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Prevalence of Hypothenar Hammer Syndrome among Drillers in Islamabad

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ABSTRACT

Background: Hypothenar hammer syndrome is described as compression of the ulnar artery due to repetitive trauma on the hypothenar eminence. HHS is a rare and undiagnosed disorder among vibration-exposed workers at different occupational sites. Its prevalence is maximum in laborers, drillers, dentists, hammerers, motor mechanics, and carpenters. The primary symptoms of this condition are pain, numbness, tingling, and whitening of fingertips. This makes them prone to functional limitations and chronic pain that may lead to poor performance in their workplace. The study aimed to determine the prevalence of Hypothenar Hammer Syndrome among drillers in Islamabad. **Methods:** A descriptive cross-sectional study was performed using the demographic data, manual diagnostic test, visual analogue scale, and self-administered Performa filled by the researcher to determine the prevalence of HHS among drillers in Islamabad. The study participants were drillers, aged between 30-45 years, working 6 to 8 hours daily. Data collection tools were Manual tests (capillary refill test and Allen test). Consent was taken from each participant before the study. Data collected was analyzed using SPSS version 26, in terms of descriptive analysis using frequency tables, bar charts, and crosstabs. **Results:** Hypothenar Hammer syndrome is prevalent among drillers in Islamabad. The result obtained was Allen test was negative (inadequate blood circulation) in 14.9% workers, and the capillary refill test was negative in 22.8% workers. **Conclusion:** Considering the results drawn, this study concluded that there is a prevalence of HHS among drillers in Islamabad.

Keywords: Allen Test, Capillary Refill Test, Hypothenar Hammer Syndrome, Ulnar Artery, Vascular Disorder, Vibration Syndrome

INTRODUCTION

Hypothenar hammer syndrome is very rare among the population. Von Rosen and Guttani were the first to describe this clinical entity. Conn et al. proposed the term "hypothenar hammer syndrome" in 1970 [1]. An unusual kind of secondary Raynaud phenomenon known as hypothenar hammer syndrome (HHS) mostly affects those who use the hypothenar portion of their hand as a hammer [2]. The term “hypothenar” describes the muscle that regulates the movement of the little finger. Repeated physical trauma could harm the ulnar artery at this point and cause stenosis or blockage. Such a condition is known as hypothenar hammer syndrome, occupational occlusive arterial disease, post-traumatic digital ischemia, and ulnar artery thrombosis [3].

The ulnar artery is especially susceptible to mechanical injury because of the anatomical structure of the Guyon canal, where it is trapped between an anvil (the hamate bone) and a hammer (an external force); in patients with HHS, the hamate bone's hook does, in fact, strike the superficial palmar branch of the ulnar artery in the Guyon space [4]. The Guyon canal, which has a ligament between the pisiform and hamate bones as its roof, is where the ulnar artery passes. The ulnar artery becomes attached to other structures for 2 to 3 cm when it leaves the Guyon canal [5]. Several sectors where workers use their hands to pound or push, such as carpenters, motor mechanics, metal workers, and drillers, have reported cases of hand-hammer syndrome (HHS).[6] Some workers in the construction sites have developed this condition as a result of high-frequency mechanical stress from hand-held vibrating equipment that comes into constant contact with this area of the hand. Therefore, vibration syndrome may be connected to this disorder [7].

In many occupations, muscular disorders of the hands and wrists are very common. Hypothenar hammer syndrome symptoms include numbness and tingling in the fingers, loss of hand or arm strength, whitening of the fingertips, and difficulties performing fine-motor tasks with the fingers [8]. In 1993, H. KAJI and colleague performed a study in Japan to find the prevalence of hypothenar hammer syndrome, and their result showed the prevalence of 0.08%. Their research concludes that the prevalence of HHS is present in workers exposed to vibrating tools [9]. Workers working at different construction sites are exposed mainly to motor vehicles and vibrating tools, which increase their symptoms gradually. Another study in 1972 showed the prevalence of 0.13% in hammering work jobs [10].

