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*Research Article*

# How Much Labor Was Lost in the US During the Covid-19 Pandemic

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**Abstract**

The US National Center for Health Statistics published the ages of patients who died in the US during the pandemic, as well as the numbers of false-negative and false-positive PCR tests. Assessment of the data showed that roughly $33.9 \times 10^9$ J of work power is lost. A cyclist may do 3,709 kJ, a weight lifter may do 3,950 kJ, a rugby player may do 3,716 kJ, and a golfer may do 2,413 kJ of work in a day. Therefore, the total loss of work potential during the pandemic would be equivalent to the work power utilized by an elite athlete biker in $91 \times 10^5$ days, a weight lifter in $85 \times 10^5$ days, a rugby player in $91 \times 10^5$ days, and a golfer in $15 \times 10^6$ days. The disease transmission rate and the reliability of the data may be substantially different in different countries and age groups; therefore, this may lead to different global work power loss results.

***Keywords:*** *Loss of work power; COVID-19 PCR test; discordant results; false negative results; false positive results.*

## 1. Introduction

The COVID-19 (SARS-CoV-2) pandemic (also known as the coronavirus pandemic) began in China in December 2019. It invaded the other areas of Asia and then the other parts of the world in early 2020. The WHO declared the end of the PHEIC (Public Health Emergency of International Concern) for COVID-19 on 5 May 2023. It is difficult to know exactly how many people have died because of this pandemic, because many people who die while infected with SARS-CoV-2 have never been tested for it, and do not enter the official totals. Conversely, some people whose deaths have been attributed to COVID-19 had other ailments that might have led to their deaths in a similar timeframe anyway. The beginning and end of the pandemics are not well-defined and differ according to the definition used. The polymerase chain reaction (PCR) test is employed to diagnose the presence of the actual genetic material of a virus or its fragments in the body of a person. A PCR test is done with a sample collected by a health care professional from the nose and mouth of the suspected patient. A COVID-19 diagnostic test result could be positive or negative [1]. A positive result means that the alleged person currently has an active infection; therefore, appropriate measures must be taken to avoid spreading the virus to others, but there is also a possibility of having false positive results. A negative result means that the suspected subject likely does not have an infection with the COVID-19 virus. But a false-negative test result could happen depending on the timing and quality of the test sample. A false positive outcome (also referred to as a type I error) occurs when a health service worker obtains a positive result when it is negative. A false positive result, also known as a type II error, is an incorrect warning [2]. A false negative warning is claiming that something is false when it is true. Yilmaz et al [3] calculated the energetic and exergetic costs of the COVID-19 infection on the patient. In a different publication, Yilmaz et al [3] argued that to continue living a healthy life, energy supplied by metabolism must be adequate to meet the expenses of the life processes. Circulation of the blood, respiration of air, excretion of urine and other end products of metabolism, movement, growth, nutrition, nervous and endocrine control systems are collectively referred to as the life processes in the scientific literature; they represent the expenses incurred through the distribution of appropriate levels of energy for each of them. If the metabolism of a person provides sufficient energy to support his or her life processes, that person may be considered a "healthy" individual. Inflammation of the lung tissue distracts this process, and depending on the deficiency of the oxygen supply, as a result, ATP production via metabolic activity will decrease. ATP is the energy transfer currency of the cells and is produced in the metabolism in two stages:

Reaction (1) happens in the cytoplasm,

$$Gluc + 2Pi + 2ADP + 2NAD \rightarrow 2PYR + 2ATP + 2NADH + 2H_2O \quad (1)$$

and reaction (2) happens in the mitochondria:

$$2PYR + O_2 + 28ADP + 28Pi + 2NADH \rightarrow 28ATP + 2NAD + 6CO_2 + 24H_2O \quad (2)$$

As it is seen here, it is expected to produce two moles of ATP from one mole of glucose through reaction 1 and twenty-eight moles of ATP from two moles of PYR (pyruvate). PYR, which is produced in the cytoplasm, is then delivered to mitochondria for further processing in the tricarboxylic acid cycle and electron transport chain. When we look at reactions 1 and 2, we see that less than 10% of the total ATP is produced in the cytoplasm, and more than 90%

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is produced in the mitochondria. In addition to serving as part of the cellular energy generation, the tricarboxylic acid cycle also serves to produce intermediaries for chemical synthesis in the cells. In the life processes of the pregnant mice, Semerciöz et al [4] found that 27.8% of the metabolites are taken by the tricarboxylic acid cycle to construct the cellular components. ATP is delivered to the locations of the cell where energy is desirable. It is hydrolyzed by reaction (3) to yield ADP and organic phosphate, and in this process, 30.5 kJ/mol ATP of energy may be produced:

$$ATP + H_2O \rightarrow ADP + Pi + H^+ \quad (3)$$

Chemical reactions, which require energy to happen, occur simultaneously with reaction (3), since they would not happen otherwise. When aerobic respiration, as explained by reaction (2), cannot occur, because of the absence of sufficient oxygen delivery to the muscles, a fraction of pyruvic acid is taken away from the metabolism after being converted into lactic acid. In general, lactic acid accumulates in the muscle cells when sufficient oxygen is not supplied to the muscles during excessive exercise. Lactic acid buildup is noticed as pain in the case of COVID-19.

