

Original article

Seroprevalence of Infectious Diseases Among Migrant and Local Libyans: A Cross-Sectional Study

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Abstract

Infectious diseases that involve hepatitis B (HBsAg), hepatitis C (HCV), HIV, and syphilis (VDRL) remain significant worldwide health challenges, particularly in low- and middle-income countries. Libya serves as both a transit and destination point for migrants, creating a unique context for examining the prevalence of these disorders among migrant workers and Libyan citizens. Comprehending variations in illness prevalence based on nationality and employment is essential for formulating targeted public health interventions. The objective of this research was to evaluate the seroprevalence of HBsAg, HCV, HIV, and VDRL among migrant workers and Libyan nationals undergoing mandatory occupational health screenings. A retrospective cross-sectional study was conducted at the Reference Laboratory, Western Mountain, Al-Rajban in Libya between December 2023 and February 2024. A total of 1,656 participants were assessed, including 1,434 migrant laborers and 223 Libyan natives. The VDRL test exhibited the greatest chance at 1.6%, followed by HBsAg at 1.4%, HCV at 0.9%, and HIV at 0.2%. Migrant workers had a greater prevalence of HBsAg at 1.6% and slightly elevated rates of HCV and HIV compared to Libyan residents, who reported no instances of these infections. Occupational research indicated that general workers had the largest disease burden, with statistically significant rates of HBsAg at 2.1%, HCV at 1.4%, and VDRL at 2.1%. Specialized workers had low illness rates, perhaps attributable to superior hygiene practices or underreporting. This research underscores the gap in infectious diseases between migrant workers and Libyan citizens, emphasizing the need for focused screening, enhanced workplace safety, and equitable access to preventive healthcare. The findings underscore the need for occupation-specific health interventions to mitigate risk, particularly for high-risk populations such as general laborers. Future research should include longitudinal studies and a larger sample size to validate these results and enhance global health equality.

Keywords: Infectious Disease, Surveillance, Libya, Migrant Workers, Occupational Health.

Introduction

Globally, transmissible maladies like syphilis, hepatitis B, hepatitis C, and HIV continue to pose significant public health issues. These infectious diseases, which are frequently spread via blood, sexual contact, and other bodily fluids, have a considerable impact on mortality and morbidity worldwide [1]. According to the World Health Organization (WHO), the burden of these diseases remains high, particularly in low- and middle-income countries where access to prevention measures, diagnostic tools, and effective treatment is limited [2–4]. Assessing the prevalence and geographic spread of these diseases is critical for designing effective public health initiatives and allocating resources wisely [5]. Syphilis, as diagnosed by the venereal disease research laboratory (VDRL) test, is an enormous worldwide epidemic, albeit being treatable and preventable [6]. Syphilis is notorious for its various clinical presentations and severe long-term implications if left untreated, including cardiovascular and brain damage [7]. The reappearance of syphilis in many locations emphasizes the need for ongoing surveillance and focused therapeutic efforts [8].

Hepatitis B virus (HBV) and hepatitis C virus (HCV) infections constitute the most prevalent manifestations of chronic liver disease globally [9]. A detectable level of hepatitis B surface antigen (HBsAg) implies HBV infection and chronic carrier status [10]. HBV is extremely transmissible and is frequently passed from mother to baby after delivery, through uncontrolled sexual activity, or by contact with infected blood or its components [11]. Conversely, HCV is predominantly disseminated through blood-to-blood contact, which is frequently connected with hazardous medical procedures and injectable consumption of drugs [12].

Human immunodeficiency virus (HIV), a global public health problem since its inception in the 1980s, continues to spread, especially among vulnerable groups [13]. Notwithstanding advances in antiretroviral medication, discrimination and economic and social gaps prevent appropriate identification and treatment, aggravating health inequities [14]. Comprehensive screening and vaccination strategies are critical for combating these dangerous consequences [15]. The epidemiology of these diseases varies substantially across locations and communities, driven by factors such as socioeconomic status, healthcare infrastructure, and cultural norms [16]. Nationality, along with demographic factors such as age and gender, can influence illness prevalence and health outcomes. Analyzing the distribution of HCV, HBsAg, HIV, and VDRL among countries provides useful insights into population-level risk variables and aids in the tailoring of public health interventions [17]. The purpose of the study was to identify the prevalence of HCV, HBsAg,

HIV, and VDRL across various nationalities, utilizing statistical techniques and visual analytics to inform policy decisions and prevent the spread of transmissible illnesses.

