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COVID-19 vaccination - Does it affect sick leave in military personnel?

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Abstract. – OBJECTIVE: Sick leave is a major negative economic effect of the COVID-19 pandemic. In April 2021, the Integrated Benefits Institute reported that employers spent a total of US $50.5 billion for workers absent due to the COVID-19 pandemic. While vaccination programs lowered the number of severe illness and hospitalizations worldwide, the number of side effects following vaccination against COVID-19 were high. The present study aimed to evaluate the effect of vaccination on the probability of taking sick leave in the week following vaccination.

***SUBJECTS AND METHODS:* The study population was comprised of all personnel serving in the Israel Defense Forces (IDF) between October 7, 2020, and October 3, 2021, (a total of 52 weeks) who were vaccinated with at least one dose of the BNT162b2 vaccine. Data on Israel Defense Forces (IDF) personnel sick leaves were retrieved and the probability of a "post-vaccination week sick leave" and a "regular (not post-vaccination week) sick leave" were analyzed. An additional analysis was performed to determine whether winter-related diseases or the sex of the personnel affected the probability of taking sick leave.**

RESULTS: The probability of taking sick leave in a post-vaccination week was significantly higher than the probability of taking sick leave in a regular week (8.45% *vs.* 4.3%, respectively, $p < 0.01$). The increased probability remained unchanged after analysis of sex-related and winter disease-related variables.

***CONCLUSIONS:* Given the major effect of vaccination against COVID-19 by BNT162b2 vaccine on the probability of taking sick leave, when medically feasible, the timing of the vaccination should be considered by medical, military, and industrial authorities with the intent to minimize the effect on overall national economy and safety.**

Key Words:
COVID-19 vaccination Sick leave, Military personnel.

Introduction

On March 2020, the World Health Organization (WHO) identified COVID-19 as a pandemic, and on April 2020 reported that over 1 million COVID-19 cases had been confirmed worldwide, representing an increase of more than tenfold in less than one month[1]. On March 2022, the WHO published an account of more than 434 million confirmed cases of COVID-19 worldwide[1].

The financial loss attributed to the COVID-19 pandemic is difficult to assess. Analysis of the global domestic product (GDP) reported by the World Bank revealed a mean percent increase of 3.021 between 2011 and 2019 while the mean GDP in 2020 deteriorated to -3.405%[2].

Several factors contributed to the major negative economic effect of the COVID-19 pandemic, and one of them is the staggering number of sick leaves. Sick leaves are used as an indicator of the working population's well-being, as well as an indicator of health effects and mortality[3]. In a recent cohort study[4] of over 1.6 million Spanish workers, the authors demonstrated to what extent the number of sick leaves increased in March 2020, following the onset of the COVID-19 pandemic. Compared to the same period in 2017-2019, the sick leaves increased by 96% for respiratory diseases and by 264% for infectious diseases, while those related to cardiovascular diseases remained stable compared to the same period across all previous years. A Swedish study[3] on 11,955 indi-

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viduals infected with COVID-19 reported that the median sick leave lasted 35 days. Another study[4] from Spain conducted in hospital emergency departments showed that there was also a high rate of medical staff taking sick leaves in areas where the COVID-19 incidence was higher.

In April 2021, the Integrated Benefits Institute conducted an analysis of the estimated cost of the lost work time. It reported that employers spent a total of $50.5 billion for absent workers due to the COVID-19 pandemic, with sick leave wages directly accounting for $15.5 billion of them[5].

On December 2020, the WHO issued its first emergency use for a COVID-19 vaccine, and the UK was the first country to start vaccinating its population with the BNT162b2 vaccine (PFIZER, New York, NY, USA / BIONTECH, Mainz, Rhineland-Palatinate, Germany), and other governments, including Israel, Italy, and others, started their vaccination campaigns shortly thereafter[1]. Since then, the effectiveness of the vaccine in lowering the number of overall COVID-19 cases and of severe illness and hospitalizations has been reported in literature. Rossman et al[6] retrieved data from the Israeli Ministry of Health compiled between August 2020 and February 2021 and demonstrated a larger and earlier decrease in COVID-19 cases and hospitalization in individuals older than 60 years, followed by younger age groups, according to the order of vaccination prioritization. A recent retrospective cohort study[7] from Italy showed that the number of asymptomatic healthcare workers infected with COVID-19 was higher before they were vaccinated and that the sick leave of the vaccinated workers was shorter.

