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# Overview on the possible role of transmission COVID-19 by cockroaches (Blattodea: Blattidae)

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**Abstract**
The extreme disease COVID-19 (coronavirus disease of 2019), which causes coronavirus, started in Wuhan city led to more than 4 million human deaths around the world. It is spread between humans by respiratory drizzle or direct contact. On the other hand, there are primary concerns about its spread by fecal through dirty behavior insects such as cockroaches. Several researchers approved that COVID-19 can be transmitted from a contaminated environment through fecal and direct contact by touching contaminated surfaces. Thus, contacting or feeding on human feces by any organism such as cockroaches may support COVID-19 transmission. This paper gives a brief overview of the mechanical transmission possibility of cockroaches to COVID-19 in two ways. Further studies on the current topic are therefore recommended.

**Keywords:** COVID-19: cockroaches, insects, coronavirus, coronavirus disease, Stool, faeces, SARS-cov-2, MERS-cov, SARS-Cov

## Introduction
The extremely disease COVID-19 (coronavirus disease of 2019), which causes coronavirus, started in Wuhan city, within the year 2019 (Shapiro and Mccauley, 2004) [35] led to more than 4 million human deaths around the world and reached many countries in a noticeably short time which turns into a universal health contingency (Dehghani and Kassiri, 2020; Zhu *et al*. 2020) [11, 47]. Until today, the beginning of this disease is still obscure. In 2020, the World Health Organization named COVID-19 as a disease caused by SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2), in the year it first emerged (Sa Santarpia *et al*. 2020) [34]. This pandemic exemplifies the most dangerous disease that affects the whole world. Researchers still learning about its different ways of spread, in general, it is spread between humans by respiratory drizzle or direct contact. On the other hand, there are primary concerns about its spread by fecal through dirty behavior insects such as cockroaches. This paper attempts to give a brief review of the possibility of COVID-19 can be transmitted in the environment via cockroaches.

## Coronavirus Types
It belongs to the Coronaviridae family, which is an animal-originated enveloped with a genome size of 26 - 32 kb (kilobase), and a single-stranded RNA (ribonucleic acid), (Farnoosh *et al*. 2020) [14]. The virus has a crown manifestation because of the glycoproteins (Cascella *et al*. 2021) [8].

Researchers identified seven kinds of coronaviruses that affected humans with different strains: 229E, NL63, OC43, HKU1, MERS-CoV (Middle East respiratory syndrome coronavirus), SARS-CoV, and SARS-CoV-2 which is the new member that causes COVID-19 (Fernstrom and Goldblatt, 2013) [15].

For SARS-CoV and MERS-CoV, many researchers have reported that the reservoirs were bats (Wong *et al*. 2019) [40]. There is not enough evidence to confirm the different reservoirs for SARS-CoV-2.

## COVID-19 Transmission
COVID-19 transmission happens hurriedly, and all ages can be in danger if they contact this virus especially the elderly and children. However, patients aged more than 60 years and who is with health problems have an high risk of increasing many COVID-19 infections (Cascella *et al*. 2021) [8]. According to Stokes *et al*. 2020, they stated that the percentage of COVID-19 patients' who need hospital care was double times that of those without medical conditions. Generally, the transmission is caused by contacting the infected individual with healthy people. In addition, it can be spread by direct coughing and sneezing, unprotected noses, or mouths of healthy people, and contact with their contaminated items and equipment. The most dangerous is that infected people with COVID-19 can pollute many surfaces they touch, which may contain many personal items. Several researchers approved that COVID-19 can be transmitted from a contaminated environment through fecal and direct contact by touching contaminated surfaces (Chowell *et al*. 2015; Dehghani and Kassiri, 2020) [9, 11]. This was confirmed by many studies that founded coronaviruses in fecal samples from infected people (Amarylle *et al*. 2020) [11]. Previous studies demonstrated that coronavirus was detected in fecal samples of affected patients more than 70 days after the first positive COVID-19 test (Amarylle *et al*. 2020) [11]. Studies by Aylward and Liang, 2020 showed that the virus test in the fecal samples of infected people was positive. Wu *et al*. 2020[14] mentioned that the virus was found in a stool sample of infected peoples with COVID-19. There is strong proof of other coronaviridae transmission via stool over the last years (Gu *et al*. 2020) [41]. In 2004, a study by Yu *et al*. approved that the spread of COVID-19 in the Amoy Gardens was because of airborne spread via inefficient sanitation and toilet ventilation systems. Other researchers detected that 20 of 69 patients had positive results of stool (Wang *et al*. 2020) [47]. In addition, many studies indicated that 10 of 10 patients had positive results of COVID-19 in stool samples (Zang *et al*. 2020) [46]. In 2020[41], Wu *et al*. published a

