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Seroprevalence Trends of HBV, HCV, and HIV Before and During the COVID-19 Pandemic: Five-Year Retrospective Data from a Tertiary Hospital in Northern Cyprus

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Abstract

BACKGROUND/AIMS: To assess five-year seroreactivity trends of hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV) in Northern Cyprus, with emphasis on the coronavirus disease 2019 (COVID-19) and post-pandemic periods.

MATERIALS AND METHODS: This retrospective cross-sectional study evaluated 278,016 serological test results for hepatitis B surface antigen (HBsAg), anti-HCV, and anti-HIV between 2020 and 2024. All tests were carried out using enzyme-linked immunosorbent assay technology on the ARCHITECT Plus ci4100 system (Abbott Laboratories, Chicago, IL, USA). The annual rate of seroreactivity was calculated and compared across years and sex groups. The results were also categorised based on signal-to-cut-off (S/CO) ratios for HCV and HIV and on IU/mL for HBsAg.

RESULTS: Overall seroreactivity rates were 1.2% for HBsAg, 0.6% for anti-HCV, and 0.2% for anti-HIV. HBV seroreactivity declined significantly from 1.5% in 2020 to 1.0% in 2023-2024 (p=0.001). HCV prevalence remained below 1%, increasing non-significantly from 0.5% to 0.7% (p=0.192); most positive samples fell within the low S/CO category. HIV prevalence remained stable at 0.2% across the study period (p=0.043).

CONCLUSION: HBV seroreactivity exhibited a declining trend over the years; HCV levels remained low but exhibited a rising trend; HIV levels remained stable and low. The results indicate that Northern Cyprus remains a low-endemic region and highlight the importance of sustained surveillance and prevention in the post-COVID-19 era. The results need to be interpreted cautiously, as they may not entirely indicate the levels of infection.

Keywords: HIV, hepatitis B virus, hepatitis C virus, COVID-19, SARS-CoV-2

INTRODUCTION

Hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV) remain major global public health challenges. According to estimates, 296 million people were living with chronic HBV, 58 million with chronic HCV, and 39 million with HIV as of 2022.[1] These infections substantially contribute to global morbidity and mortality through complications such as liver cirrhosis, hepatocellular carcinoma, and acquired immunodeficiency syndrome.[2,3]

In Europe and the Eastern Mediterranean, HBV and HCV transmission is particularly associated with people who inject drugs, migrants, and individuals with multiple sexual partners.[4] Although HIV prevalence in these regions remains relatively low compared to global averages, rising rates among men who have sex with men (MSM) and young adults are noteworthy.[5] Despite advances in prevention and treatment, important challenges persist. HBV continues to circulate in populations with low vaccination coverage, while HCV remains largely underdiagnosed due to limited awareness and access to testing.[6,7]

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On the other hand, the coronavirus disease 2019 (COVID-19) pandemic (2020-2022) further disrupted healthcare systems worldwide, interrupting routine screening, surveillance, and public health programs.[8,9] Lockdowns, travel restrictions, and the diversion of health resources led to marked declines in serological tests like HIV, HBV, and HCV.[9,10] In the World Health Organization (WHO) European Region, community-based testing fell by up to 80% in early 2020, disproportionately affecting key populations such as people who inject drugs, MSM, migrants, and sex workers.[9-12] These disruptions delayed diagnosis and treatment, thereby increasing the risk of ongoing transmission. According to that, several studies across Europe, Latin America, and the Middle East have documented significant reductions in testing volumes alongside paradoxical increases in positivity rates, reflecting a shift toward testing primarily symptomatic or high-risk individuals.[4,8,9]

In Northern Cyprus, previous research has consistently indicated low endemicity for HBV, HCV, and HIV.[13,14] However, updated data describing recent temporal trends of these infections in this setting remain limited. Therefore, this study aimed to evaluate five-year trends in HBV, HCV, and HIV seroreactivity at a tertiary care hospital during and after the COVID-19 pandemic. In this study, we aimed to address this gap and provide updated information on trends in the seroprevalence of HBV, HCV, and HIV during the COVID-19 pandemic and the post-pandemic period.

