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ORIGINAL

# Physical fitness assessment of a Venezuelan industrial direct labor force population

## Evaluación de la aptitud física de una población de mano de obra directa industrial venezolana

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## ABSTRACT

**Introduction:** the purpose of this research is to evaluate the physical fitness variables of Venezuelan workers, considering exercise batteries or submaximal tests that have been little used in the industrial environment.
**Methods:** a quantitative, descriptive, cross-sectional, epidemiological and field study was conducted in a Venezuelan population of industrial direct labor workers in bipedestation. The sample consisted of 185 workers (M: 136, W: 49) in the main industrial areas of the state of Aragua-Venezuela.
**Results**: results were obtained on the physical fitness of Venezuelan industrial direct labor workers presenting average results in both sexes. Calculations for obtaining $HR_{max}$ and RAC in ml $O_2$ $min^{-1}$ $kg^{-1}$ were considered.
**Conclusions**: a population of industrial direct labor was observed, of low physical capacity with values associated with age (42,87 M-38,43W), physical wear and tear, poor physical fitness habits, poor dietary habits and decrease in muscle mass.

**Keywords:** Physical Fitness; Workers; Exercise.

## RESUMEN

**Introducción:** la presente investigación tiene como finalidad evaluar las variables en aptitud física de los trabajadores venezolanos tomando en cuenta baterías de ejercicios o pruebas submáximas que han sido poco utilizadas en el medio industrial.
**Métodos:** se realizó un estudio cuantitativo, descriptivo, transversal, epidemiológico y de campo en una población venezolana de trabajadores de mano de obra directa industrial en bipedestación. La muestra fue de 185 trabajadores (H: 136, M:49) en las principales zonas industriales del estado Aragua-Venezuela.
**Resultados**: Se obtuvieron resultados sobre la aptitud física de los trabajadores venezolanos de mano de obra directa industrial que presenta los resultados promedios en ambos sexos. Se tomó en cuenta los cálculos para la obtención de la $FC_{máx}$. y la CAR en ml $O_2$ $min^{-1}$ $kg^{-1}$.
**Conclusiones**: se observó una población de mano de obra directa industrial, de baja capacidad física con valores asociados a la edad (42,87 H-38,43M), desgaste físico, malos hábitos de aptitud física, malos hábitos alimenticos y disminución de la masa muscular.

**Palabras clave:** Aptitud Física; Trabajadores; Baterías de Ejercicio.

## INTRODUCTION

Physical fitness is a person's ability to perform effective physical work without excessive fatigue, involving activities that demand cardiorespiratory capacities, from which the individual can recover promptly to perform other tasks that may require other physical effort.[1] Likewise, through measurements of muscular fitness and endurance, mobility can be evaluated and the low capacity to perform physical exercise in healthy or sick subjects can be detected.[2]

Physical fitness is closely related to the subject's physical conditions and well-being, and physical activity and health were developed as such at the end of the 1990s under the sponsorship of the public health community. Likewise, this author mentions that these works were presented at the International Conferences on Physical Activity, Fitness and Health in 1988 and 1992 by Bouchard, Shepard and Stephens. They also point out that they developed a model defined as a complex model that takes into account the level of habitual physical activity, physical fitness and health.[3]

Within the context of knowledge, physical fitness is a function of the anthropometry of the subject, such as, for example: body mass index (BMI), abdominal perimeter (AP) and other measurements that the analyst believes may contribute to the study such as biceps circumference, triceps or other muscle measurements, while the physiology of the subject is related, for example: age, relative aerobic capacity (RAC), resting heart rate ($_{HRrest}$), maximum heart rate (HRmax). There are many ways to assess fitness, but the most common method is the $VO_2$ max test. [4]

Likewise, we can point out that relative aerobic capacity (RAC) is related to maximal oxygen consumption ($VO_2$ max.), with exhaustive exercise or referred to your work activity. Similarly, the CAR is a good indicator of the capacity (*performance*) to perform physical work; it is usually expressed in ml $O_2$/Kg-min. The CAR can have the capacity to perform prolonged dynamic work, which is determined by means of the $VO_2$ max. consumed, which is correlated with the Heart Rate (HR).[5]