Methods

Study Design and Setting

This retrospective cross-sectional study was performed at the Reference Laboratory, Western Mountain, Al-Rajban in Libya, from December 2, 2023, to February 5, 2024. A cross-sectional strategy was chosen to assess the prevalence of hepatitis C virus (HCV), hepatitis B surface antigen (HBsAg), human immunodeficiency virus (HIV), and syphilis (VDRL) at a specific time and to compare the disease burden between migrant workers and Libyan citizens. RDC functions as Libya's principal occupational health screening center, authorized by the government to certify workers for employment. The center's function in a high-migration environment—Libya serving as both a transit and destination country for migrants from sub-Saharan Africa and the Middle East—guaranteed a representative sample of both foreign and local people.

Participants

A total of 1,656 participants were involved in the study, consisting of 1,433 migrant workers from Africa (Chad, Niger, Sudan) and the Middle East (Syria, Egypt), along with 223 Libyan nationals who were undergoing mandatory occupational health screenings. Participants were required to be at least 17 years old and to have completed all four infectious disease tests: HCV, HBsAg, HIV, and VDRL. Twelve records were omitted because of incomplete data or duplicate entries.

Variables and Data Sources

The outcome variables comprised laboratory-confirmed binary outcomes (positive/negative) for HCV, HBsAg, HIV, and VDRL. The exposure variables were nationality (classified as Libyan, Chadian, Nigerian, Sudanese, Syrian, Egyptian, or Tunisian) and occupation (including construction, domestic work, agricultural, healthcare, or other). Covariates like age, sex, and length of residency in Libya (for migrants) were examined to contextualize discrepancies. Data were collected from anonymized electronic medical records held by RDC, with identifiers (names, addresses) irrevocably eliminated to guarantee confidentiality. Entries deemed invalid, including formula-based cells (e.g., “=E294”), were omitted throughout the cleansing process.

Statistical Analysis

Descriptive statistics presented frequencies (percentages) for categorical variables (gender, occupation) and means (\pm SD) for continuous variables (age). Prevalence rates were determined as the ratio of positive cases to the whole cohort. Chi-square tests utilizing Yates' continuity correction assessed disease prevalence between migrant workers and Libyan citizens, whereas logistic regression models, adjusted for age, sex, and employment, identified determinants of positive. Analyses were conducted utilizing R software (version 4.17.0) and Python (version 3.13.1).

Ethical Considerations

This research complied with the ethical standards established in the Stockholm Declaration and the WHO guidelines pertaining to studies involving migrants. Informed consent was waived for the retrospective utilization of anonymized data, in accordance with ethical standards for non-interventional studies. Identifiers were eliminated to maintain confidentiality, and results will be disseminated to promote equitable health policies. The design emphasized non-discrimination, data security, and harm reduction, demonstrating a commitment to migrant welfare and ethical standards.