MATERIALS AND METHODS

Ethical Approval and Patient Consent

This study was approved by the Near East University Scientific Research Ethics Committee (approval number: 2025/138, date: 28.11.2025). Due to the retrospective nature of the study and the use of anonymised laboratory data, the requirement for informed patient consent was waived by the Ethics Committee. All procedures were conducted in accordance with the ethical standards of the institutional and national research committees and with the Declaration of Helsinki.

Study Design and Setting

This cross-sectional study analysed 278,016 retrospectively collected serological test results for HBV, HCV, and HIV from a tertiary care hospital in Northern Cyprus, Nicosia, covering the period from January 2020 to December 2024. All serological analyses were performed using the ARCHITECT Plus ci4100 system (Abbott Laboratories, Chicago, IL, USA). According to the manufacturer's data, the assays demonstrate high analytical performance, with reported sensitivity and specificity values exceeding 99% for hepatitis B surface antigen (HBsAg), anti-HCV, and anti-HIV detection. These tests were primarily conducted as part of routine clinical screening, including preoperative assessments and infectious disease screening protocols. Duplicate test results from the same individual within the same year were excluded when identifiable. Records with incomplete or missing key data were also excluded from subgroup analyses where applicable.

Data from the hospital's electronic laboratory information system were provided as de-identified serology results. These results included information on year of testing, test type (HBsAg, anti-HCV, anti-HIV), test result [signal-to-cut-off (S/CO) ratio of ≥1 was considered a positive result, while a S/CO ratio of <1 was considered a negative result], and demographic information that may be available (sex and age). Although geographical origin data were available in the hospital system, they were not included in the analysis due to variability in data recording and the need for extensive standardisation. Confirmatory testing (e.g., nucleic acid amplification tests or immunoblot assays) was not consistently available; therefore, the results reflect screening test reactivity rather than confirmed infection.

Furthermore, to refine the interpretation of positive results and reduce potential false-positive misclassification, HBsAg-positive samples were reclassified into three analytic strata: 0.20-9.90 IU/mL, 10.0-20.0 IU/mL, and ≥20.0 IU/mL.[15] For HIV, positive cases were classified as strongly positive when the S/CO ratio exceeded 400.[16] For HCV, positive samples were characterised into three categories based on their S/CO values: low reactivity (1-5), moderate reactivity (5-10), and high reactivity (>10).[17] The high S/CO category was often reported separately because low-level reactivity may indicate false-positive results. By including S/CO distributions, we aimed to limit our overestimation of prevalence and to provide a more reliable interpretation of the true infection burden in the population studied.

Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics, version 18 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to summarise demographic characteristics and calculate annual seropositivity rates for HBsAg, anti-HCV, and anti-HIV from 2020 to 2024. Categorical variables were presented as frequencies and percentages. Comparisons across years and demographic subgroups (sex) were conducted using cross-tabulations, and the statistical significance of group differences was assessed using chi-square tests. A p-value of <0.05 was considered statistically significant.

RESULTS

From 2020 to 2024, 278,016 individuals underwent screening for HBV, HCV, and HIV at a tertiary hospital in Northern Cyprus (Table 1). The overall seroreactivity rates were 1.2% for HBV (HBsAg), 0.6% for HCV (anti-HCV), and 0.2% for HIV (anti-HIV). HBV positivity was identified in 1,081 of 92,339 individuals (1.2%), with males exhibiting significantly higher rates than females (1.4% versus 0.9%, $p<0.001$). Anti-HCV antibodies were detected in 554 of 92,946 individuals (0.6%), with a slight but non-significant increase over the study period, from 0.5% in 2020 to 0.7% in 2024 ($p=0.192$). Seroreactivity for HCV was comparable between the sexes (0.6% in males versus 0.5% in females, $p=0.081$). HIV seropositivity was observed in 181 of 92,731 individuals (0.2%); the highest prevalence was in 2021 (0.3%), and subsequent annual rates ranged from 0.1% to 0.2%. HIV positivity was significantly higher in males than in females (69.6% vs. 30.4%, $p=0.001$). Detailed prevalence data, including sex-specific and annual distributions, are presented in Table 2.