paper in which they describe that the first-time positive fecal sample from infected cases with COVID-19 was two weeks after the respiratory samples became negative. Similarly, in 2020, Wang [47] *et al*. demonstrated that 2 cases had a positive result presented in fecal samples while respiratory signals were negative. Furthermore, Xiao *et al*. 2020 [42] described that the virus was isolated from the stool specimen of a patient with COVID-19 on the 29th day after the beginning of symptoms. Also, a study by Jeong *et al*. 2020 [25] examined that when a stool sample from a COVID-19 patient was used to inoculate naive ferrets, they could isolate the viruse from the animals. And another study showed that 30 days after infection, infected cases still have COVID-19 virus in their fecal (Yeo *et al*. 2020) [43]. In 2020, Grassia *et al*. explained that the COVID-19 virus may stay more time in the digestive system more than in the respiratory system. The evidence presented in this section suggested that the COVID-19 virus can be alive in the digestive system for a long time. Thus, contacting or feeding on human feces by any organism such as cockroaches may support COVID-19 transmission (Nasirian, 2017) [29]. The question now, does dirty behavior insects such as cockroaches transfer the deadly coronavirus to the human??

**Insects Transfer Diseases**

Insects are the predominant and the most greatly successful species of all organisms on earth. They are extraordinarily adaptable creatures because they have a strong exoskeleton, variety in size, and their ability to escape from enemies and dispersal to new environments, in addition, they can produce large numbers of offspring relatively quickly (Hoffmann and Frodsham, 1993) [22]. Therefore, the most dominant form of transmission among insect pathogens is direct and typically follows a host-host pathway of infection via physical contact or congenital transfer or host environmental host pathway (James and Yoshinori, 1987) [24]. There are two methods for insects to transmitting pathogens, biological and mechanical transmission. In biological transmission, multiplication or development should happen within the insect. In mechanical transmission, the pathogens were transported on their body parts or throughout the digestive canal without any transformation (Harwood and James, 1997) [20]. Insects play fundamental roles in diseases transmissions such as mosquitoes, lice, fleas, bed bugs, and cockroaches. Bacteria, fungi, and protozoa, and viruses were the four main groups of pathogens that can be transmitted by insects (Brian, 2009) [6]. These pathogens can cause acute and fatal diseases. In the last years, several viruses have emerged and threatened human health such as SARS-CoV, MERS-CoV, Nipah virus, Epstein-Barr virus, Lassa fever virus, Marburg virus, Zika virus, Rift Valley fever virus, Chikungunya virus, Dengue virus, Ross River virus, and COVID-19 virus (Dehghani and Kassiri, 2019) [12]. Interestingly, these viruses can be transmitted to humans by insects such as cockroaches (Mayer *et al*. 2017) [28]. Cockroaches are the slovenliest insect found everywhere that transmit various pathogenic microorganisms (Gore and Schal, 2007) [16], because they spend most of their time in sewage, sewer pipes which usually contains a high density of pathogens (Basseri *et al*. 2016) [4]. Also, they feed on garbage, and they have large opportunities to disseminate human pathogens (Pai *et al*. 2005) [30]. In addition, their nocturnal and filthy habits of eating their feces make them ideal carriers of numerous pathogenic microbes (Allen, 1987) [1]. In 2009, Allotey *et al*. approved that deadly pathogen were carried by cockroaches as well as they were presented in their feces. Cockroaches are living in our homes, and they are actively moving between our food, feces, items, and between us (Vazirianzadeh *et al*. 2014; Kassiri *et al*. 2012) [38, 23]. As previously mentioned, the coronavirus can stay alive for long a time in the environment, which could lead to fecal-oral transmission by any organism in contact with or feeding on infected human feces such as cockroaches. From this point, we suggest that cockroaches can be a mechanical transmission to COVID-19 in two ways: direct contact with humans and indirect contact of contaminated items with humans.