Although the incidence of severe adverse effects post-vaccination has been and remains low, many reported side effects are reported in the days following vaccination. In one prospective UK study[8] on 282,103 individuals who were vaccinated with the BNT162b2 vaccine, systemic side effects were reported by 13.5% of individuals after the first dose of the vaccine and by 22% after the second dose. Local side effects at the injection site were reported by 71.9% of individuals after the first dose of the vaccine and by 68.5% after the second dose[8].

Sick leaves have a major effect on a country's economy. The Confederation of British Industry estimates the total annual costs in the UK at £11 billion per year. The equivalent costs in the US are reported to exceed $30 billion[9]. It is possible to make various adaptations if sick leaves following vaccination are excessively high in the civilian environment. For example, construction projects may be postponed and delayed, education and health services may be (at least partially) provided online. However, in a military environment, the defense readiness of the military against hostile enemy activity can neither be similarly postponed nor performed online. As such, the effect of the vaccination itself on sick leaves in the military environment needs to be addressed in order to avoid prolonged absence from work, damage to ongoing projects, and ultimately to minimize its adverse effect on national security.

The aim of our study is to evaluate whether there is an increase in sick leave days following COVID-19 vaccination among enlisted Israel Defense Forces (IDF) personnel.

Subjects and Methods

The study population included all personnel serving in the IDF between October 7, 2020, and October 3, 2021 (52 weeks) who were vaccinated with at least one dose of the BNT162b2 vaccine. Non-vaccinated soldiers were excluded from the study. Data on the number of sick leaves reported during the week following vaccination against COVID-19 (seven days from vaccination, hereafter referred to as "post-vaccination weeks") and the number of sick leaves in work weeks without vaccination (hereafter referred to as "regular weeks") were retrieved from the Human Resources Corps electronic attendance system of the IDF.

Each sick leave was counted once, regardless of its length, and dated according to the first day of absence from duty. Cases in which two consecutive sick leaves were interrupted by weekends, holidays, or one day of attendance, were counted as a single sick leave.

We calculated the number of sick leaves during the post-vaccination week and the number of sick leaves during regular weeks for each participant. The probability of a "post-vaccination week sick leave" was equal to the total amount of post-vaccination sick leaves divided by the number of vaccination weeks (one to three weeks, depending upon the number of vaccine doses). The probability of a "regular week sick leave" was calculated by dividing the total number of regular week sick leaves by the number of yearly non-vaccination weeks (52 weeks minus the number of vaccination weeks).

Statistical Analysis

An independent *t*-test was performed in order to examine the different effects of winter diseases and sex on sick days. An ANOVA test was used to overcome additional confounders. A *p*-value lower than 0.05 was considered statistically significant.

The statistical analysis was carried out with the SPSS Statistics for Windows (version 25.0) statistics software package (IBM Corp., Armonk, NY, USA).

Results

Data from 119,933 consecutive vaccinated individuals were analyzed. Most of the soldiers serving between October 4, 2020, and October 3, 2021, received the first vaccine dose and a similar percentage received the second dose between January 2, 2021, and March 5, 2021.

Distribution of Sick Leaves

The distribution of "regular week sick leaves" (out of 49-52 regular weeks) and "post-vaccination week sick leaves" (out of 1-3 post-vaccination weeks) is described in Table I.

The probability of sick leave following a COVID-19 vaccination (mean 0.0845, SD 0.19255) was almost double the probability of sick leave in a regular week (mean 0.043, SD 0.0479). This difference was highly significant [t (119,933) = 77.97, $p < 0.001$].

