revealed that the three measurements of IVD were higher in males, which corresponds to the results of (Lee *et al*., 2004; Köken *et al*., 2014). This result was expected based on the rules of bone allometry, as males show larger bone dimensions than females on average (Rühli *et al*., 2006). However, Yukawa *et al*. (2012), also found that the measurements of IVD were higher in males but after values adjusted by height, the results were approximately 3 % greater in females. Some studies found that the prevalence of decreased IVD and the other signs of disc degeneration do not differ significantly between females and males (Lehto *et al*., 1994; Tao *et al*., 2021). Moreover several studies have identified the C5-C6 level as the most commonly affected segment (Lehto *et al*., 1994; Matsumoto *et al*., 1998; Suzuki *et al*., 2018; Tao *et al*., 2021).

Our results showed that the effect of sex on IVF measurements was not statistically significant. However, the mean IVF-H was greater in males while the mean IVF-W was greater in females. The same results were reported by (Rühli *et al*., 2006; Momani *et al*., 2022). Likewise, Ebraheim *et al*., (1996) reported no significant effect of gender on IVF dimensions. Porter *et al*. (1980) suggested that the relatively larger volume of epidural fat in females may contribute to wider neural canals, especially, in case of pregnancy-related mechanical stress. On the other hand, two other studies reported that both IVF height and width were significantly greater in males than in females (Lentell *et al*., 2002; Ahmed *et al*., 2014).

In our study, age had a significant effect on the measurements of IVD-AH and IVD-PH. with both measurements showing a decrease as age increased. In contrast, age did not have a significant effect on intervertebral disc middle height (IVD-MH), intervertebral foraminal height (IVF-H), or width (IVF-W). These findings are consistent with those reported by Momani *et al*. (2022) and Rühli *et al*. (2006). However, Humphreys *et al*. (1998) reported a decline in IVF width and intervertebral disc measurements with advancing age, while IVF height remained unaffected.

Intervertebral disc degeneration is a progressive wear-and-tear process that occurs over time. Many studies confirmed that age is the major risk factor of this process (Lehto *et al*., 1994; Matsumoto *et al*., 1998, 2013; Suzuki *et al*., 2018; Tao *et al*., 2021). With advancing age, water content of the disc decreases and is gradually replaced by fibrous tissue. In addition, proteoglycan content decreases, the lamella that form the annulus fibrosus become irregular, interdigitating, and bifurcating (Urban & Roberts, 2003). These structural and biochemical changes lead to degenerative changes that can be detected using MRI and other imaging modalities. Many researches evaluated disc degeneration based on criteria such as reduced IVD height, change in disc intensity, disc bulging or protrusion, formation of dorsal osteophytes, and stenosis of the spinal canal. These degenerative features have been reported to occur most frequently in individuals over 40 years of age (Lehto *et al*., 1994; Matsumoto *et al*., 1998, 2013). The decrease in disc height may result in narrowing of the IVF height at the corresponding level, as well as increased laxity and thickness of the spinal ligaments. Furthermore, bulging of the annulus can contribute to a reduction in the width of the intervertebral foramina (Boutin *et al*., 2000).

Matsumoto *et al*. (1998) demonstrated that foraminal stenosis is a part of the degeneration process. Patients usually present after the age of 55 years with foraminal stenosis most commonly due to osteophyte formation (Shedid & Benzel, 2007). Hypertrophy of the inferior facet joint also causes a reduction in IVF-W measurement, leading to foraminal stenosis and consequently, radiculopathy caused by compression of the traversing spinal nerve root. (Humphreys *et al*., 1998). In general, foraminal stenosis is classified as either acquired or congenital. Therefore, age alone is not the only etiological factor; foraminal stenosis may also result from trauma, systemic conditions, and iatrogenic causes.

Our results showed that BMI categories had no significant effect on IVD and IVF measurements; these findings are consistent with those of Okada *et al*. (2009), in their MRI-based study they reported no significant correlation between disc degeneration progression and factors like BMI. Furthermore, they found that age was the only factor that was associated with the progression of disc degeneration (Okada *et al*., 2009).

Few studies have investigated the correlation between BMI and cervical IVD and IVF measurements. This may be explained by the fact that the cervical spine tolerates only the weight of the head, whereas, most of the body weight is carried by lumber vertebrae (Müller *et al*., 2021). Many studies have reported a strong correlation between obesity and lumber spine disorders; Rodriguez-Martinez *et al*. (2016) reported an increased risk of lumbar disc and facet degeneration in individuals with a BMI greater than 25, which may be attributed to the greater compressive axial loads exerted on the facet joints in obese subjects. Furthermore, several studies have shown a higher incidence of lumbar disc herniation among obese individuals (Liuke *et al*., 2005; Dario *et al*., 2015), as well as an increased prevalence of pathological lumbar lordosis (Song *et al*., 2004).

Numerous studies have investigated the effect of occupation on IVD measurements. However, their results are contradictory. To date, we could not find any study about the correlation between occupation and IVF measurements.

In our study, we found that working status has a significant effect on IVD and no significant effect on IVF measurements. The mean IVD measurements were higher in employed participants than in those who do not work, noting that 62.5 % of the employed participants are male. Moreover, the nature of work does not have a significant effect on either IVD or IVF measurements.

