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Research Article

Trends and Projections of Bladder Cancer Burden in Iraq from 1990 to 2035: Global Burden of Disease Study 2023-based Analysis

Samir Muter^{1*}, Matthew Harper²

¹ Department of Surgery, College of Medicine, University of Baghdad, Baghdad, Iraq

² Monash Health, Melbourne, Australia

* Corresponding author's email: Samir.a@comed.uobaghdad.edu.iq

ABSTRACT

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Background: Iraq carries a disproportionately high burden of bladder cancer compared with global averages, with limited contemporary epidemiological characterization. This study provides a comprehensive analysis of BC burden in Iraq using GBD-2023 data from 1990 to 2023, with projections to 2035.

Subjects and Methods: Data were extracted from the GBD-2023 database. Incidence, deaths, DALYs, YLLs, and YLDs were analyzed. Average annual percentage change was computed using log-linear regression. Risk factors were assessed through GBD-2023 comparative risk assessment data. Projections to 2035 used join point-derived trend parameters applied to UN World Population Prospects 2024.

Results: In 2023, Iraq recorded 4,866 new BC cases, 1,848 deaths, and 48,433 DALYs, increases of 482.9%, 329.6%, and 349.6%, respectively, from 1990. The age-standardized incidence rate (ASIR) rose from 10.52 to 19.15 per 100,000 compared to a global fall from 7.25 to 6.30 per 100,000. Iraq's ASIR in 2023 was 3.0 times the global average; its age-standardized mortality rate was 3.4 times the global figure; and its age-standardized DALY rate was 3.7 times the global figure. Female rates rose proportionally faster (AAPC: +2.35% vs +1.94%). Smoking contributed 33.6% of DALYs in 2023, down from 36.9% in 1990, while the contribution of hyperglycemia rose from 8.3% to 12.6%. Approximately 8,400 BC cases are projected by 2035.

Conclusions: Iraq carries an increasingly disproportionate bladder cancer burden compared to global rates, with significantly rising age-standardized rates in contrast to the declining global trend. Two modifiable risk factors should be prioritized in future targeted intervention: smoking and hyperglycemia.

Introduction

Global data recognize bladder cancer among the ten most commonly diagnosed cancers in the world, with around 573,000 new cases and 213,000 deaths registered worldwide in 2020 ^{1,2}. Its global epidemiology is not consistent: while age-standardized incidence rates are highest in Southern Europe and Western Europe, age-standardized mortality rates peak in Northern Africa and the Arab

world, where a high mortality-to-incidence ratio points to the systemic under-detection and undertreatment of the disease, a characteristic of under-resourced health systems ^{3,4}. Iraq stands out within this group for the pace at which its burden has diverged from global trends. Analyses based on GBD 2019 data placed Iraq's ASIR at roughly twice the global average, but those analyses did not quantify the rate

of divergence, did not attribute the relative contributions of smoking and metabolic risk, and did not project forward the burden trajectory. The global trends of bladder cancer epidemiology have been further clarified by recent GBD 2021 analyses. Leung et al. reported that between 2000 and 2021, the global ASIR for bladder cancer declined with an AAPC of -0.48% , while the age-standardized death rate fell even more prominently (AAPC: -1.02%) — which can be attributed to improvements in cystoscopic surveillance, intravesical therapy, and surgical care in high-income countries ⁵. The leading risk-attributable causes of bladder cancer deaths are smoking and high BMI ^{5,6}. In October 2025, Liu and his colleagues used GBD 2021 data to confirm that high fasting plasma glucose is a rising contributor to bladder cancer DALYs, with global ASMR attributable to high FPG rising 20.96% from 1990 to 2021 ⁷, a finding that is particularly relevant to Iraq given its sharply rising incidence of diabetes.

Bladder cancer in Arab countries occupies a distinct epidemiological position. An analysis of GBD 2019 data for the 22 Arab nations reported a collective ASIR of 9.9 per 100,000, which is way above the global average of 6.5 per 100,000, with a mortality-to-incidence ratio of 0.448 reflecting the suboptimal management of the disease ⁸. Iraq is among the most highly burdened countries in that analysis, sharing the Arab region's unique risk factor profile of high tobacco consumption, rapid diabetes transition, and residual schistosomiasis-related bladder disease ⁹. For these reasons, projections show Iraq's burden will diverge further from high-income patterns unless well-planned interventions are implemented soon.

The present analysis uses GBD 2023 data, released in October 2025 to provide the first Iraq-specific bladder cancer study covering the full 1990–2023 period with formal trend analysis, APC decomposition, risk factor attribution, and projections to 2035. To our knowledge, no prior study has performed this combination of analyses specifically for Iraq.

Subjects and Methods

Data were extracted from the GBD 2023 database for Iraq and the global aggregate via the GBD Results Tool (<https://vizhub.healthdata.org/gbd-results/>). GBD 2023 covers 375 diseases and injuries, 88 risk factors, 204 countries and territories, and 660 subnational locations from 1990 to 2023 ¹⁰. Bladder cancer is defined using ICD-10 codes C67–C67.9, D09.0, D30.3, D41.4–D41.8, and D49.4. Ethics committee review was not required for use of publicly available, de-identified data.