Distribution of Sick Leaves Among Males and Females

The likelihood of males taking sick leave during both regular weeks (mean 0.0377, SD 0.04310) and post-vaccination weeks (mean 0.0712, SD 0.17740) was lower than that for females (regular week: mean 0.0539, SD 0.05485, post-vaccination week: mean 0.1117, SD 0.21778). Both of those differences were highly significant ($p < 0.001$), whereupon an ANOVA test with repeated measures was performed with sex being the between-subjects factor and type of week (regular or post-vaccination) being the within-subjects factor. The interaction between sex and type of week was also highly significant [f (1,119931) = 65,150.61, $p < 0.001$]. Due to the significant interaction results, a paired samples *t*-test was done separately for the male and female groups. The likelihood of taking sick leave in a post-vaccination week was significantly higher than in a regular week for both sexes [t (80,537) = 55.509, $p < 0.001$] for males and [t (39,394) = 55.338, $p < 0.001$] for females.

Sick Leaves and Winter-related Diseases

A separate analysis was carried out for January and February to eliminate the effect of winter-related diseases on the results. Sick leaves in nine weeks (January 2, 2021, to March 5, 2021, hereafter "winter period") were compared between the two groups [sick leaves post-vaccination (hereafter "winter vaccination weeks") and sick leaves without vaccination (hereafter "regular winter weeks")]. Soldiers who served during the 52 weeks between October 4, 2020, and October 3, 2021, and received at least one vaccine dose during the winter period were included in the analysis. Soldiers who did not receive a vaccine dose during the winter period were excluded from this analysis.

The probability of taking sick leave during winter vaccination weeks was calculated in the same way as previously described, but 1-2 vaccination weeks were subtracted from 9 maximum winter weeks (depending upon the number of vaccine doses the soldier received) for the winter vaccination weeks. First, the hypothesis that the probability of taking sick leaves in regular winter weeks would be greater than in regular non-winter weeks was tested. The calculation of the probability of taking sick leave during regular non-winter weeks was carried out by dividing the number of regular non-winter week sick leaves by the number of regular non-winter weeks. Second, the probability of taking a sick leave during regular winter weeks was evaluated by a paired samples *t*-test (mean 0.0701, SD 0.10355) and found to be greater than the probability of taking a sick leave during regular non-winter weeks (mean 0.0364, SD 0.04592). This difference was highly significant [t (111,255) = 112.847, $p < 0.001$].

Table I. Distribution of sick leaves among military personnel.

	N	Mean	Standard deviation
Regular week sick leaves	119,933	2.12	2.37
Post-vaccination week sick leaves	119,933	0.22	0.48

The Probability of Taking a Sick Leave during the Winter (Post-vaccination and Regular Weeks)

The probability of taking sick leaves during vaccination winter weeks (mean 0.0993, SD 0.24120) was greater than the probability of taking sick leaves during regular winter weeks (mean 0.0701, SD 0.10355). This difference was highly significant [t (111,255) = 38.810, $p < 0.001$]. The probability of taking a sick leave during a regular winter week was 7.01%, while the probability of taking a sick leave during a post-vaccination winter week was 9.93%. These results show that the likelihood of taking a leave of absence after vaccination during the winter was approximately 1.4 times the likelihood of taking a leave of absence in a regular winter week. This difference was also highly significant ($p < 0001$).

Distribution of Sick Leaves During the Winter Among Males and Females

The likelihood of males taking a sick leave during a regular winter week (mean 0.0649, SD 0.09942) and during a post-vaccination winter week (mean 0.0842, SD 0.22324) was lower than that for females (regular winter week: mean 0.0809, SD 0.11093, post-vaccination winter week: mean 0.1310, SD 0.27227). Both of those differences were highly significant ($p < 0.001$). We, therefore, conducted an ANOVA test with repeated measures with sex being the between-subjects factor and the type of winter week (regular or post-vaccination) being the within-subjects factor. The interaction between sex (male/female) and type of winter week (regular or post-vaccination) was highly significant [f (1.111,253) = 369.045, p <0 .001].