Unfortunately, researchers have not approved the effect of direct contact of infected cockroaches with COVID-19 to humans or even animals. Most studies in the field of coronavirus have only focused on the blood-sucking insects especially mosquitoes but not cockroaches. It seems because the possibility of transmission of SARS-CoV-2 by cockroaches may be focused on closed environments also it could be particularly relevant in conditions of poor environmental hygiene and associated with a particularly high density of potential mechanical vectors favoring fecal-oral virus circulation (Dutto *et al*. 2021) [21]. However, few writers have been able to study the other types of coronaviruses on some insects. Usually, the viruses are attached to different parts of the insect which gives the viruses more time to live on and in the insects. Pirtle *et al*. 1991[31] studied that the Poliovirus survives up to 50 days in Periplaneta americana Recently, Reuben *et al*. 2020 [33] mentioned that cockroaches can interact with contaminated feces and transmit coronavirus to humans. In 2020, Heller [21] *et al*. mentioned that None-blood sucking insects can potentially become contaminated directly onto the oral mucous membranes or conjunctival tissues of healthy people. In contrast, another study found that wastewater and wastewater-based epidemiology are one of the causes for COVID-19 in communities (Randazzo *et al*. 2020) [32]. Which is a favorite place for cockroaches to live, and hypothetically, insects feeding on or interacting with viral contaminated human secretory or excretory products can easily transmit the virus. From our second suggestion, which focused on those cockroaches that can be a mechanical transmission to COVID-19 throughout indirect contact of contaminated items with humans, many studies linked cockroaches to the spread of many pathogens including COVID-19 disease in the environment. The other way for viruses to transfer pathogens from insects to humans is throughout contaminated surfaces. Strong evidence confirms that the coronavirus can stay alive for a long time on different surfaces (Casanova *et al*. 2010) [7]. Therefore, the insect that lives in closed environments such as cockroaches can transfer viruses by contact with contaminated surfaces of infected people (Dehghani and Kassiri, 2020) [11]. The first serious discussion and explanation of transferring coronaviruses and some arboviruses such as enterovirus and rota via cockroaches was in 1983 by Mayr. In the same way, in 2020, Reuben [33] *et al*. reported that cockroaches have been shown to mechanically transmit SARS-CoV and other coronaviruses. As well, in 2016, Corman [10] *et al*. isolated MERS-CoV from human items such as bedsheets, bedrails, intravenous fluid hangers, and X-ray devices (Bin *et al*. 2016) [5]. Also,

other types of coronaviruses have been found on surfaces for more than 9 days (Kampf *et al*. 2020) [26]. Chee *et al*. 2020 found that affected people with COVID-19 without respiratory symptoms can contaminate the environment and their items. In 2020, Heller [21] *et al*. mentioned that non-blood sucking insects such as cockroaches can contaminate people and surfaces throughout their secretions and excretions like feces and vomit and transmit deadly viruses (Graczyk *et al*. 2005; Vazirianzadeh *et al*. 2014) [17, 38]. Secretions such as blood (1%) and feces (26%) were reported to contain COVID-19 (Iwen *et al*. 2020) [23].

Our review confirms that the different types of coronaviruses including COVID-19 can be transferred by cockroaches to healthy people if they contact infected stool. From this point, the removal of cockroaches is important not only in homes but also in public places.

**Conflicts of Interest**

The author declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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