Figure 1 illustrates the annual trends in HBV, HCV, and HIV seroreactivity between 2020 and 2024. The highest rate was reported for HBV during the study period, but it declined sharply from 1.5% in 2020 to 1.0% in 2023-2024, demonstrating a consistent downward trend. On the other hand, the prevalence of HCV remained below 1% but showed a consistent upward trend, rising from 0.5% in 2020 to 0.7% in 2024. The prevalence of HIV was the lowest of the three, remaining low and stable, ranging between 0.1% and 0.3%, with a rise in 2021 followed by a decline to 0.1% in 2024 (Figure 1). Overall, these results indicate a prolonged downward trend in seropositivity for HBV, a gentle but

Table 1. Overall seroprevalence of HBV, HCV, and HIV in Northern Cyprus (2020-2024), including male and female distributions with corresponding p-values

Marker	Total tested (n)	Positive (n)	Seroprevalence (%)	Male positive (n, %)	Female positive (n, %)	p-value* (male vs. female)
HBsAg	92,339	1,081	1.2	740 (1.4%)	341 (0.9%)	<0.001
Anti-HCV	92,946	554	0.6	338 (0.6%)	216 (0.5%)	0.081
Anti-HIV	92,731	181	0.2	126 (0.3%)	55 (0.1%)	0.001

*Chi-square test (Pearson) was used to compare male vs. female seropositivity. All positive cases are reported with signal-to-cut-off values ≥1, indicating reactivity above the negative threshold.
HBV: Hepatitis B virus, HCV: Hepatitis C virus, HIV: Human immunodeficiency virus, HBsAg: Hepatitis B surface antigen.

Table 2. Annual distribution of HBV, HCV, and HIV seroreactivity in Northern Cyprus, 2020-2024

Year	HBV tested (n)	HBV positive (n, %)	HCV tested (n)	HCV positive (n, %)	HIV tested (n)	HIV positive (n, %)
2020	12,134	179 (1.5%)	13,097	67 (0.5%)	13,034	24 (0.2%)
2021	16,442	232 (1.4%)	16,343	101 (0.6%)	16,290	42 (0.3%)
2022	17,693	221 (1.2%)	17,600	94 (0.5%)	17,539	34 (0.2%)
2023	20,966	205 (1.0%)	20,851	121 (0.6%)	20,827	48 (0.2%)
2024	25,104	244 (1.0%)	25,055	171 (0.7%)	25,041	33 (0.1%)
Total	92,339	1,081 (1.2%)	92,946	554 (0.6%)	92,731	181 (0.2%)
p-value	p=0.001		p=0.192		p=0.043	

Data are presented as number of individuals tested and number (percentage) of reactive cases. Seroreactivity is defined as ELISA screening positivity (S/CO ≥1). p-values represent comparisons across years.
HBV: Hepatitis B virus, HCV: Hepatitis C virus, HIV: Human immunodeficiency virus, ELISA: Enzyme-linked immunosorbent assay, S/CO: Signal-to-cut-off.

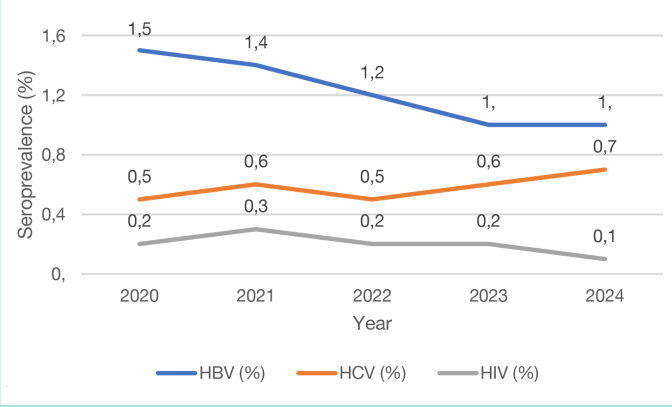

Figure 1. Annual seroprevalence of HBV (HBsAg), HCV (anti-HCV), and HIV (anti-HIV) in Northern Cyprus between 2020 and 2024. Rates are expressed as percentages of tested individuals.

HBV: Hepatitis B virus, HCV: Hepatitis C virus, HIV: Human immunodeficiency virus, HBsAg: Hepatitis B surface antigen.

consistent upward drift in HCV prevalence, and very low HIV prevalence during the five-year surveillance period (Table 2).