Given the significant interaction results, a paired samples t-test was done separately for the male and female groups. The likelihood of males taking a sick leave during the post-vaccination week (mean 0.0712, SD 0.17740) was higher than the likelihood of their taking a sick leave during a regular week (mean 0.0377, SD 0.04310), a difference that was highly significant [t (80,537) = 55.509, $p < 0.001$]. The results for the female group were similar, with the likelihood of taking sick leave during the post-vaccination week (mean 0.1117, SD 0.21778) being higher than the likelihood of taking sick leave during a regular week (mean 0.0539, SD 0.05485), yielding a highly significant difference [t (39,394) = 55.338, $p < 0.001$]. We then performed a dependent t-test separately for the male and female groups. The likelihood for the males to take a sick leave during the post-vaccination winter week (mean 0.0842, SD 0.22324) was higher than the likelihood for them to take a sick leave in a regular winter week (mean 0.0649, SD 0.09942). This difference was also highly significant [t (75,263) = 22.454, $p < 0.001$]. The results in the female group were similar, with the likelihood of their taking sick leave during the post-vaccination winter week (mean 0.1310, SD 0.27227) being higher than their doing so during a regular winter week (mean 0.0809, SD 0.11093), with a highly significant difference [t (35,990) = 33.857, $p < 0.001$]. No significant correlation was found between age and the likelihood of taking sick leave for both sexes.

Discussion

Leave of absence is an integral part of the workplace economy. During the COVID-19 pandemic, the magnitude of sick leaves was raised by 116% in the first trimester of 2020, as demonstrated in the Spanish population among whom a considerable number required a leave of absence related to COVID-19[4]. Hospitalization due to COVID-19 was demonstrated as being the strongest predictor for a longer leave of absence ($p < 0.001$, 95% CI 1.63-1.99)[3]. Old age and previous sick leaves were also found to correlate to an extended leave of absence[3]. Thus, the COVID-19 pandemic not only closed industries but also placed a tremendous and lengthy burden on the workplace economy and health insurance[3].

Vaccination against COVID-19 was confirmed to be effective in lowering transmission rate, morbidity, and mortality[9,10]. However, it has also been shown that protection provided by the vaccine wanes over time[11,12]. Therefore, the current understanding is that multiple doses are needed to control the COVID-19 pandemic. The need for several vaccinations against COVID-19 carries with it the need to consider the potential increase in their side effects leading to the loss of workdays.

The national policy of paying wages during sick leave is a major factor in the length and willingness to return to work after a sick leave[4,13]. This practice of paid sick leave encourages workers to stay at home and prevent COVID-19 spread[14]. During military service in Israel, it is customary to pay wages to the personnel during a leave of absence due to sickness. The findings of the current analysis demonstrated that for the same IDF personnel, the odds of taking a leave of absence

after COVID-19 vaccination were doubled compared to a regular week (8.45% *vs.* 4.3%, respectively, $p < 0.001$). In addition, females took sick leaves more often than males, both during regular weeks (5.39% *vs.* 3.77%, $p < 0.001$) and during post-vaccination weeks (11.17% *vs.* 7.12%). The likelihood of taking sick leave during the week following vaccination against COVID-19 was doubled compared to a regular week in both the male and female groups (7.12% *vs.* 3.77% $p < 0.001$ and 11.17% *vs.* 5.39% $p < 0.001$, respectively). It is important to note that only sick leaves of the military personnel themselves were included, and that leaves of absence to take care of a sick family member were excluded.

Another confounder that could have affected the data was the seasonal variation of taking sick leaves. The taking of sick leaves reportedly tends to rise during the winter season[15]. Our findings are in line with that trend, with 7.01% of the sick leaves being reported in the winter compared to 3.64% during the rest of the year ($p < 0.001$). A comparison of sick leaves taken in an ordinary winter to those taken in winter after a COVID-19 vaccination revealed a greater likelihood for the latter (7.01% *vs.* 9.93%, respectively, $p < 0.001$). We analyzed this seasonal effect in the male and female groups and demonstrated that females had a higher likelihood to take sick leaves in both the regular and post-vaccination weeks during the winter season (8.09% *vs.* 6.49% $p < 0.001$ and 13.10% *vs.* 8.42%, respectively).

