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MANUAL HANDLING WEIGHT LIMITS, BASED ON ANTHROPOMETRICS AND SPECIFIC LOAD AND TASK REQUIREMENTS

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Abstract Manual handling tasks are a part of lots of enterprises, from construction works, logistics, to healthcare and retail. The physical demands of moving an object, like lifting, carrying, and moving, can put workers at risk of injury. It is crucial to maintain a safe working place, to prevent musculoskeletal injuries and disorders. Understanding and adhering to manual handling weight limits, is one of the major prerequisites to achieve safety, during load handling. A model table was designed for the estimation of the "personal maximum manual handling weight limit", based on the worker's anthropometrics and the weight and task's synthetic elements.

Keywords: Manual handling; health and safety; musculoskeletal stress; handling weight limits.

1. INTRODUCTION

The statistics concerning the manual handling in UK, show that the resulting injuries account for over 1/3 of all workplace injuries. It's estimated that around 7.3 million working days are lost each year because of injuries such as musculoskeletal disorders. It's clear that manual handling tasks and the resulting MSK problems impact directly productivity and efficiency [1].

The manual handling weight limits (MHWL) refer to the maximum amount of weight that a person can safely move. Following these limits, can protect workers from overexertion, strains, sprains, and other musculoskeletal injuries. HSE guidelines suggest that the maximum safe lifting weight an individual should lift or carry without assistance is 25kg (55lbs) for men and 16kg (35lbs) for women [2]. Respectively, the National Institute for Occupational Safety and Health (NIOSH), recommends for lifting with two hands under ideal conditions, the recommended limit up to 23kg (51lbs) [3]. Especially for patient handling, those limits are not protective, and assistive devices should be used, when necessary, particularly. Either way, the maximum proposed weight limit assumes that the task is performed under ideal conditions, with correct training and using appropriate lifting techniques. Additionally, the manual lifting of heavy weights and the level of risk associated with it can also be influenced by posture, height of placement, and positioning.

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There are several factors that may impact the manual handling weight limits, like the individual's ability and preparation, the task itself and the available equipment. More specific, those factors include: a) the movement requirements, like pushing, pulling, placing and transferring a heavy load, b) the physical capacity and limitations of the worker, including fitness level, mental health, medical history etc., c) the characteristics of the load, like shape, size, compactness, handling grip, geometry etc., d) the lifting techniques and worker's posture, using both or one hand, having training on ergonomics and manual handling etc. and e) the environmental factors, which may include the area constrains, the floor and corridors safety, other obstacles, microclimate, light, air, sound, vibrations etc.

For these reasons, EU member States, follow and have already adapted through their legislation work, the "Directive 90/269/EEC - manual handling of loads" of 29 May 1990, on the minimum health and safety requirements for the manual handling of loads where there is a risk particularly of back injury to workers, with its latest update (19/03/2021). This Directive lays down minimum health and safety requirements for the manual handling of loads where there is a risk particularly of back injury to workers.

It is obvious that, apart from the generally defined max limits by the HSE and NIOSH, there is no more detailed approach to setting an "personal maximum manual handling weight limit" ($PMHWL_{max}$) which is obtained by considering combined, the individual characteristics of the worker and the characteristics of the load and the task. People with larger body volumes and dimensions (weight, height, BMI), can manage and distribute larger loads safely, always with special conditions of proper technique and training, compared to their colleagues who are lagging in body volumes and dimensions. This involves a purely mechanical approach and relies on the interaction of the body volume and the load, due to muscularity and body inertia, which can be imposed on the inertia of the load.

2. AIM OF THE STUDY

For this reason, a model table was designed, based on which the safe $PMHWL_{max}$ can be determined, for each person, based on the anthropometric population data of weight, height, BMI and the corresponding distributions (percentiles), in combination with the weight handling elements, resulting from the purpose, the strategy of the management-handling of the load and the capacity of the worker (Table 1).

3. METHOD

We used the references to anthropometric parameters, weight in kilograms, height in centimeters and BMI, for adult males and females aged 20 and over and number of examined persons, mean, standard error of the mean, and selected percentiles, by all races and age, from the United States, 2015–2018 (National Center for Health Statistics, National Health and Nutrition Examination Survey) [4]. Based on these, we noted the average values corresponding to each percentile (5^{th},10^{th} ,15^{th} ,25^{th} ,50^{th} ,75^{th} ,85^{th} ,90^{th} ,95^{th}) in every parameter, in men and women. We adopted the recommended manual handling weight limits for men and women from the HSE, 25 kg and 16 kg respectively and assigned it to the 50^{th} percentile of body weight and BMI distributions. We proceeded by adding 1kg to each of the largest percentiles (i.e. for males: 75^{th} 26 kg, 85^{th} 27 kg, 90^{th} 28 kg, 95^{th} 29 kg and $>95^{th}$ 30 kg) and subtracting