Hypothenar hammer syndrome is a rare condition and often misdiagnosed or diagnosed late [11]. Based on the patient's medical history, employment history, and symptoms, hypothenar hammer syndrome is diagnosed. There are two provocative tests to diagnose the HHS: Allen’s test (a test used to detect ulnar artery input to palmar arch circulation) and the capillary refill test. Also, the Angiography is performed to diagnose a thrombosed palmar ulnar artery [12]. It is important to recognize the possibility of HHS in vibration-exposed workers by appropriate physical examination, diagnostic test, and medical investigation. Little & Ferguson (1972) claimed that the illness can go unnoticed in its early phases, indicating the need for improved observation [13]. Hypothenar Hammer Syndrome is an uncommon vascular condition that may arise from repeated hand injuries or blows [14]. Avoiding the cold, wearing padded protective gloves, and quitting smoking (since smoking decreases blood circulation) can decrease the risk of HHS. A few medications can aid in reestablishing blood flow. In certain situations, surgery may be required. This study helps in finding the prevalence of hypothenar hammer syndrome among drillers and provides awareness to the drillers on how they can prevent HHS by taking preventive measures.

MATERIALS AND METHODS

This descriptive cross-sectional study was conducted at various construction sites in Islamabad over a period of five months following approval of the synopsis. The target population comprised construction site drillers. The sample size was calculated using the formula $n= [z2 \cdot p \cdot (1-p)/e2]/[1+(z2 \cdot p \cdot (1-p)/(e2 \cdot N))]$, with $z = 1.96$, $p = 0.5$, $N = 103$, and $e = 0.05$, yielding a sample size of 82. To improve representativeness, the final sample size was increased to 114 based on population availability. A non-probability convenience sampling technique was used. The main measurable outcome was the prevalence of hypothenar hammer syndrome, assessed through a structured proforma and specialized tests such as Allen’s test and capillary refill test. The inclusion criteria included drillers aged between 30–45 years, working 4–6 hours per day, with at least 2–4 years of drilling experience. Workers with muscular conditions due to accidents or trauma, drillers younger than 30 years, or those working fewer than 4 hours were excluded.

DATA COLLECTION PROCEDURE

Informed consent was obtained from each participant before data collection. Participants who were willing to take part signed a consent form, after which data was collected using a pre-structured proforma filled out by the researcher. Relevant clinical information and results of Allen's test and capillary refill test were recorded systematically to determine the presence of hypothenar hammer syndrome.

STATISTICAL ANALYSIS

The collected data was entered and analysed using SPSS version 26 (Statistical Package for Social Sciences). Descriptive statistics were applied to summarize the demographic variables, and prevalence rates were calculated for hypothenar hammer syndrome. Results were presented in tabular and graphical forms wherever appropriate.

RESULTS

In the study, a total of 114 participants were included pertaining to the sample size. The age group 30 – 45 outlined in the research was further classified as follows: (30-35), (36 -40), and (41-45). The total number of participants according to the inclusion criteria with respect to gender is shown in Figure 1, A. Out of the total sample size, 38.60% were in the 30 -35 age group, 36.84% were in the 36-40 age group, and 24.56% were in the 41-45. Data revealed that out of 114 participants, 2.63% have 4 hours of hammering exposure time, 19.30% have 5 hours of hammering exposure time,50.00% have 6 hours of hammering exposure time, 22.81% have 7 hours of hammering exposure time, and 5.26% have 8 hours of hammering exposure time. As shown in Figure 1, B. The study showed that 8.77% of participants had mild (1-3) pain, 82.46% had moderate (4-7) pain, and 8.77% had severe (8-10) pain as shown in Figure 1, C. The graph shows the association between the Visual analogue scale and the age of drillers. Out of 114, the prevalence of moderate pain is higher in the 30 -40 age group, as shown in Figure 1, D.