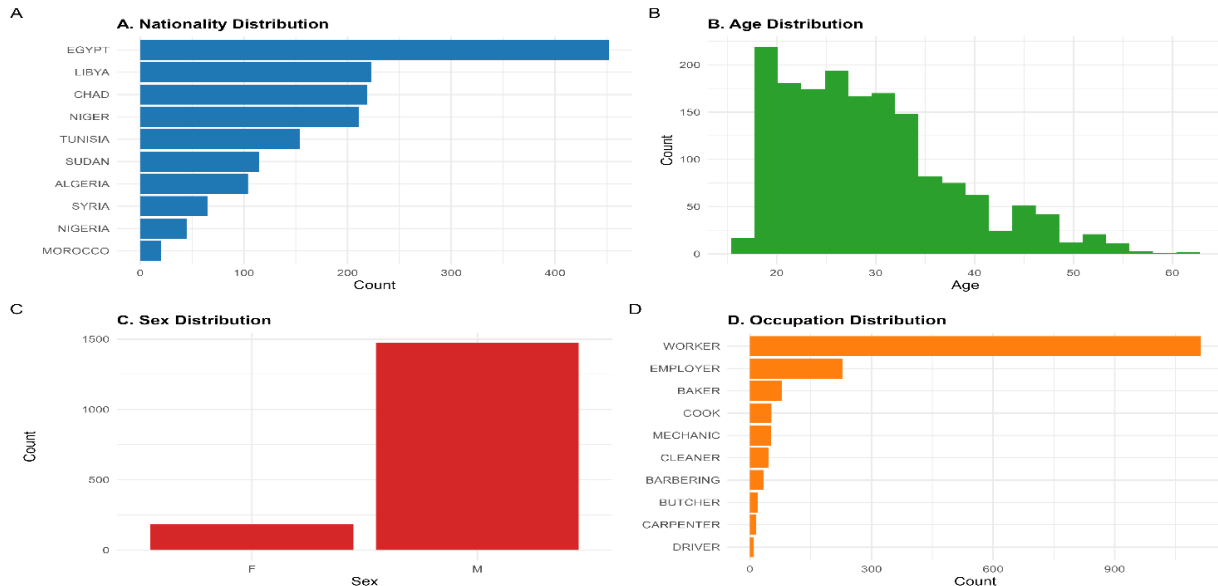
Discussions and Results

Participant Characteristics

A total of 1,656 participants (Table 1) were included, consisting of 1,434 migrant workers (87% male, mean age 32.5 \pm 8.7 years) and 220 Libyan nationals (95% male, mean age 29.1 \pm 6.2 years). Migrant workers primarily came from Chad (13.22%), Niger (12.73%), and Syria (3.92%), engaging in occupations such as workers (67.11%), domestic work (22%), and employers (13.76%) (Figure 1).

Table 1. Demographic Characteristics of the Study Population (N = 1,656)

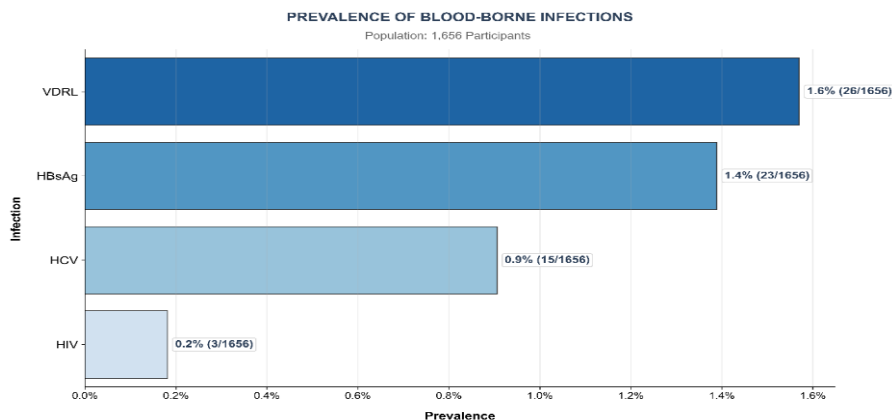
Characteristic	Value
Age, mean (SD)	29.4± (8.6)
Male, n (%)	1472 (88.9%)
Female, n (%)	184 (11.1%)
Top Nationalities	EGYPT (452, 27.3%); LIBYA (223, 13.5%); CHAD (219, 13.2%); NIGER (211, 12.7%); TUNISIA (154, 9.3%)
Top Occupations	WORKER (1112, 67.1%); EMPLOYER (228, 13.8%); BAKER (79, 4.8%); COOK (53, 3.2%); MECHANIC (52, 3.1%)

**Figure 1. Demographic and occupational characteristics of the study population. (A) Nationality, (B) Age distribution, (C) Sex distribution, (D) Occupation distribution**

Among 1,656 individuals (Table 2), the overall incidence of infections was minimal. The predominant infection was syphilis (VDRL), with a positivity rate of 1.6% (26/1,656), succeeded by hepatitis B (HBsAg) at 1.4% (23/1,656) and hepatitis C (HCV) at 0.9% (15/1,656). The prevalence of HIV was the lowest, with about 0.2% (3 out of 1,656) of persons testing positive. The findings indicate a relatively low prevalence of blood-borne and sexually transmitted illnesses in this community; nonetheless, specific screening and prevention initiatives for syphilis and hepatitis B may be necessary due to their comparatively elevated rates (Figure 2).