In our cohort, all positive results were considered to be those with an S/CO value greater than 1.[15,16] To better characterise the strength of seropositivity and minimise potential false-positive interpretations, all positive cases were further stratified by quantitative values. The distribution of results across these categories is presented in Table 3. Based on that, low-to-moderate antigenemia likely represents carrier or early infection, while ≥20 IU/mL indicates active infection for HBsAg in 277 patients between 2020 and 2024. Additionally, among the 554 HCV-positive individuals, the majority (72.6%) showed low reactivity in the 1-5 S/CO range, 9.2% were in the intermediate 5-10 S/CO range, and 18.2% were strongly positive (S/CO >10). Moreover, among the 181 HIV-positive results detected between 2020 and 2024, only 26.6% of cases demonstrated strong reactivity with S/CO values above 400, consistent with a high likelihood of true HIV infection.

Additionally, an age-stratified analysis of seroreactive cases showed a consistent pattern across HBV, HCV, and HIV. Age distribution data for seroreactive cases are presented in Table 4. The majority of cases were observed in the 19-30 age group (HBV: 47.1%, HCV: 44.0%, HIV: 49.2%), followed by the 31-45 age group (HBV: 30.0%, HCV: 25.1%, HIV: 32.8%). Lower proportions of cases were observed among older age groups, whereas cases among individuals under 18 years of age remained rare across all infections.

The sex distribution of HBV, HCV, and HIV seroreactivity between 2020 and 2024 showed that males had higher HBV seroreactivity (1.4%) than females (0.9%), indicating a notable sex difference (Table 1). HCV seroreactivity was similar between sexes, with rates of 0.6% in males and 0.5% in females. In contrast, HIV seroreactivity demonstrated a more pronounced disparity, with rates approximately three times higher in males (0.3%) than in females (0.1%). Overall, seroreactivity for HBV and HIV was higher among males, whereas the slight difference observed for HCV was not statistically significant (p=0.081).

DISCUSSION

This study provides the first post-pandemic assessment of HBV, HCV, and HIV seroreactivity trends in Northern Cyprus. The main finding is that Cyprus remains a region of low endemicity for all three infections, with HBV prevalence showing a marked decline, HCV showing a modest but non-significant upward trend, and HIV remaining low and stable. These findings support our hypothesis that the overall endemicity profile

Table 3. Distribution of reactive HBV (HBsAg), HCV, and HIV results according to S/CO and IU/mL categories

Test	Category (S/CO or IU/mL)	Number of patients (n)	Percentage (%)	Interpretation
HBsAg	0.20-9.90 IU/mL	687	63.6%	Low-level reactivity
	10.0-20.0 IU/mL	117	10.8%	Moderate reactivity
	≥20.0 IU/mL	277	25.6%	High-level reactivity
	Total	**1081**	**100%**	
Anti-HCV	1.0-5.0 S/CO	402	72.6%	Low-level reactivity
	5.0-10.0 S/CO	51	9.2%	Moderate reactivity
	≥10.0 S/CO	101	18.2%	High-level reactivity
	Total	**554**	**100%**	
Anti-HIV Ag/Ab	1.0-400 S/CO	134	74.0%	Low-level reactivity
	≥400 S/CO	47	26.0%	High-level reactivity
	Total	**181**	**100%**	

Positive results were defined as samples with an S/CO value ≥1. For anti-HCV, S/CO ranges of 1-5, 5-10, and >10 are presented to illustrate the distribution of reactivity levels. For anti-HIV, samples with S/CO >400 are shown separately to indicate strong reactivity. However, all reactive HIV results require confirmatory testing regardless of S/CO values. These categorizations are provided for descriptive purposes only and do not replace confirmatory diagnostic testing.
HBV: Hepatitis B virus, HCV: Hepatitis C virus, HIV: Human immunodeficiency virus, S/CO: Signal-to-cut-off, HBsAg: Hepatitis B surface antigen.