COVID-19 makes it very hard to deliver the energy demanded for the life processes, because of the shortage of O2. COVID-19 patients may be placed in a respiratory unit, where higher oxygen pressures are provided to compensate for the increased resistance to oxygen delivery in the lungs [2]. In the respiratory unit, the pressure of oxygen cannot exceed three times the partial pressure of oxygen of the air; otherwise, the lungs may be damaged. The impact of the COVID-19 disease may be assessed in five levels. At the highest impact, patients may be found positive, but recover without any symptoms or clinical signs. COVID-19 patients, who have the most severe symptoms, may have difficulty in respiration, experience malfunctioning organs, and shock. Patients who experience severe symptoms are usually provided with an elevated level of oxygen supply, up to 300% of the partial pressure of oxygen in the air.

Less than 25-27% of the energy obtained from the food can be used for external or internal work performance [5, 6], and almost 75 % is delivered out from the body as heat during the metabolic events [7]. In case of natural death, Kuddusi [8] suggested that the lifespan-entropy-generation-limit was 11,404 kJ/K kg, and then the people were passing away. The relationship between aging and the calories of food is calculated according to metabolic activity. The diet is expected to provide sufficient or more energy for metabolism [9]. This oxidative stress, in turn, is required to intensify the telomere attrition, which has been linked to aging in many creatures, including mice and humans. An elevated rate of metabolism causes an elevated level of entropy generation and suggests correlations that can be helpful in future aging studies. Öngel et al [9] studied the results of telomere length-regulated entropic assessment with four different diets, indicating that women live longer than men. Faster shortening of the telomere lengths in men was the major reason for this estimation. The Mediterranean diet includes foods with anti-oxidative outcomes, and people who are on this diet are subject to slower telomere attrition since they are exposed to less oxidative damage. The Western diet (American diet) is composed mainly of concentrated grains, salt, sugar, saturated lipids, and processed meat are associated with increased cancer risk and chronic diseases. Vegan diets are among the widespread contemporary would have 112 and 86 years of lifespan, on the women and men would have 108 and 85 years of lifespan, 108 and 85 years of lifespan, on the ketogenic diet, women and men may have 110 and 80 years of lifespan and on the vegan diet, women and men may have 99 and 88 years of lifespan; with the average lifespan of 95 years.

The exergy method of calculations was also used in references [10-15], and they may be helpful to gain a comprehensive understanding of the subject.

## 2. Materials and Methods

The data [16] were obtained from the US National Center for Health Statistics (NCHS), which operates under the Centers for Disease Control and Prevention, a principal agency of the US Federal Statistical System, at Hyattsville, Maryland, and presented in the initial two columns of Table 1. Data describing the weight of the people were adapted from the National Center for

## 3. Results and Discussion

*Table 1. Calculation of the loss of work power.*

| Age of the patients (years) | Calculation of the work power lost due to the deaths of the people | Work power lost (J) |
|---|---|---|
| 0-17 | (1,516 children died) (35 kg/child) (309.5 K) (65 years until retirement) (1/0.26 work performed with consumption of 1 J of nutrients) | $6.10 \times 10^9$ |
| 18-29 | (6,870 people died) (65 kg/person) (309.5 K) [65-(18+ 29)/2] (years until retirement) (1/0.26 work performed with consumption of 1 J of nutrients) | $3.40 \times 10^9$ |
| 30-39 | (42,627 people died) (65 kg/person) (309.5 K) [65-(30+39)/2] (years until retirement) (1/0.26 work performed with consumption of 1 J of nutrients) | $1.55 \times 10^9$ |
| 40-49 | (45,627 people died) (65 kg/person) (309.5 K) [65-(30+39)/2] (years until retirement) (1/0.26 work performed with consumption of 1 J of nutrients) | $1.66 \times 10^9$ |
| 50-64 | (200,067people died) (65 kg/person) (309.5 K) [65-(50+64)/2] (years until retirement) (1/0.26 work performed with consumption of 1 J of nutrients) | $1.38 \times 10^{10}$ |
| 65-74 | | |
| 75-84 | These people have already retired and do not perform any work of commercial value | |
| 85 years old and over | | |
| 18-29 | Work power loss due to the false negative test results by the 18-29-year-old university students | $7.4 \times 10^9$ |
| 18-29 | Work power loss due to the false positive test results by the 18-29-year-old university students | $1.3 \times 10^5$ |
| TOTAL WORK POWER LOSS | | $33.9 \times 10^9$ |