To assess $VO_2$ max., direct procedures are required with laborious empirical tests such as stress tests or cyclo-ergospirometry with sophisticated equipment or indirect ones such as the step test of the U.S. Forest Service. On the other hand, there are other practical methods associated with physical exercises or battery tests called submaximal tests used in sports, which can be applied to measure muscular fitness in an industrial environment, taking into account how expensive the equipment of the direct methods can be.[6]

It should be noted that the application of these physical exercise tests applied to the industrial environment, may subject workers to physical fitness tests, to assess whether they are suitable for a specific job position in a given organization, and follow up with an annual performance evaluation. In this order we can point out that physical fitness (PA) is an important threshold competence in the world of work, because it considers people eligible for certain jobs, considering that the balance between cardiorespiratory capacity and physical workload, will determine the times of activity and rest in a job.[7]

Taking into account the above, within the industrial field there are few studies related to physical fitness and the protocol of exercise batteries, in this regard we can mention: Occupational risks, physical fitness and self-reporting of the health conditions of transport drivers and that of trunk muscular resistance in load operators in Colombia; Regression Functions Predictors of Muscular Fitness in Venezuelan Manual Workers: A Pilot Test and Prediction of Anthropometric Dimensions in Bipedestation and Physical Fitness in Venezuelan Industrial Direct Labor Workers (MODIV).[1,2,8,9]

In view of the facts, the objective of the present research is to evaluate the variables of physical fitness in workers using a protocol of exercise batteries, which allow the Venezuelan worker to be adequately positioned in his job, seeking to promote a better quality of life and health within the foundations of public health.

## METHODS

A quantitative, descriptive, cross-sectional, epidemiological and field study was carried out in a Venezuelan population of industrial direct labor workers in bipedestation. The accessible or sampled population is made up of the finite portion of the target population that has been accessed or constitutes the accessible population. In this case, the most accessible and homogeneous population is located in the Central Region of Venezuela, according to the gene frequency and percentage of admixture. [10]

Taking into account the previous assumption, the availability of time and resources of the researchers was taken,[12] in this sense, the industrial zones of Aragua state, located in the Central Region of Venezuela, were investigated as a population base for the due survey and application of the population sample. The sample was of 185 workers (H: 136, M: 49) in the main industrial zones of the state of Aragua-Venezuela, taking as a reference the work Prediction of Anthropometric Dimensions in Bipedestation and Physical Aptitude in Venezuelan Industrial Direct Labor Workers. [1]

The sampling of this research was of the simple random probability type and stratified by age and sex,[12] Likewise, samples were taken in the occupational medical services of the industrial companies in the state of Aragua, following the guidelines for health examinations, ordered in Article 27 of the Partial Regulation of the

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Organic Law of Prevention and Conditions of the Working Environment (RPLOPCYMAT).[13]

Inclusion and exclusion criteria referred to industrial direct labor workers, healthy, people with amputations, disability qualification or certification,[14] pre-existing diseases such as heart conditions, diabetes and post covid-19 were excluded.

The informed consent of the participant or collaborator was based on the letter of the Ministry of Health, General Hospital "Dr. Manuel Gea González", together with the Declaration of Helsinki of the World Medical Association - Ethical Principles for Medical Research Involving Human Subjects. Once the informed consent document was read, the subjects who agreed to participate voluntarily allowed themselves to be measured and collaborated in the investigation of anthropometric measurements in Venezuelan workers.[15]

The instruments used in the research were: a wall height meter with a scale for measuring height and weight, a tape measure for measuring circumferences, a stopwatch for measuring times and a sphygmomanometer or monitor for recording $HR_{resting}$. The procedure for the measurement of physical fitness in the workers was, once the informed consent was read, the worker had to rest initially for approximately 10 min for the measurement of the $HR_{resting}$ with the objective of reaching the resting levels, these values should be located between 60-100 beats /min. [16]

To assess physical fitness, the exercise test batteries used in the research Prediction of Anthropometric Dimensions in Bipedestation and Physical Fitness in Venezuelan Industrial Direct Labor Workers were taken into account. [1] In this sense, the upper, middle and lower body were evaluated.