Table 4. Age distribution of seroreactive cases by infection type

Age group	HBV n (%)	HCV n (%)	HIV n (%)
0-18	14 (1.3%)	11 (2.0%)	3 (1.6%)
19-30	509 (47.1%)	244 (44.0%)	90 (49.2%)
31-45	324 (30.0%)	139 (25.1%)	60 (32.8%)
46-60	117 (10.8%)	81 (14.6%)	17 (9.8%)
>60	117 (10.8%)	79 (14.3%)	11 (6.6%)
Total	**1081 (100%)**	**554 (100%)**	**181 (100%)**

HBV: Hepatitis B virus, HCV: Hepatitis C virus, HIV: Human immunodeficiency virus.

would remain low, while also revealing pandemic-related complexities in transmission dynamics.

HBV showed the highest overall prevalence (1.2%), but demonstrated a significant decline during the study period, from 1.5% in 2020 to 1.0% in 2023-2024. This downward trend aligns with the long-term success of vaccination and public awareness campaigns, which have been central to hepatitis B control in Cyprus as reported in previous studies.[4,18-20] Nevertheless, the persistence of higher positivity among males (1.4% vs. 0.9%) indicates that behavioural and occupational risk factors, as well as potential gaps in vaccination coverage, continue to shape transmission.[21] The overall prevalence remains below the 2% threshold defining low endemicity, reaffirming Cyprus as a country where HBV is effectively controlled.[22,23]

On the other hand, HCV prevalence remained under 1% throughout the study period, with a slight but consistent upward trend (0.5% to 0.7%). Although not statistically significant, this increase may reflect changes in risk behaviours and healthcare access during the COVID-19 pandemic, such as reduced harm reduction services, delayed treatment, and altered testing patterns.[24,25] The lack of significant gender differences suggests that exposure risks are broadly shared across sexes.[26] Compared with neighbouring countries such as Türkiye and Greece, HCV prevalence (<1%) from Northern Cyprus is consistent with the Greek results (0.9%) and lower than Türkiye, where population estimates ranged from 0.8 - 1.5%.[27-29] These findings suggest that Cyprus is more consistent with Southern European epidemiology than in higher-prevalence regions in the Middle East and North Africa, where the prevalence of HCV is higher than 3-4%.[30] However, the persistence of even low-level increases emphasises the need for continuous surveillance and harm reduction initiatives, particularly among people who inject drugs.[31,32]

Conversely, HIV prevalence was lowest overall, at 0.2%, and remained relatively stable throughout the five-year period, with a peak of 0.3% in 2021 and a decline to 0.1% in 2024. While these rates are comparable with small European nations such as Malta and Slovenia (≤0.3%, ECDC 2023), the marked male predominance (≈70%) is consistent with global epidemiology, especially among MSM and highlights the need for targeted interventions, including community-based testing, behavioural education, and stigma reduction.[31,32] Importantly, the comparative stability of HIV levels during the COVID-19 pandemic is compared to reports from countries such as Italy and Spain, where temporary decreases in levels of testing led to underreporting.[33] This would suggest that Cyprus's smaller health system may have been better placed to be more resilient in maintaining continuity of essential HIV services.[34,35]

Furthermore, the predominance of seroreactive cases among young adults suggests an increased risk of exposure in this age group, likely related to behavioural and social factors, whereas the low proportion of cases in younger individuals may reflect lower exposure and/or vaccination effects, particularly for HBV. The COVID-19 pandemic is a particularly critical contextual factor when interpreting these results. Reductions in routine testing and delayed care were widely reported in Europe and the Eastern Mediterranean, potentially leading to underdiagnosis of chronic viral infections.[8,36,37] In Cyprus, while some of the observed fluctuations may reflect deferred testing or shifts in the tested population, the overall stability of HIV and the decline in HBV indicate relative resilience of the healthcare infrastructure.[35]

Nevertheless, an important limitation of this study relates to the reliance on enzyme-linked immunosorbent assay-based screening assays without confirmatory testing. While we stratified S/CO values to differentiate weak from strong reactivity, false positives cannot be excluded, particularly for borderline results.[15-17] In regards to HBsAg,

positive samples were reassigned among three analytic strata: 0.20-9.90 IU/mL (low reactivity), 10.0-20.0 IU/mL (moderate reactivity), and ≥20.0 IU/mL (strong reactivity).[15] This was done to minimise ambiguity in the interpretation of borderline results, though confirmatory assays, including neutralisation assays or HBV deoxyribonucleic acid (DNA) polymerase chain reaction (PCR) assays, would be necessary for unambiguous classification. For HIV, we addressed this by reporting cases with S/CO >400 separately as highly likely true positives; 69.9% of positives with lower S/CO may require confirmatory testing, such as HIV ribonucleic acid (RNA) PCR. According to international guidelines (CDC and WHO), all reactive HIV screening results require confirmatory testing, regardless of S/CO values. Therefore, the findings of this study should be interpreted as screening reactivity rather than as confirmed infection. However, such confirmatory data were unavailable in this retrospective dataset. A similar approach was applied to HCV, where classification into low, moderate, and high reactivity categories aimed to refine interpretation.