Machino *et al*. (2022) studied the association between occupation and cervical IVD morphology among eleven occupational groups categorized according to four types of work (heavy object lifting, prolonged maintenance of the same position, cervical flexion, and cervical extension). Their results demonstrated no significant effect of occupations on cervical disc morphology (Machino *et al*., 2022).

In our study, we found that using computers has no significant effect on IVD and IVF measurements. We did not find any available studies assessing the relationship between computer use and cervical IVD or IVF morphometric measurements to compare our measurements with. However, Hakala *et al*. (2006) suggested that computer use of more than two hours per day represented a threshold for development of neck pain, likely due to prolonged static posture involving forward head position and sustained cervical flexion during using the computer.

Lin *et al*. (2020) found that mechanical neck pain is associated with reduced range of movement in the cervical region, impaired neck joint position sense and increased stiffness of cervical soft tissues (Lin, Hua *et al*., 2020). Ming *et al*. (2004) reported that neck and shoulder pain related to computer use can be due to cervical disc degeneration, and compression on nerve root. Furthermore, they reported that poor postures due to bad viewing angles of the screen, improper chair and desk positioning resulted in shortening of the soft tissues, muscle tension, weakness, and neck muscle fatigue. This poor posture consequently overloads the neck and shoulder muscles, which leads to calcifying tendonitis and spondylosis. They concluded that poor posture, and long-lasting and intensive use of computer was identified as a risk factor for cervical disc degeneration (Ming *et al*., 2004).

CONCLUSION

This study assessed the normal morphometric data for cervical intervertebral discs and intervertebral foramen in the Jordanian population, providing valuable reference values for radiological assessment, preoperative planning, and the diagnosis of foraminal stenosis. The effects of age, sex, BMI, occupation, and computer use on IVD and IVF measurements were evaluated. IVD measurements showed a significant decrease with advancing age and were lower in females. In terms of occupational factors, IVD heights were significantly greater in employed participants, whereas these variables demonstrated no significant influence on IVF measurements. Additionally, BMI and computer use did not have a significant effect on either IVD or IVF morphometry. Recommendations

Further studies are recommended to investigate the morphometry of cervical vertebral bodies and pedicles, as well as factors that may influence these parameters. Additionally, more research within the Jordanian population is warranted to evaluate cervical disc degeneration, its associated risk factors and radiological manifestations, including changes in disc signal intensity, disc bulging, osteophyte formation, and spinal canal stenosis.

QRUNFULEH, D. I.; SALMAN, A.; SAMARA, O. A.;ALDURAIDI, H. & ELBELTAGY, M. Estudio morfométrico del disco intervertebral y el foramen intervertebral de la región cervical de la población jordana. *Int. J. Morphol., 44(3)*:778-788, 2026.

RESUMEN: El dolor de cuello es una dolencia común en todo el mundo. Una de sus principales causas es la compresión del nervio espinal. Esta compresión se puede deber a una hernia discal como también a cambios degenerativos. Estos procesos degenerativos provocan alteraciones en la morfometría del disco intervertebral, incluyendo una reducción de la altura del disco y un estrechamiento del foramen intervertebral. Este estudio se realizó para evaluar la morfometría de las vértebras cervicales, los forámenes intervertebrales y el disco intervertebral en la población jordana, y para determinar el efecto de la edad, el sexo, el índice de masa corporal (IMC), la ocupación y el uso de la computadora en estas mediciones. Se trató de un estudio transversal prospectivo. Los datos se recopilaron del departamento de radiología del Hospital Universitario de Jordania (JUH). Se incluyeron cien participantes (40 hombres y 60 mujeres) que se habían sometido a una resonancia magnética (RM) de la columna cervical. Los participantes completaron un cuestionario que recogía información sobre edad, sexo, ocupación, postura laboral y uso diario de ordenador. Se midieron la altura y el peso, y se calculó el índice de masa corporal (IMC). Las mediciones de los discos intervertebrales incluyeron la altura del disco anterior (IVD-AH), la altura del disco medio (IVD-MH) y la altura del disco posterior (IVD-PH). Las mediciones de los forámenes intervertebrales incluyeron la altura del foramen (IVF-H) y el ancho del foramen (IVF-W) en cada nivel cervical. Los resultados demostraron que las mediciones de los discos intervertebrales (IVD) disminuyeron significativamente con la edad y fueron menores en las mujeres ($P < 0,05$). En cuanto a los efectos ocupacionales, las alturas de los IVD fueron significativamente mayores en los participantes empleados. Por el contrario, la edad, el sexo y la ocupación no tuvieron un impacto significativo en las mediciones de los forámenes intervertebrales (IVF). El establecimiento de datos morfométricos normativos para los discos intervertebrales cervicales y los forámenes intervertebrales es valioso para la evaluación radiológica, la planificación preoperatoria y el diagnóstico de la estenosis foraminal.

PALABRAS CLAVE: Columna cervical; Disco intervertebral; Foramen intervertebral; Anatomía radiológica; Resonancia magnética.

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