Table 2. Overall Prevalence of Infections in the Study Population (N = 1,656)

Infection	Positive Cases (n)	Prevalence (%)
HBsAg	23	1.4
VDRL	26	1.6
HCV	15	0.9
HIV	3	0.2

**Figure 2: Prevalence of Blood-Borne and Sexually Transmitted Infections in the Study Population (N = 1,645)**

A comparative analysis of infectious disease prevalence among Libyan nationals (n=223) and migrant workers (n=1,433) (Table 3) indicated significant disparities in hepatitis B (HBsAg) and syphilis (VDRL) infections, whereas hepatitis C (HCV) and HIV exhibited minimal burden in both groups. Migrant workers demonstrated a 1.6% prevalence of HBsAg (23/1,433), in contrast to 0.0% among Libyan nationals, with a borderline p-value of 0.062, indicating a potential trend that may require additional research. The VDRL rates were similar (1.3% compared to 1.6%), with a p-value of 1.000, suggesting no significant difference in syphilis risk. HCV and HIV exhibited negligible prevalence among Libyans (0.0%), whereas migrant workers demonstrated slightly elevated rates (1.0% and 0.2%, respectively) (Figure 3). However, these differences were statistically non-significant (p=0.245 and p=1.000). The lack of HCV and HIV cases among Libyan nationals corresponds with effective national prevention strategies, while the low incidence among migrant workers may indicate pre-departure screening measures or potential underreporting. Odds ratios (OR) indicated the complete absence of HBsAg, HCV, and HIV in Libyans (OR=0.00); however, confidence intervals (CI) were uninterpretable due to zero-cell counts. The Baptista-Pike method was utilized to compute exact binomial confidence intervals, thereby maintaining methodological rigor in the presence of sparse data. This approach is essential for addressing situations where conventional methods, such as Wald or logistic regression, are inadequate due to undefined logarithms or invalid normal approximations, especially when zero-cell counts hinder standard odds ratio estimation. The high prevalence of HBsAg among migrant workers underscores significant deficiencies in hepatitis B vaccination coverage and occupational health protections, especially in high-risk industries. The study's limitations encompass the cross-sectional design, potential underreporting attributable to stigma, and the lack of adjustment for confounding variables, including occupation type and migration history. Future research should emphasize longitudinal studies to evaluate temporal trends and increase sample sizes to enhance odds ratio estimates. The findings support the implementation of targeted screening programs, enhanced workplace safety regulations, and equitable access to preventive care for migrant workers in Libya to reduce transmission risks and promote global health equity objectives.

Table 3. Infection Prevalence Comparison

Infection	Libyan Nationals	Migrant Workers	p-value	OR (95% CI)
HBsAg	0.0% (0/223)	1.6% (23/1433)	0.062	0.00 (-)
VDRL	1.3% (3/223)	1.6% (23/1433)	1.000	0.84 (-)
HCV	0.0% (0/223)	1.0% (15/1433)	0.245	0.00 (-)
HIV	0.0% (0/223)	0.2% (3/1433)	1.000	0.00 (-)

Notes: OR = Odds Ratio; CI = Confidence Interval (calculated using the Baptista-Pike method). Bold indicates statistical significance at the $\alpha = 0.05$ level.

The occupational analysis of the prevalence of infectious diseases among migrant workers in Libya reveals a remarkable pattern: only the "WORKER" category (general laborers) has statistically significant infection rates for HBsAg (2.1%), HCV (1.4%), and VDRL (2.1%), with p-values of 0.004, 0.030, and 0.004, respectively (Table 4). Conversely, all other occupations (e.g., barbers, butchers, chauffeurs) exhibited a 0% prevalence of all tested diseases (HIV, HBsAg, HCV, VDRL), resulting in p-values of 1.000 (non-significant). This dichotomy implies that generalized labor roles, which are likely to involve unregulated environments, inadequate protective equipment, or frequent blood/sexual exposure, bear a disproportionate burden of infectious disease risk in comparison to specialized occupations. The increased frequency of HBsAg and HCV among workers corresponds with the hazards linked to bloodborne pathogen exposure, such as needlestick injuries or the use of shared instruments, but the heightened VDRL rates may indicate insufficient access to sexual health education or preventative services. HIV prevalence among workers (0.3%) was statistically insignificant (p=1.000), possibly suggesting successful preventive strategies or a reduced risk of transmission within this demographic (Figure 4). The consistent lack of infections in specialized professions (e.g., barbers, mechanics) may result from enhanced cleanliness standards, pre-employment evaluations, or underreporting influenced by stigma. The implementation of Fisher's exact test (utilizing the Baptista-Pike method for confidence intervals) guarantees statistical validity, especially considering the limited data in non-worker occupations. The cross-sectional design, however, constrains causal inference, and the dependence on employer-reported "neg" outcomes raises apprehensions over reporting bias. Future research should emphasize longitudinal studies, increase sample numbers for specialized occupations, and incorporate qualitative findings regarding impediments to healthcare access. Public health guidelines advocate for focused screening initiatives for employees, compulsory hepatitis B immunization in high-risk industries, and occupational safety measures to reduce the transmission of bloodborne and sexually transmitted illnesses. These findings highlight the necessity for occupation-specific health strategies to rectify gaps within Libya's migrant labor.