Calvo-Bonacho et al[4] recently demonstrated that no working sector was safe from the COVID-19 pandemic. The healthcare profession reportedly experienced the largest rise in absenteeism[4,16]. Comparable to healthcare workers, IDF personnel are required to perform activities during which they are less able to avoid exposure to COVID-19. Similar to many workplaces, the IDF is constantly adapting to the new national health status and WHO recommendations for keeping exposure as low as possible for military personnel[17]. Even though IDF soldiers are, for the most part, young and free of comorbidities, personal protection equipment is obligatory, and vaccination is strongly advised and encouraged.

One of the strengths of this study is the ability to examine sick leave in previously screened mostly healthy young soldiers in two parallel timeframes. Another advantage of our study is the big data source in a single unified health system with a medical electronic file for each soldier, thereby enabling both the identification of all sick leaves being taken and the uniform vaccination schedule. Previous reports[18] on workplace absenteeism after COVID-19 vaccination relied on workers self-reporting their leave of absence.

Limitations

There are some limitations to this study. The IDF soldiers do not represent the common working-age population, being mostly young (predominant age range 18-21 years) and free of significant comorbidities. An elderly worker in a civilian environment may be more severely affected by the COVID-19 pandemic and vaccination side effects and might be more reluctant to return to work from sick leave. Another limitation is that we did not compare the number of sick leaves taken after each of the three vaccination phases (first, second and third dose).

Conclusions

COVID-19 vaccination offers great promise to the workplace economy while bearing the highly costly liability of increased sick leaves. The current study demonstrated that more females than males took sick leaves following vaccination and that there were no associated seasonal variations. Healthcare and workplace organizers should bear in mind vaccination-related sick leave when preparing a vaccination plan and take appropriate measures. Additional studies are required to adapt our current findings to civilian populations.

Conflict of Interest

The Authors declare that they have no conflict of interests.

Ethics Approval

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1964 and its later revisions. The study was approved by the IDF Medical Corps Institutional Review Board (authorization number 1024). The review board concluded that no informed consent was required due to the fact that the information was acquired through use of human resources and attendance registration systems, and not medical files.

Availability of Data and Materials

All data were retrieved from Human Resources Corps' electronic attendance system. Data will not be made available due to confidentiality restrictions imposed by the IDF.

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Authors' Contribution
LBG, IG, and SOC conceived and designed the study; LBG and IG participated in the literature search; EL, DT, LBG, and IG collected and analyzed the data; SOC and EK reviewed and edited the manuscript. All authors read and approved the final manuscript.