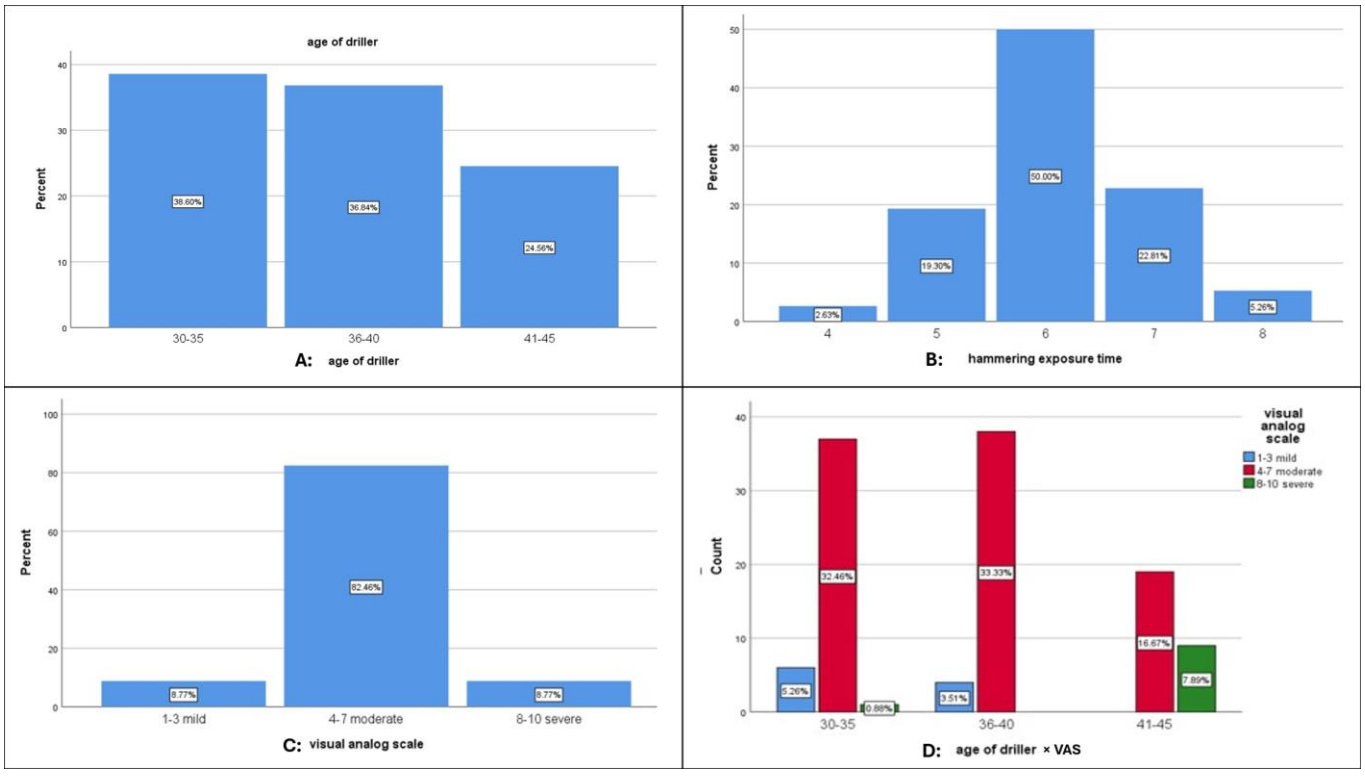

Figure 1: A: Age Distribution, B: Hammering Exposure Time, C: Visual Analogue Scale, D: Chi-Square Test of VA & Age

The results in Table 1 show that most of the drillers tested positive for hypothenar hammer syndrome using both diagnostic tests. Allen's test revealed that 85.1% of participants had a positive result, indicating compromised ulnar artery circulation, while only 14.9% tested negative. Similarly, the capillary refill test showed 77.2% positive cases and 22.8% negative cases. These findings suggest a high prevalence of vascular compromise among drillers in Islamabad, with Allen's test detecting slightly more positive cases compared to the capillary refill test.

Table 1: Allen Test and Capillary Refill Test for Diagnosis of Hypothenar Hammer Syndrome among Drillers in Islamabad

Test	Positive Cases	Negative Cases
Allen's test	85.1%	14.9%
Capillary refill test	77.2%	22.8%

Table 4.2 shows that pain aggravation (96.5%) and pain (65.8%) were the most reported symptoms of hypothenar hammer syndrome among workers, followed by tenderness (56.1%) and paresthesia (47.4%). Swelling (36%) and discoloration (29.8%) were moderately reported, while digital ischemia (20.2%), pulsatile mass (10.5%), and disability (4.4%) were the least frequent symptoms, indicating that pain-related complaints are the predominant clinical manifestation in this population.

Table 4.2 Shows the Detailed Presence and Absence of HHS Symptoms in workers

Symptoms of HHS	Yes %	No %
Pain	65.8	34.2
Swelling	36	64
Tenderness	56.1	43.9
Digital ischemia	20.2	79.8
Paresthesia	47.4	52.6
Pulsatile mass	10.5	89.5
Disability	4.4	95.6
Discoloration	29.8	70.2
Pain aggravation	96.5	3.5

The graph indicates the relationship between the visual analogue scale and the time of hammering exposure. According to the frequency of participants, workers with 6 hours of hammering exposure experience moderate pain, as depicted in Figure 2. A. The Chi-square test graph indicated the relationship between the Allen test and the age of the driller. Figure 2. B indicates that 10.53 percent of workers of the 41-45 age group gave a negative Allen test (poor blood circulation), and the Chi-square test graph indicates the relationship between the Capillary Refill test and hammering exposure time. Findings showed that the Capillary Refill test is negative in the workers with 6 hours of hammering exposure time, as indicated in Figure 2.C. Graph indicates the relationship between the Allen test and hammering exposure time. The findings showed that in workers with 6 hours of hammering exposure time, the Allen test is negative at 6.14% as illustrated in Figure 2.D.