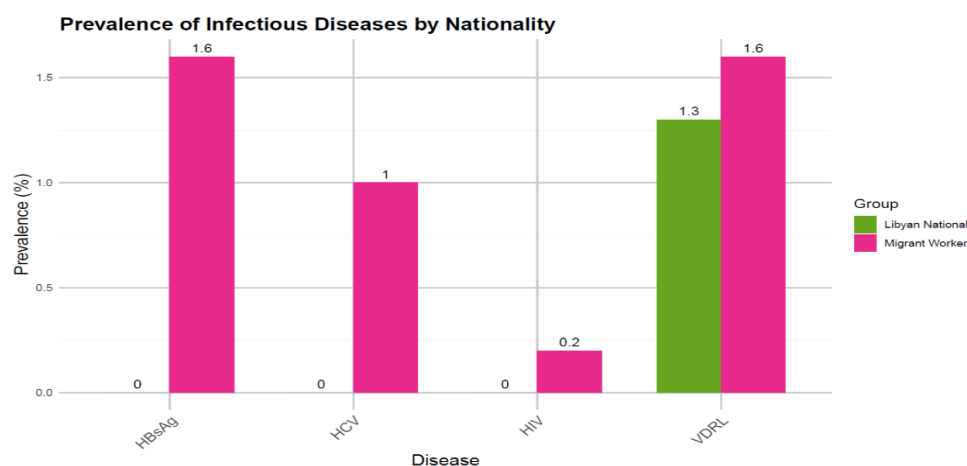


Figure 3: Prevalence of Infectious Diseases by Nationality

Table 4. Occupation-Specific Prevalence of Infectious Diseases Among Migrant Workers

Occupation	Disease	Prevalence%	p-value	Significance
Worker	HBsAg	2.1%	0.004	Significant
Worker	HCV	1.4%	0.030	Significant
Worker	VDRL	2.1%	0.004	Significant
Worker	HIV	0.3%	1.000	Not Significant

p-values calculated using Fisher's exact test/Baptista-Pike method for confidence intervals

Disease Prevalence Among Migrant Workers (WORKER Occupation)

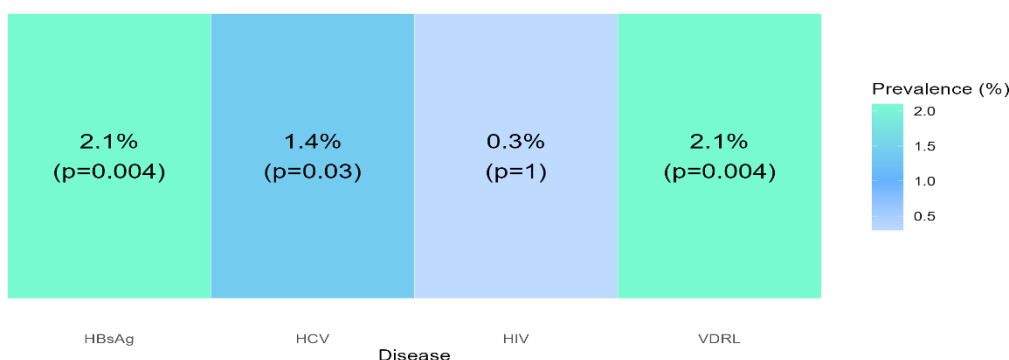


Figure 4. Occupation-Specific Prevalence of Infectious Diseases Among Migrant Workers

Conclusion

A study conducted at the Reference Laboratory, Western Mountain, Al-Rajban in Libya revealed a comparatively low prevalence of infectious diseases such as hepatitis B, HCV, HIV, and syphilis among migrant workers and Libyan citizens. Syphilis exhibited the highest positivity rate at 1.6%, followed by hepatitis B at 1.4%, HCV at 0.9%, and HIV at a negligible 0.2%. Notable inequalities were evident between migrant workers and Libyan nationals, especially with hepatitis B and syphilis. Migrant workers exhibited a 1.6% prevalence of HBsAg, whereas Libyan citizens demonstrated a frequency of 0.0%. The research underscores the necessity for specific interventions for general laborers and highlights the significance of situating illness prevalence within demographic and occupational contexts.