The first row explains that in the 0 to 17-year age group, 1,516 children died. If the average weight of these children were 35 kg/child, at 309.5 K (37 °C), they would have 65

years until retirement, and perform 1/0.26 of work with consumption of 1 J of nutrients. The following rows were constructed by following a similar technique. The work power was based on the number of people; on the other hand, productivity depends on the skills of the people and how they use them. The work power was considered in Table 1, not the productivity. The physical/energetic work capacity depends only on the number of people in the labor market.

A graphical description of the COVID-19 disease on the body of a person is presented in Figure 1.

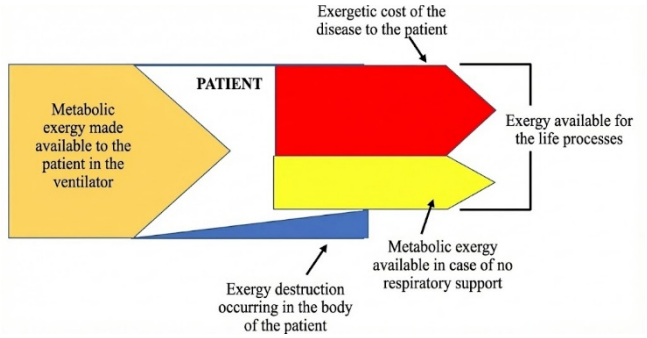


*Figure 1. Graphical description of the COVID-19 disease in the body of a person.*

The diseased person was assumed to be taken to a ventilator. The exergetic cost of the inefficient metabolism is described with the red arrow, and the patient's remaining metabolic activity is described with the yellow arrow. The blue fraction of the figure describes the exergy destruction in the body of the patient.

Jarvis and Kelley [18], after performing different modeling studies, concluded that one false negative may lead to approximately 2.25 inoculations. If we should consider that the virus was spread between the 18-29 years old university students, we may calculate the work power lass as = (1,025 false negatives) (2.25 number spread by false negatives) (65 kg/person) (309.5 K) [65-(18+ 29)/2] (years until retirement) (1/0.26 work performed with consumption of 1 J of nutrients) = 7.4 $x10^9$ J.

If we should focus on the effect of the false positives on the 18-29 years old university students and they isolate themselves for two weeks we may calculate the work power loss as = (447 false positives) (65 kg/person) (309.5 K) (14 days/365 days) (1/0.26 work performed with consumption of 1 J of nutrients) = 1.3$x10^5$ J

When we add up these numbers, we may estimate that approximately 33.9$x10^9$ J of work power is lost during the pandemic in the US. Yildiz et al [19] estimated that a cyclist may do 3,709 kJ, a weight lifter may do 3,950 kJ, a rugby player may do 3,716 kJ, and a golfer may do 2,413 kJ of work per day. Therefore, the total loss of work potential during the pandemic would correspond to the work power utilized by an elite athlete biker in 91$x10^5$ days, a weight lifter in 85$x10^5$ days, a rugby player in 91$x10^5$ days, and a golfer in 15$x10^6$ days.

## 4. Conclusion

The number of people who died in the US during the pandemic, their ages, and accounts of false negative and false positive PCR tests are available in the publications of the US National Center for Health Statistics. Analysis of the data showed that approximately 33.9$x10^9$ J of work power was lost. A cyclist may do 3,709 kJ, a weight lifter may do 3,950 kJ, a rugby player may do 3,716 kJ, and a golfer may do 2,413 kJ of work in a day. Therefore, the total loss of work potential during the pandemic would be equivalent to the work power utilized by an elite athlete biker in 91$x10^5$ days, a weight lifter in 85$x10^5$ days, a rugby player in 91$x10^5$ days, and a golfer in 15$x10^6$ days. The inoculation rate and the reliability of the data may vary substantially across different countries and age groups; therefore, this may lead to significantly different work power loss results.

## Conflict of Interest

Author approves that to the best of their knowledge, there is not any conflict of interest or common interest with an institution/organization or a person that may affect the review process of the paper.

## Credit Author Statement

**M. Özilgen**: Conceptualization, Writing- Reviewing and Editing, Visualization, Investigation

## Nomenclature

| | |
|---|---|
| *ADP* | Adenosine diphosphate |
| *ATP* | Adenosine tri phosphate |

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