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respectively, 1kg in each of the smallest percentiles (25th 24 kg, 15th 23 kg, 10th 22 kg, 5th 21 kg), forming a maximum load based on anthropometrics (MLA) range of 21-30 kg, (Figure 1), (Table 1). The same was done with the values and percentiles for women, forming a maximum load based on anthropometrics (MLA) range of 12-21 kg, (Figure 2), (Table 1). After the MLA is initially found, we calculate from the section that includes the weight handling elements, an analogous score, based on which we arrive at a correction coefficient (CC) of the original MLA, in order to find the "personal maximum manual handling weight limit" ($PMHWL_{max}$) , for the specific purpose and weight: $PMHWL_{max}$ = MLA+(MLA*CC), (Table 1).

Table 1. Calculation of the Personal Manual Handling Weight Limit ($PMHWL_{max}$) in kg, after estimating the MLA and the Correction Coefficient.

MALE			MLA	WEIGHT HANDLING ELEMENTS		
Body weight	percentiles	BMI	Kg			
60-65	5th	20-22	21	Max Load based on Anthropometrics (**MLA**)=……	IF	IF
66-68	10th	22.1-23	22	**CHOOSE ACCORDINGLY: YES or NO**	**Y**	**N**
69-74	15th	23.1-25	23	the task is repetitive?	-1	0
75-84	25th	25.1-28	24	coexisting vibration on the body?	-1	0
85-87	**50th**	28.1-32	25	is the holding/grip isometric?	-2	0
88-101	75th	32.1-35	26	is the holding/manipulation dynamic?	-1	0
102-110	85th	35.1-37	27	are there switching isometric/dynamic?	-3	0
111-119	90th	37.1-41	28	does the transfer take up to 5m?	0	0
120-131	95th	>41	29	does the transfer take up to 10m?	-1	0
132-150	>95th		30	does the transfer take up to 15m?	-2	0
				does the transfer take > 15m?	-3	0
				distance from the trunk, or bending or twisting trunk?	-3	0
FEMALE			MLA	elevation above shoulders height↑?	-2	0
Body weight	percentiles	BMI	Kg	elevation from waist height↑ up to shoulder?	-1	0
49-52	5th	19-21	12	elevation from waist height↑up to the reach end?	-3	0
53-56	10th	21.1-22	13	elevation from ground level↑ up to waist?	-2	0
57-61	15th	22.1-23	14	elevation from ground level↑ up to shoulder?	-3	0
62-69	25th	23.1-28	15	elevation from ground level↑up to the reach end?	-4	0
70-73	**50th**	28.1-33	16	is there elevation tool/accessory available?	1	0
74-88	75th	33.1-37	17	does the object has a handling grip?	0	-1
89-97	85th	37.1-40	18	is the object symmetrical ?	0	-1
98-104	90th	40.1-44	19	is the object compact?	0	-1
105-120	95th	>44	20	the age range between 20 to 50?	0	0
121-150	>95th		21	the age range between 51 to 60?	-1	0
MLA: Max Load based on Anthropometrics				the age range between 61 to 70?	-2	0
				is physically unsuited to carry out the task in question?	-3	0
				is wearing unsuitable clothing or footwear?	-2	0
				does not have adequate knowledge or lift training?	-2	0
				is the **BMI**> 40?	-2	0
				SCORE (SUM)	=	
				Correction Coefficient (CC) = SCORE / 100	=	
				Personal manual handling weight limit $PMHWL_{max}$ = MLA+(MLA*CC)	=	

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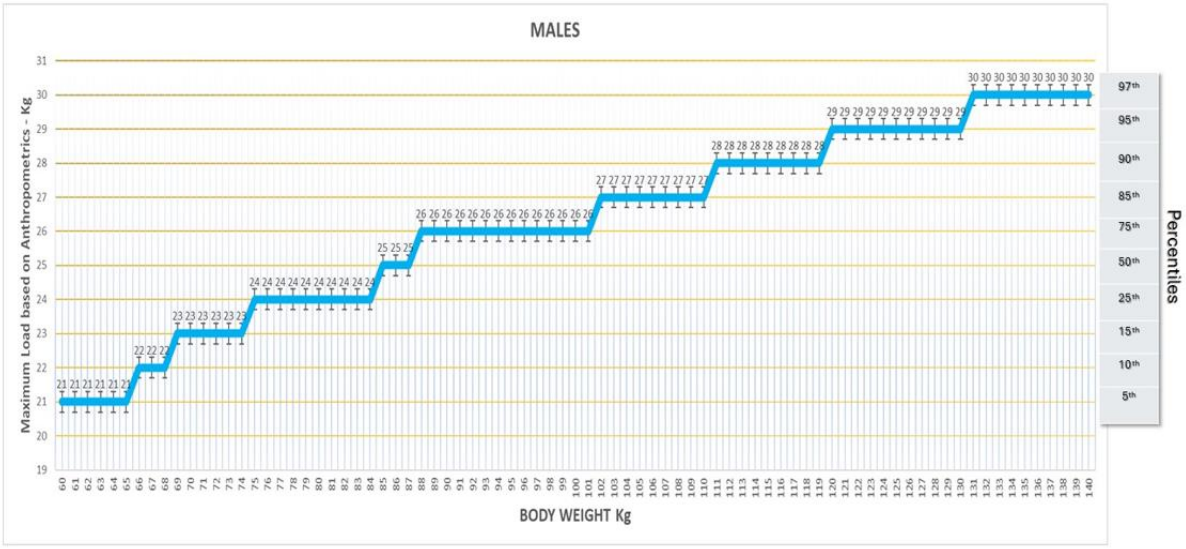