Study Limitations

This study has several limitations. First, its retrospective single-centre design may limit the generalizability of the findings to the broader population of Northern Cyprus. Second, serological data were obtained from hospital-based testing and may not fully reflect community-level prevalence. Third, confirmatory molecular testing (e.g., HBV DNA, HCV RNA, HIV RNA) was not available for all positive cases, which may have led to misclassification, particularly in low (S/CO) results.[15] Finally, fluctuations in healthcare access and testing behaviour during the COVID-19 pandemic may have influenced annual testing volumes and observed prevalence trends.

Cyprus remains a low-endemic setting for HBV, HCV, and HIV. The prevalence of HBV is declining, that of HCV is slightly increasing, and HIV prevalence is low, with a notable male predominance. These findings reinforce the value of vaccination, harm reduction, and gender-sensitive interventions, while also stressing the importance of resilient screening systems that can withstand disruptions such as those caused by the COVID-19 pandemic.[38-40] Strengthening surveillance and tailoring prevention strategies to high-risk groups remain essential priorities for sustaining control of blood-borne infections in the post-pandemic era.[41]

CONCLUSION

The integrated analysis of HIV, HBV, and HCV seroprevalence in Northern Cyprus highlights important trends in disease prevalence. It suggests that while public health initiatives have contributed to reductions in HBV and HIV rates, there is a need for enhanced focus on HCV prevention and gender-targeted interventions. As these diseases continue to pose challenges to public health, prevention, education, and treatment strategies must evolve to meet the changing needs of the population. This study provides a five-year overview of seroreactivity trends during and after the COVID-19 pandemic. However, it is limited by its single-centre scope, lack of detailed patient risk-factor data, and absence of confirmatory or nucleic acid amplification testing follow-up. Such follow-up could have provided a more comprehensive understanding of the true infection burden and diagnostic accuracy. The rebound in testing volumes and sustained high positivity rates underscore the need for adaptable, resilient public health systems that can preserve essential surveillance during crises.

MAIN POINTS

- The current research provides a five-year (2020-2024) overview of the patterns of seroreactivity to hepatitis B virus, hepatitis C virus (HCV), and human immunodeficiency virus (HIV) in Northern Cyprus during the coronavirus disease 2019 pandemic.
- HBV showed the highest seroreactivity rate but demonstrated a consistent decline over the study period, supporting the long-term impact of vaccination and prevention programs.
- The rate of HCV seroreactivity remained below 1%, but showed a slight increase, indicating the need for continuous monitoring and preventive measures.
- Seroreactivity to HIV stays low and steady during the study period despite the clear male predominance among the positive results.
- Continuous screening campaigns and a strong public health surveillance system are vital for controlling blood-borne diseases.

ETHICS

Ethics Committee Approval: This study was approved by the Near East University Scientific Research Ethics Committee (approval number: 2025/138, date: 28.11.2025).

Informed Consent: Due to the retrospective nature of the study and the use of anonymised laboratory data, the requirement for informed patient consent was waived by the Ethics Committee.

Footnotes

Authorship Contributions

Concept: B.K., M.K., K.S., Design: B.K., M.K., K.S., Data Collection and/or Processing: B.K., M.K., E.D., K.S., Analysis and/or Interpretation: B.K., M.K., E.D., K.S., Literature Search: B.K., M.K., E.D., Writing: B.K., M.K., E.D.

DISCLOSURES

Conflict of Interest: One author of this article, Kaya Süer, is a member of the Editorial Board of the Cyprus Journal of Medical Sciences. However, he was not involved in any stage of the editorial decision of the manuscript. The editors who evaluated this manuscript are from different institutions. No conflict of interest was declared by the authors.

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