University of Jordan

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Human Factors and Work Measurement Laboratory

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Objective

The maximum amount of force or tension applied by the muscles in the forearm is known as grip strength. Studies have suggested that grip strength can be used to forecast physical impairment in older people and give an idea about a patient's general well-being. Therefore, this investigation aims to assess the grip strength of every student using a hand-held dynamometer.

Introduction

Strength is the ability of muscles to work against resistance. Grip strength is commonly employed to estimate overall body strength as it can be measured using a grip dynamometer. There are two categories of bodily strength: static and dynamic strength.

Static strength: represents the maximum voluntary muscular exertion in a restrained position without movement and holding the contraction or contracting against an immovable force.

A Static Load is defined as holding the same position for a period of time and it is especially stressful in combination with:

- High Force
- Awkward Posture
- Duration of time that the muscles are contracted.

And the second type is dynamic strength which is the maximum voluntary muscular exertion of a body part in motion. Dynamic (Isotonic) muscle strength involves muscular contraction against resistance in which the length of the muscle changes.

Factors affecting body strength:

- Gender (Women (in general) have 2/3 the strength of men).

- Conditioning (athletic conditioning -Weight lifter vs. marathon runner)
- Size: The Leverage of muscles
- Predisposing conditions such as genetic or previous injury.

In this experiment, we will measure the grip strength of each student in the laboratory and explain how the process went exactly in this report.

Apparatus

A hand dynamometer is an evaluation tool that's used to measure isometric grip force (hand grip strength). Some versions use hydraulics to measure the force while others use electronic load cells. Once the grip position is adjusted, the user holds the handle and squeezes the handle. The peak hold needle will keep the highest rating on a hydraulic version until reset, while the digital version automatically displays the test results.

Figure 1 Dynamometer

Procedure

The subject must sit on a well-designed specific chair in a neutral posture (the knee and elbow at 90 degrees), use the hand dynamometer in different gripping situations, and take the grip strength values for each student. The subject holds the dynamometer in their hand and sits on the chair, with his/her arm at right angles and the elbow by the side of the body. The dynamometer must be at zero reading before beginning, then the student squeezes the dynamometer with maximum isometric force and holds it for 3 seconds. Make sure to not move any other body parts to get higher accuracy of the reading. The process is repeated for the non-dominant hand, and for 3 fingers grip, and for 5, 6, 3 cm grip spans.

Neutral Posture (seated): is the work position where your body is strongest and most efficient.

- Arms loosely at your side
- Forearms parallel with the floor.
- Hands in the "handshake" position
- The back has a natural "S" curve.
- The knees are bent at 90-105 degrees.
- The feet should be shoulder-width apart, pointing slightly outward.
- Head looking forward, slightly downward.

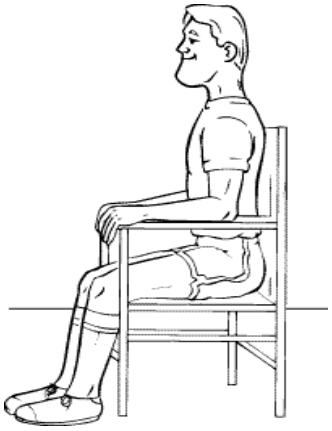


Figure 2 Neutral Position While Seated

Data Collected

Name	*Dominant hand scores*				*Non-dominant hand scores*
	Full grip			*3 fingers grip (5 cm grip size)*	*Full gripping with 5 cm grip*
	5 cm	*6.5 cm*	*3.5 cm*		
females					
Haya	16	18	12	10	18
Hiba Ja.	20	20	24	15	27
Dina	35	30	32	25	31
Rifqa	22	24	22	12	16
Raghad	16	14	22	13	19
Tamara	10	10	14	7	9
Nour Abu.	15	16	14	10	8
Hiba Sh.	28	21	18	13	28
Nour Sah.	20	14	9	10	19
Aya	20	14	12	8	13
Males					
Daniel	38	44	36	33	28
Jaber	56	50	44	28	44
Ahmad Zghoul	42	40	36	28	32
Husam Amoori	60	54	53	34	53
Zaid Nimri	56	42	44	24	55
Obada	54	46	42	22	56
Mohammad Awwad	46	42	36	27	54
Nadeem	34	35	32	30	35