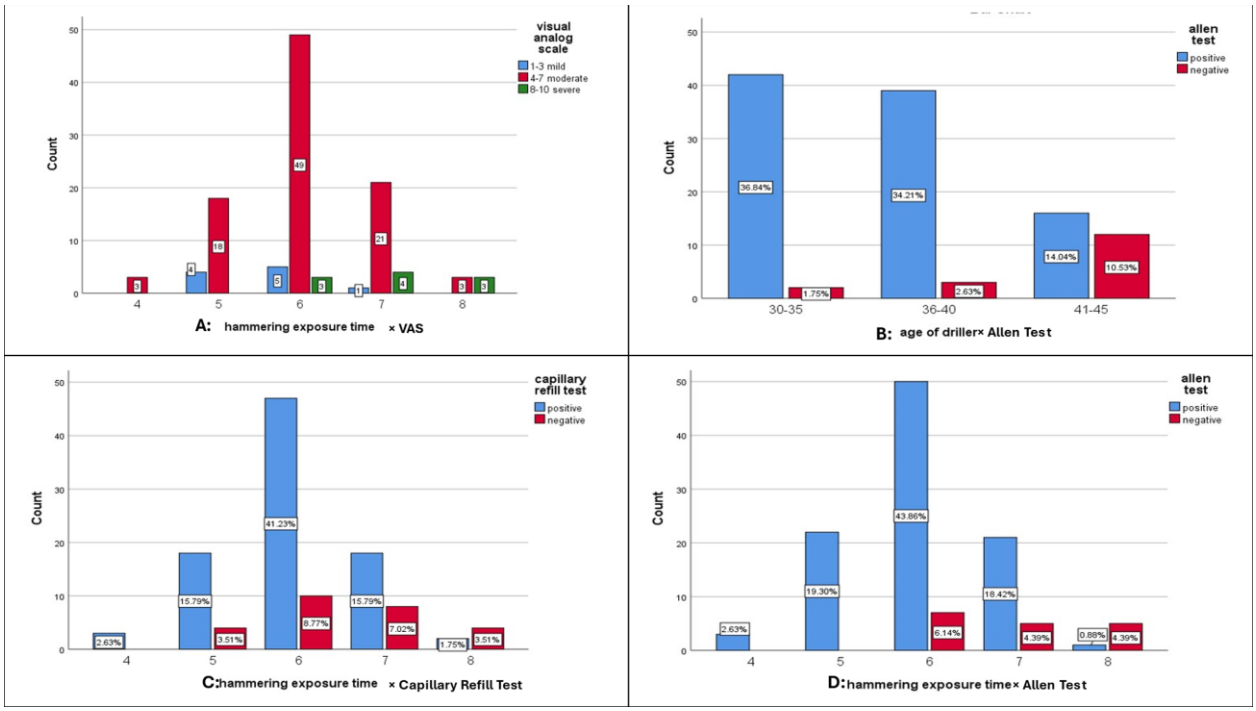

Figure 2: Chi-Square Test among Patients' Variables and Diagnostic Tools

DISCUSSION

Hypothenar Hammer Syndrome (HHS) is a major occupational health issue for workers who frequently use their hands for pounding, pushing, or twisting instruments of hard objects. The disorder is a result of recurrent trauma to the hypothenar eminence over which the ulnar artery crosses the hamate bone, causing vascular injury, which may be in the form of thrombosis, development of an aneurysm, or embolism of the digit [15]. This discussion reviews the results of our research on HHS among drillers in Islamabad in terms of the current research evidence, both similarities and differences in the literature are identified, and the possible reasons for such tendencies are investigated. The current prevalence rates (85.1% positive through the Allen test and 77.2% positive through the capillary refill test) are in line with multiple recent studies that have explored occupational groups with comparable exposure patterns [16]. These results highlight the high risk of long-term vibration exposure on the vascular integrity of the hands of workers who must work with drilling equipment for long hours (ours is 6-8 hours a day). The median age group in our study (30-45 years) is representative of the common demographic description of the affected workers in various studies, including the one done on tire shop workers in Malaysia and mine workers in Pakistan [16, 17].