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References

1) Timeline of WHO's response to COVID-19. [cited 2022 Jan 30]. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/interactive-timeline
2) GDP (current US$) | Data [Internet]. [cited 2022 Jan 30]. Available from: https://data.worldbank.org/indicator/NY.GDP.MKTP.CD
3) Westerlind E, Palstam A, Sunnerhagen KS, Persson HC. Patterns and predictors of sick leave after Covid-19 and long Covid in a national Swedish cohort. BMC Public Heal 2021; 21: 1023.
4) Calvo-Bonacho E, Catalina-Romero C, Fernández-Labandera C, Fernández-Meseguer A, González-Quintela A, Martínez-Muñoz P, Quevedo L, Valdivielso P, Sánchez-Chaparro MÁ. COVID-19 and Sick Leave: An Analysis of the Ibermutua Cohort of Over 1,651,305 Spanish Workers in the First Trimester of 2020. Front Public Heal 2020; 19: 580546.
5) COVID-19 Lost Time from Work Could Cost Employers More Than $50 Billion Per Integrated Benefits Institute Analysis [Internet]. [cited 2021 Nov 5]. Available from: https://www.ibiweb.org/covid-19-lost-work-time-costs-2021/
6) Rossman H, Shilo S, Meir T, Gorfine M, Shalit U, Segal E. COVID-19 dynamics after a national immunization program in Israel. Nat Med 2021; 27: 1055-1061.
7) Alquézar-Arbé A, Piñera P, Jacob J, Martín A, Jiménez S, Llorens P, Martin-Sanchez FJ, Burillo-Putze G, Garcia-Lamberechts EJ, Gonzalez del Castillo J, Rizzi M, Agudo Villa T, Haro A, Martin Diaz N, Miro O. Impacto organizativo de la pandemia COVID-19 de 2020 en los servicios de urgencias hospitalarios españoles: resultados del estudio ENCOVUR. Emergencias (Sant Vicenç dels Horts) 2020; 32: 320-331.
8) Menni C, Klaser K,Anna May, Polidori L, Capdevila J, Louca P, Sudre CH, Nguyen LH, Drew DA, Merino J, Hu C, Selvachandran S, Antonelli M, Murray B,Canas LS, Erika Molteni, Mark S Graham, Modat M, Joshi AD, Mangino M, Hammers A, Goodman AL, Chan AT, Wolf J,Steves CJ, Valdes AM, Ourselin S, Spector TD. Vaccine side-effects and SARS-CoV-2 infection after vaccination in users of the COVID Symptom Study app in the UK: a prospective observational study. Lancet Infect Dis 2021; 21: 939-949.
9) Bevan S, Hayday S. HR Response to Organisational Change Costing Sickness Absence in the UK I E S. [cited 2021 Nov 11]; Available from: www.employment-studies.co.uk
10) Polack FP, Thomas SJ, Kitchin N, Absalon J, Gurtman A, Lockhart S, Perez JL, Pérez Marc G, Moreira ED, Zerbini C, Bailey R, Swanson KA, Roychoudhury S, Koury K, Li P, Kalina WV, Cooper D, Frenck RW, Hammit LL, Türeci Ö, Nell H, Schaefer A, Ünal S, Tresnan DB, Mather S, Philip R. Dormitzer PR, Şahin U, Jansen KU, Gruber WC. Safety and Efficacy of the BNT162b2 mRNA Covid-19 Vaccine. N Engl J Med 2020; 383: 2603-2615.
11) Shrotri M, Navaratnam AMD, Nguyen V, Byrne T, Geismar C, Fragaszy E, Beale S, Fong WLE, Patel P, Kovar J, Hayward AC, Aldridge RW. Spike-antibody waning after second dose of BNT162b2 or ChAdOx1. Lancet 2021; 398: 385-387.
12) Chris Baraniuk. How long does covid-19 immunity last? BMJ 2021; 373: 1605.
13) Försäkringskassan. Svar på regeringsuppdrag Rapport-Effekter som covid-19 har på sjukförsäkringen. Available from: https://www.forsakringskassan.se/download/18.62c6089e1799604047f194f/1660564286183/effekter-som-covid-19-har-pa-sjukforsakringen-delrapport-1-svar-pa-regeringsuppdrag-dnr-fk-2020-000065.pdf
14) Heymann J, Raub A, Waisath W, Mccormack M, Weistroffer R, Moreno G, Wong E, Earle A. Protecting health during COVID-19 and beyond: A global examination of paid sick leave design in 193 countries. Global Public Health 2020; 15: 925-934.
15) Rugless MJ, Taylor DMD. Sick leave in the emergency department: Staff attitudes and the impact of job designation and psychosocial work conditions. Emerg Med Australas 2011; 23: 39-45.
16) Groenewold MR, Burrer SL, Ahmed F, Uzicanin A, Free H, Luckhaupt SE. Increases in Health-Related Workplace Absenteeism Among Workers in Essential Critical Infrastructure Occupations During the COVID-19 Pandemic – United States, March-April 2020. MMWR Morb Mortal Wkly Rep 2020; 69: 853-858.

17) World Health Organization, International Labour Organization. Occupational health and safety in public health emergencies: a manual for protecting health workers and responders. Available from: https://www.who.int/publications/i/item/9789241514347.

18) Levi ML, McMillan D, Dhandha V, Allan J, D'ercole F. COVID-19 mRNA vaccination, reactogenicity, work-related absences and the impact on operating room staffing: A cross-sectional study. Perioper Care Oper Room Manag 2021; 25: 100220.