Table1: Dominant vs .Non-Dominant Gripping

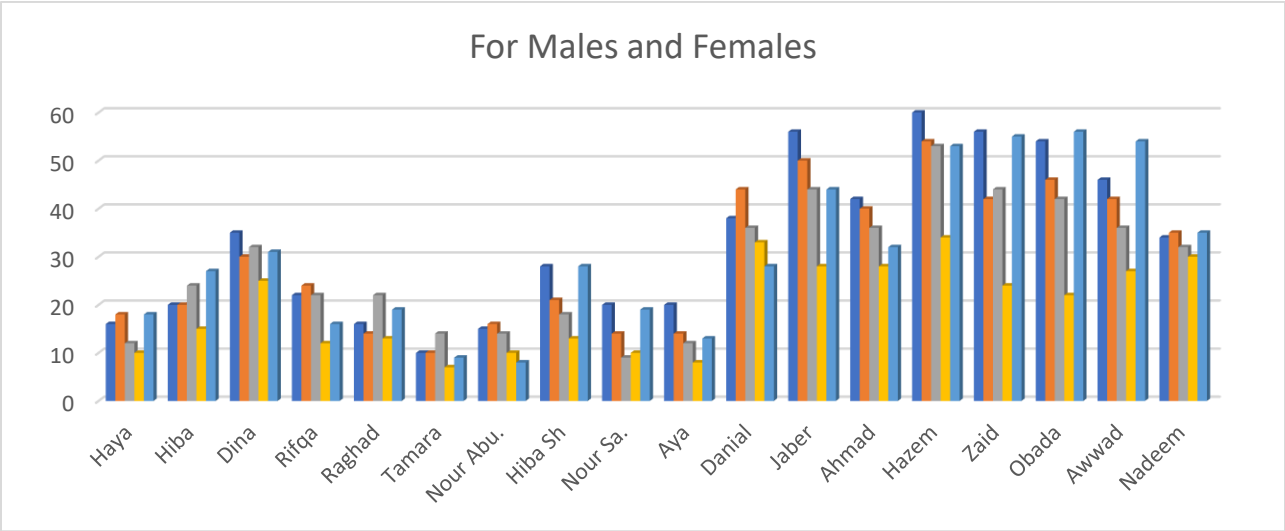
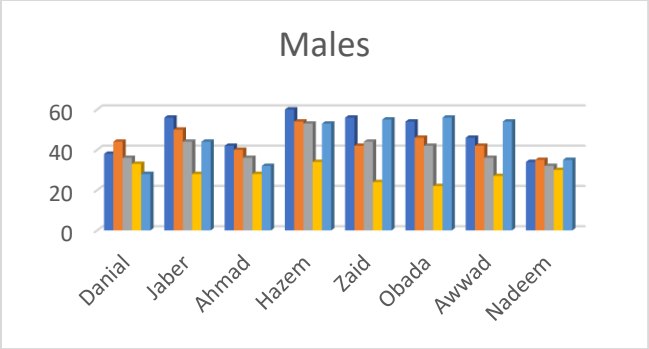
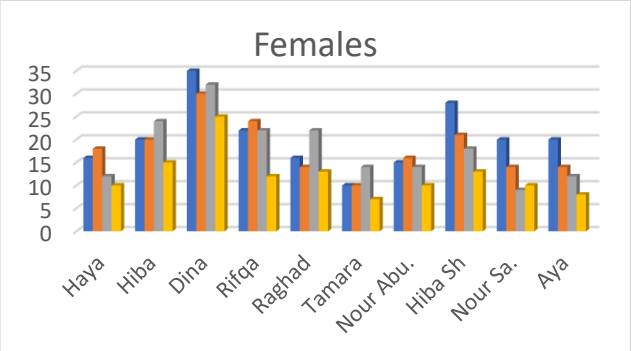


Figure3: Barr Chart for the Females vs. Males Gripping Forces





Discussion Parameters

1) The maximum score and the minimums core of each trial.

max	***60.00***	***54.00***	***53.00***	***34.00***	***56.00***
min	***10.00***	***10.00***	***9.00***	***7.00***	***8.00***

From our table, we notice that the column that includes the data of the 5 cm and the 6.5 cm gripping size illustrates that the maximum value taken was for Hussam of 60, 54 Kg.F respectively, while the minimum value was achieved by Tamara of 10 Kg.F, for the 3.5 cm gripping we see that also Hussam has the highest value for it, while Nour Sahily had the lowest reading for this grip size of 9 Kg.F.