Our diagnostic method based on the Allen test and the assessment of capillary refill provided more positive results than some of the earlier studies and this could be attributed to the methodological differences, instead of actual differences in prevalence. Though our study gave a positive result of 85.1% using the Allen test, a long-term follow-up study of 47 patients with hypothenar hammer syndrome indicated that angiography is the gold standard in definitive diagnosis as it may identify more complicated pathologies like aneurysms and occlusions of digital arteries that could not be detected by clinical tests, indicating that our results could be lower than the actual extent of vascular damage [18]. In addition, the studies on dental technicians published in 2024 used MRI images, which revealed the presence of soft tissue damage and partial tears in the triangular fibrocartilage complex, which cannot be detected using vascular tests only, which is why it is possible that comorbid musculoskeletal damage was present, which our study did not measure, but could be one of the causes of the pain symptoms experienced by our participants [19].

The difference in the tools of assessment used in the studies makes it difficult to compare the results directly. In contrast to our study, which was based mainly on clinical tests, most of the recent studies, such as the dental technician case report, have

employed the Stockholm Workshop Scale to neurosensory grade and the International Consensus Criteria to standardize staging of HAVS [17, 19]. Our lack of these standard measures in our methodology can restrict the direct comparability of our results with the results of those studies. Also, a study carried out in Malaysia on tire shop workers used vibration dosimetry using human vibration meters to accurately measure the exposure levels, which would allow the exposure-response analysis to be done more accurately than the way we did it by relying on self-reported exposure hours. This difference in measurement method might be one of the reasons for the differences that we found with the other research [17, 19].

The fact that most of the symptoms were associated with pain, with 96.5% of the participants reporting that the vibration aggravated their pain and 65.8% of the participants reporting that they experienced pain, is in line with several recent studies on vibration-exposed workers [19]. A 2024 population study on dental technicians also reported chronic wrist pain that is made worse by exposure to vibration, and neurosensory symptoms of numbness and tingling. Hand discoloration, tingling, and loss of grip strength were also the most common complaints in research among mine workers in the Khewra salt mines and closely matched our observation of substantial neurosensory manifestations, with 47.4% of the participants complaining of paraesthesia [20]. The reasons why classic vascular symptoms like digital ischemia (20.2) and pulsatile mass (10.5) were relatively less reported in our cohort than the pain symptoms are possibly due to several factors [17]. In warmer areas such as Malaysia, similar studies have also found a lower incidence of vibration white finger, an overt vascular manifestation of HAVS, despite the presence of severe neurological symptoms, indicating that climatic factors might be involved in the low expression of overt vascular symptoms [17, 21]. Moreover, the patterns of symptoms may be influenced by the frequency and intensity of exposure to vibration, as a 2025 study of jackhammer operators found that the most common clinical manifestations were reduced grip and pinch strength, and not vascular ones, suggesting that different tools and exposure properties can result in differing clinical manifestations [17, 21].

We established that moderate pain was predominant in the 30-40 age group, which is in line with the prior studies that have reported the onset of symptoms to be the highest in the 40s due to prolonged occupational exposure [21]. The association between dose and response was also evident, as the more the vibration was used daily, the more severe the symptoms were, which was consistent with the other parts of the world on grip strength loss and neurological issues [18]. These findings indicate that standardized exposure quantification, thorough screening, which includes vascular and neurological, and occupational interventions, including risk assessment tools, exposure control measures, and protective equipment, are necessary to minimize health risks caused by vibrations.

LIMITATIONS AND RECOMMENDATIONS

The limitations of this study can be summarized as a small sample size, which can lead to the risk of statistical error, a rather limited research period, which might not be adequate to determine the actual prevalence of HHS, and a lack of such tools as the DASH scale to evaluate the shoulder and arm pain that is often reported by drillers. Moreover, there is little local literature on the subject that can be used to compare with national data. Future research ought to be carried out outside Islamabad to have more representative results, and the workplace intervention ought to involve regular breaks with stretching activities and avoiding long-term exposure to constant vibration to prevent cumulative trauma and lower the chances of developing HHS.

CONCLUSION

Our study concluded that, as per Allen test criteria, 14% drillers had symptoms of hypothenar hammer syndrome, and as per capillary refill test criteria, 22% drillers had symptoms of hypothenar hammer syndrome. The visual analogue scale VAS revealed majority of drillers had moderate pain.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

AUTHORS' CONTRIBUTION

All authors contributed equally to the conception, design, data collection, analysis, and writing of the manuscript "Prevalence of Hypothenar Hammer Syndrome among Drillers in Islamabad."

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