To assess the upper part of the body, *push-up* tests were applied, in which the subject lies supine (face down) on a mat on the floor with the legs together and the hands under the shoulders, pointing them forward. [17] In this exercise, the subject should push upward by extending his/her arms, as a support the men rest on their toes and the women on their knees. The worker will do it as many times as he/she can do it without time limit, the test will end once the exercise is stopped or the investigator observes difficulty of the worker to do the test.

The reference values for measuring the physical endurance of the upper body of the subjects were established according to the parameters of The Canadian Physical Activity,[18] which establishes for men and women parameters ranging from: needs improvement to excellent, by age group up to more than 60 years of age.

On the other hand, the musculature of the middle part of the body was evaluated using the 1-minute test for the abdominals (Curl-Up),[19,20] . The equipment consists of a carpet and a stopwatch. The subject lies on a mat on the floor in a supine position (face up) with the knees bent at a 45-degree angle, with the feet completely flat on the floor. The hands should rest on the thighs, or if necessary the head can be cradled with the hands to support the neck, also, it is important not to use the hands to lift the head.

The test takes the number of times the worker performs the exercise in one minute or if the worker stops earlier. Benchmark values were compared on the Netfit.co.uk[21] tables on abdominal testing for both men and women by age group and values ranging from poor to excellent.

Finally, the assessment of the aptitude of the musculature of the lower part of the body required simple equipment: a carpet, a stopwatch, a folding chair or a 43-45 cm chair with a straight back, the worker must place him/herself in a standing position, cross his/her hands and sit and stand up until the minute is completed or stop before the established time proposed by the 1-minute sit-to-stand test. Once the number of times the exercise was performed in that minute was counted, it was evaluated according to the criteria established by Golding, Myers, & Sinning, W, in which both men and women were categorized by age groups in categories ranging from very poor to excellent.[22]

It is important to note that, in the interval between each physical test, a rest of approximately 5 to 10 minutes was taken, depending on the demands of each worker, to replenish their strength and perform the next physical test.

Likewise, to obtain the values of HRmax we used the equation: $FC_{Max}$ = 205,8 - (0,685 x age),[23] used in a previous study for a population of Venezuelan industrial workers, which allows us to have an approximation of physical fitness in Venezuelan workers. [1]

It should be noted that the $HR_{Max,}$ is an indicator used to estimate the relative aerobic capacity (RAC) with the submaximal tests or batteries, to estimate the $VO_{2max}$ based on the $HR_{Max}$ and $_{HRrest}$ in athletes between 21-51 years old. In this sense, the equation used in this pilot study on a Venezuelan population of workers: VO2max = 15,3 ($FC_{max}$ /FCreposo).[1]

The minitab-2017 statistical package was used for statistical calculations related to averages.

## RESULTS

The results obtained in Table 1 on the physical fitness of Venezuelan industrial direct labor workers are shown below, which presents the average results in both sexes.

Table 1. Measurements of physical fitness variables in workers MODIV

| Variables | Men n= 136 | | Women n=49 | |
|---|---|---|---|---|
| | Media | Des. Standard | Media | Des. Standard |
| Age (years) | 42,87 | 12,38 | 38,43 | 12,93 |
| Size ( cm) | 170 | 7,5 | 155,42 | 6,83 |
| Weight (Kg) | 77,15 | 15,15 | 66,79 | 15,62 |
| Fcrew (ppm) | 79,25 | 12,38 | 80,22 | 13,44 |
| BMI (kg/m )$^2$ | 26,69 | 4,79 | 27,69 | 6,39 |
| Abdominal circumference (Cm) | 89,85 | 11,59 | 83,07 | 13,25 |
| Biceps Perimeter ( Cm) | 31,55 | 3,50 | 29,55 | 5,55 |
| Quadriceps Perimeter | 89,857 | 11,598 | 50,082 | 5,469 |
| Twin Perimeter | 35,824 | 35,824 | 36,551 | 4,306 |
| N° Lizards | 10,83 | 7,30 | 6,7 | 5,35 |
| No. of abdominals | 13,27 | 9,58 | 13,8 | 11,3 |
| N° of sent/lev | 20,84 | 5,42 | 20,69 | 4,81 |
| CAR.: ml $O_2$ $min^{-1}$ $kg^{-1}$ | 34,93 | 5,96 | 35,14 | 5,78 |