Also we see that Hussam had the maximum value for the 3 fingers gripping of 5 cm grip size while Tamara had the minimum value of 7 Kg.F, and when using the non-dominant hand for full gripping with 5 cm grip, we see that Obada had the highest value with 56 Kg.F and Nour Abusall got the minimum value of 8 Kg.F.

2) Strength of the dominant hand and the non-dominant hand for each subject where do we find more strength, in dominant or non-dominant hand? Why?

From the attached figures, we can notice that almost all the participants have a stronger dominant hand compared to their non-dominant, this is basically since people in real-life activities use their dominant hand either during exerting high forces such as when opening doors, using power tools or brushing your teeth. On the other hand, we see that part of the students during the experiment tended to exert high forces by their non-dominant. This is due to the repeatability concept, which states that: when someone is conditioned to do a certain pattern of exercises during an experiment, he/she will exert more force unconsciously.

3) Using full gripping of the hand (power grip) and precise gripping (3 fingers).

Males	*Max*	*3 fingers*	*Females*	*Max*	*3 fingers*
Daniel	44	33	Haya	16	10
Jaber	56	28	Hiba Ja.	24	15
Ahmad Zghoul	42	28	Dina	35	25
Husam Amoori	60	34	Rifqa	24	12
Zaid Nimri	56	24	Raghad	22	13
Obada	54	22	Tamara	14	7
Mohammad Awwad	46	27	Nour Abu.	16	10
Nadeem	35	30	Hiba Sh.	28	13
Avg	49.125	28.25	Nour Sah.	20	10
Reduction for males		0.42	Aya	20	8
			Avg	21.9	12.3
			Reduction for females		0.44

As illustrated in the table above, there is indeed a huge drop in the exerted force when using the precise gripping compared to the full gripping of hand, from our calculations we noticed that the estimated difference between these forces for males is about 42% of the maximum gripping force, also for females it's about 44% drop, which actually gives us an indicator of how pressure distribution might affect the amount of the exerted forces on the dynamometer.

4) Changing the grip size (5cm, 3.5cm, 6.5cm) for each subject.

Changing the grip size affects the force exerted, as the grip size is directly related to the hand size. Those with longer fingers recorded their highest strength at the 6.5cm grip size, and those with shorter fingers recorded their highest strength at the 3.5cm grip size.

Some students with relatively large hands, such as student Mohammad Awwad, recorded a lower strength at 6.5cm grip size due to fatigue of muscles.

Two female students (Hiba S and Tamara) recorded the same strength for the 5cm and 6.5cm grip sizes and we can relate this to them being motivated.

5) The gender effect on the score.

In general, females have almost 2/3 of the males' strength. This is well demonstrated in the collected data as males have a higher mean than females for almost all the readings. This can be attributed to the fact that males usually males tend to have larger bones, which provide a more stable foundation for muscle attachment and generate more force.

Errors

Making mistakes such as sitting improperly, using an unsuitable seat, holding the device incorrectly, not taking sufficient breaks between each attempt, or having sweaty hands, or having errors on the dynamometer, can all influence the outcome of measurements. Ensuring accurate and precise measurements can help us develop devices that are more effective, productive, and suitable for their intended purpose, while also reducing injuries in the workplace and saving time and effort.

Conclusion

We can also conclude on the significance of grip strength testing by dividing up the mission among the team members in accordance with the task at hand. If the job needs a lot of strength, we give it to a young male. If not, an old man or a female can take the task. Ensuring accurate and precise measurements can help us develop devices that are more effective, productive, and suitable for their intended purpose, while also reducing injuries in the workplace and saving time and effort.