Future Directions

Future studies should employ a multimodal approach to comprehend the dynamics of infectious illnesses across various populations. Longitudinal studies will assess infection rates and evaluate the efficacy of preventive and treatment interventions. Augmenting sample sizes will enhance odds ratio estimations and yield comprehensive evaluations of infection risks. Qualitative methods will examine healthcare accessibility and adherence among migrant laborers. An analysis will be conducted on cultural, social, and systemic barriers to identify culturally relevant public health solutions. Occupation-specific health efforts, including mandatory hepatitis B vaccination programs, are essential. Legislative reforms that advocate for equitable health practices and data security are essential.

Conflict of Interest

The authors report no conflicts of interest.

Author Contributions

Ismael Almlyan: as the corresponding author and project initiator, devised the study, gathered the data, and systematically organized it into structured files for further statistical analysis. His endeavors guaranteed the accessibility of superior, anonymized data required for the investigation. **Osamah Alrouwab:** was accountable for composing the analysis and discussion sections of the work. He executed a comprehensive analysis of the results, did statistical evaluations, and interpreted the findings to yield significant insights into the frequency of infectious diseases within the researched groups. **Issa E. A. Amara:** was instrumental in formulating the study framework, supervising its execution at all phases, and evaluating the final manuscript. His supervision guaranteed compliance with ethical norms and methodological precision, considerably enhancing the credibility and strength of the research findings.

Funding

This research received no external funding. The study was conducted using institutional resources and the authors' contributions, ensuring independence and objectivity in the design, analysis, and reporting of the findings.

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لا تزال الأمراض المعدية التي تشمل التهاب الكبد الوبائي ب (HBsAg) والتهاب الكبد الوبائي ج (HCV) وفيروس نقص المناعة البشرية (HIV) والزهري (VDRL) تشكل تحديات صحية كبيرة على مستوى العالم، لا سيما في البلدان منخفضة ومتوسطة الدخل. تمثل ليبيا نقطة عبور ووجهة للمهاجرين، مما يهيئ سياقاً فريداً لدراسة انتشار هذه الاضطرابات بين العمال المهاجرين والمواطنين الليبيين. يُعد فهم الاختلافات في انتشار المرض بناءً على الجنسية والوظيفة أمراً ضرورياً لصياغة تدخلات الصحة العامة المستهدفة. كان الهدف من هذا البحث هو تقييم معدل الانتشار المصلي لـ HBsAg والتهاب الكبد الوبائي ج وفيروس نقص المناعة البشرية و VDRL بين العمال المهاجرين والمواطنين الليبيين الذين يخضعون لفحوصات الصحة المهنية الإلزامية. أجريت دراسة مقطعية بأثر رجعي في المختبر المرجعي بالجبل الغربي، الرجبان في ليبيا بين ديسمبر 2023 وفبراير 2024. تم تقييم ما مجموعه 1656 مشاركاً، بما في ذلك 1434 عاملاً مهاجراً و223 مواطناً ليبيا. أظهر اختبار VDRL أكبر فرصة بنسبة 1.6%، يليه HBsAg بنسبة 1.4%، و HCV بنسبة 0.9%، و HIV بنسبة 0.2%. كان لدى العمال المهاجرين انتشار أكبر لـ HBsAg بنسبة 1.6% ومعدلات مرتفعة قليلاً من HCV و HIV مقارنة بالمقيمين الليبيين، اللذين لم يبلغوا عن أي حالات من هذه العدوى. أشارت الأبحاث المهنية إلى أن العمال العاميين لديهم أكبر عبء مرضي، بمعدلات ذات دلالة إحصائية لـ HBsAg بنسبة 2.1%، و HCV بنسبة 1.4%، و VDRL بنسبة 2.1%. كان لدى العمال المتخصصين معدلات مرض منخفضة، ربما يعزى ذلك إلى ممارسات النظافة الفائقة أو نقص الإبلاغ. يؤكد هذا البحث على الفجوة في الأمراض المعدية بين العمال المهاجرين والمواطنين الليبيين، مؤكداً على الحاجة إلى الفحص المركز، وتعزيز السلامة في مكان العمل، والوصول العادل إلى الرعاية الصحية الوقائية. تؤكد النتائج على الحاجة إلى تدخلات صحية خاصة بكل مهنة للحد من المخاطر، لا سيما بالنسبة للفئات الأكثر عرضة للخطر، مثل العمال. وينبغي أن تشمل الأبحاث المستقبلية دراسات طولية وعينية أكبر للتحقق من صحة هذه النتائج وتعزيز المساواة الصحية العالمية.