## DISCUSSION

Table 1 shows the general average results for both sexes. In this sense, 26 % of the sample is female workers and 74 % of the sample is male, showing a significant gender gap in this population sample as a result of the sexual division of labor (SDL). From the assumption of the gender vision, these gaps are associated with the sexual division of labor (SDL), which made it possible to identify how the different tasks or trades within a productive process are assigned to men and women.[24,25,26,27] Likewise, the average age of female workers was 38,43±12,93 years, while for male workers it was 42,87±12,38 years.

In female workers, the abdominal perimeter or circumference was 83.07 cm, being at high risk (between 82 cm ≤ CC < 88 cm), while in male workers it was 89,85 cm Normal (CC < 95 cm). Similarly, the BMI of female workers: 27,69 kg/$m^2$ in overweight or pre-obese levels (25,0 kg/$m^2$ – 29,9 kg/$m^2$ ) and in male workers: 26,69 kg/$m^2$ being in the same overweight or pre-obese level (25,0 kg/$m^2$ – 29,9 kg/$m^2$).

As for, their average values associated with the physical fitness of female upper body workers: No. push-ups 6,77 (≤7, referential value) needs to improve their upper body endurance, similarly, in men: 10,83 is regular or moderate (10-12, referential value) being a little better, as referred by The Canadian Physical Activity.[18] The number of abdominals in women: 13,8 average value (13-26, reference value) in the middle part of the body, in men: 20,84 average (16-30, reference value) referred to the Netfit tables.[21]

Likewise, in their lower limbs the women's No. of sitting and standing: 20,69 average value (19-22, reference value), while, the men's side: 20,84 located in poor (17-22, reference value), referred to the Golding, Myers & Sinning tables.[22] Finally, the CAR of female workers: 35,14 ml $O^2$ $min^{-1}$ $kg^{-1}$ poor (≤40, referential value), on the other hand, in male workers CAR: 34,93 ml $O^2$ $min^{-1}$ $kg^{-1}$ poor (≤37, referential value), as referred to The Canadian Physical Activity table.[18,28,29,30,31]

These results indicate the low physical capacity of the Venezuelan direct labor workers taken in this study, in that sense, it can be inferred that the values associated with age (42,87 H-38,43M), physical wear and tear, poor physical fitness habits, poor eating habits, decrease in muscle mass which, consequently, begins to weaken their functional capacities that they have obtained over time and the loss of the capacity of the cardiovascular system that transports to the muscles the oxygen they need.

It is worth noting that the use of physical activity improved health levels in Mexican workers, [25,32,33] however, these authors point out that although both men and women are willing to engage in physical activity (73 % W, 69,4 M) following the patterns given by the World Health Organization (WHO,2021), this is only done for short periods of time and then 82% are sedentary, an aspect that has repercussions on health.[34,35,36,37]

In this sense, it should be taken into account that the World Health Organization[26] refers to the physical activities that an adult (18-64 years old) should have in order to maintain a healthy body and recommends: moderate activities: (150-300min/week) of aerobic or vigorous activity (75-150min/week) and muscle strengthening twice a week. In the case of intense activity: (300 min/week) vigorous activity or 150 min, with a decrease in sedentary lifestyle.

## CONCLUSIONS

We observed a population of direct industrial labor, of low physical capacity with values associated with

age (42,87 H-38,43M), physical wear and tear, poor fitness habits, poor eating habits, decrease in muscle mass that consequently begins to weaken their functional capacities that they have obtained over time and the loss of the capacity of the cardiovascular system that shows a population that should be the subject of study and follow-up within public health.

The use of a set of non-invasive physical battery tests that allowed physical capacity studies in the workplace is highlighted, which may represent in the future a protocol in the follow-up and monitoring of workers' health, which will allow the establishment of public policies to improve the health of workers in their industrial environment.

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