Figure 1. MLA - Maximum load based on anthropometrics (body weight), for men.

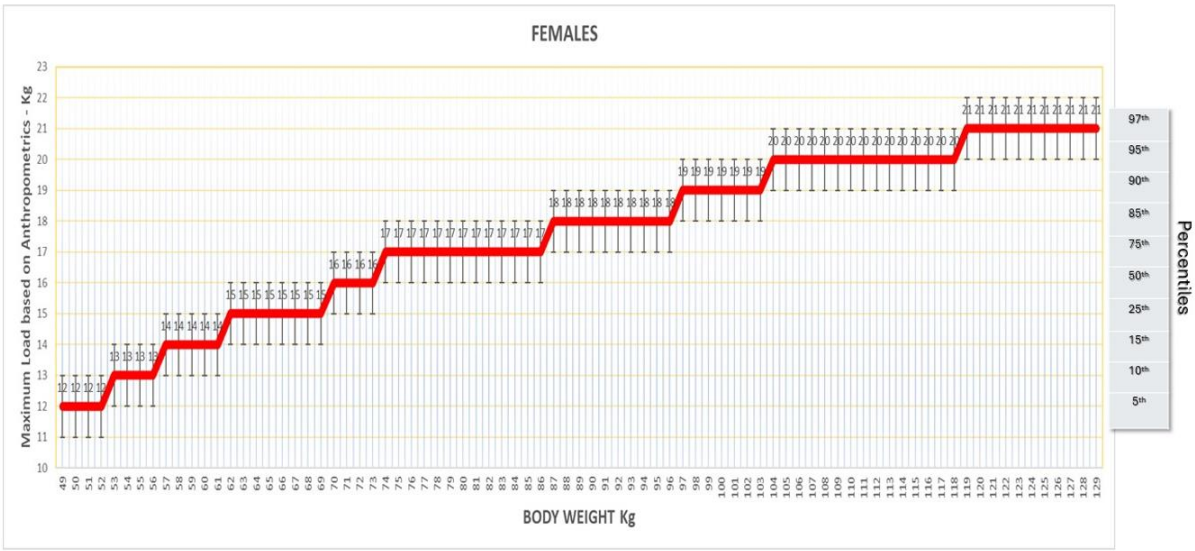

Figure 2. MLA-Maximum load based on anthropometrics (body weight), for women.

4. DISCUSSION AND CONCLUSION

It is a fact that there is a great variety in the body structure, in the physical and mental capabilities, in the education and skills, of the people who make up the workforce at a global level, so that the safe limit of manual handling of a given weight, can be differentiated accordingly. It is important, however, to take into account the exogenous factors that may potentially differentiate the mechanical effect of the load on our body, as well as those that define the environment in which the task is performed. The proposed method takes into account these endogenous and exogenous factors, aiming at safe and efficient work.

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References

[1] Health and Safety Executive (HSE), 2025, Health and safety statistics 2024/25, Health and Safety Executive, London. https://www.hse.gov.uk/statistics/

[2] Health and Safety Executive (HSE), 2020, Manual handling at work: a brief guide (INDG143 rev4), TSO, London. https://www.hse.gov.uk/pubns/indg143.PDF

[3] National Institute for Occupational Safety and Health (NIOSH), 2024, The Revised NIOSH Lifting Equation calculates the risk for single and multiple manual lifting tasks, Centers for Disease Control and Prevention, Washington, DC. https://www.cdc.gov/niosh/ergonomics/about/RNLE.html

[4] Fryar, C. D., Carroll, M. D., Gu, Q., Afful, J., and Ogden, C. L., 2021, Anthropometric reference data for children and adults: United States, 2015–2018, *Vital and Health Statistics*, Vol. 3(46), pp. 1–44, National Center for Health Statistics, Hyattsville, MD.