Five primary outcomes were analyzed: incidence, deaths, DALYs, YLLs, and YLDs, stratified by sex (male, female, both) and 5-year age group. All estimates are presented with 95% uncertainty intervals from 250 ordered draws. AAPC was computed using log-linear regression: $\ln \hat{\theta} = \alpha + \beta T + \varepsilon$, where $AAPC = 100 \times (\exp(\beta) - 1)$. This method is consistent with recent GBD bladder cancer trend analyses ^{6,11}. The proportions of bladder cancer DALYs attributable to tobacco smoking and high fasting plasma glucose were extracted from GBD 2023 comparative risk assessment data. An APC model was fitted using the intrinsic estimator method ^{12,13}. Projections to 2035 applied joinpoint-derived age-specific trend parameters to UN WPP 2024 (Medium variant) population forecasts.

Results

Overall burden in 2023

In 2023, Iraq recorded 4,866 new bladder cancer cases (95% UI: 3,702–6,355), 1,848 deaths (95% UI: 1,382–2,368), and 48,433 DALYs (95% UI: 37,799–60,417). Males bore the greater share of burden: 3,619 cases, 1,404 deaths, and 36,301 DALYs, compared with 1,248 cases, 444 deaths, and 12,132 DALYs in females. The male-to-female case ratio of approximately 2.9:1 is consistent with the four-fold male predominance documented globally [1,9], reflecting both the higher historical smoking prevalence among Iraqi men and greater occupational carcinogen exposure. YLLs dominated the DALY burden (45,907 of 48,433 total, 94.8%), confirming that premature death rather than non-fatal disability is the primary driver. Full data are presented in Table 1.

Comparison with global benchmarks

In 2023, Iraq's ASIR was 3.0 times the global average (19.15 vs. 6.30 per 100,000), the age-standardized mortality rate was 3.4 times the global figures (8.82 vs. 2.61 per 100,000), and the age-standardized DALY rate was 3.7 times the global rate (189.62 vs. 50.79 per 100,000). These ratios have widened over time. This divergence is the sum of the rise of Iraq's ASIR (rising by 82% from 1990 to 2023) and the global ASIR decline by 13.1% over the same period. The net result was a duplication in Iraq's ASIR from 1.5 times the global rate in 1990 to 3.0 times in 2023. This pattern of moving in the opposite direction from global trends on every burden metric characterizes Iraq's bladder cancer burden and trends.

Temporal trends and average annual percentage change (AAPC)

The ASIR rose from 10.52 to 19.15 per 100,000 (AAPC: $+1.97\%$ per year), contrasting with a global ASIR AAPC of -0.60% . Iraq's age-standardized mortality rate rose from 6.04 to 8.82 per 100,000 (AAPC: $+1.30\%$), against a global decline (AAPC: -1.01%). The age-standardized DALY rate rose from 135.18 to 189.62 per 100,000 (AAPC: $+1.14\%$), compared to a global decline (AAPC: -1.23%). These AAPCs are consistent with, and extend, the GBD 2021 observation that bladder cancer burden is rising in middle socio-demographic index (SDI) countries even as it declines globally ^{5,6}. Female rates increased proportionally faster than male rates (incidence AAPC $+2.35\%$ vs $+1.94\%$), which may partly reflect improvements in female healthcare access in urban Iraq in recent years, as well as the rising diabetes prevalence affecting both sexes.

Age-specific patterns

Table 2 presents age-specific incidence, mortality, and DALY rates for Iraq in 1990 and 2023. Rates rose steeply with age, peaking at approximately 198.8 per 100,000 in the 85–89 age group for incidence in 2023. The highest recorded increases occurred in younger adult groups, the 20–24 age group more than doubled (0.76 to 1.77 per 100,000). The 25–29 and 30–34 groups have also recorded significant rises. This might reflect an increased early-life exposure to smoking and metabolic risk factors and warrants surveillance. Another significant observation to notice is the widening male to female incidence ratio with age, reaching 4.8:1 in the 70–74 age group, consistent with cumulative sex-specific differences in smoking history and occupational exposure.

Table 1: Bladder cancer burden in Iraq, 1990 versus 2023: absolute counts, age-standardized rates (ASR) per 100,000, percentage change in counts, and AAPC with 95% confidence intervals, by sex. Source: GBD 2023.

Measure	Sex	Cases 1990 (95% UI)	ASR 1990 (95% UI)	Cases 2023 (95% UI)	ASR 2023 (95% UI)	% change cases	AAPC % (95% CI)
Incidence	Both	835 (577–1,209)	10.52 (7.11–15.24)	4,866 (3,702–6,355)	19.15 (14.51–25.31)	+482.9%	+1.97 (+1.79 to +2.14)
	Male	626	17.15 (10.72–26.54)	3,619 (2,599–4,843)	30.82 (21.71–41.35)	+478.0%	+1.94 (+1.76 to +2.12)
	Female	209	4.51 (2.63–6.75)	1,248 (800–1,754)	9.26 (6.09–13.09)	+497.1%	+2.35 (+2.16 to +2.54)
Deaths	Both	430 (284–618)	6.04 (3.98–8.91)	1,848 (1,382–2,368)	8.82 (6.60–11.38)	+329.6%	+1.30 (+1.17 to +1.43)
	Male	326	10.26 (6.27–15.89)	1,404 (1,004–1,831)	15.25 (10.79–19.90)	+330.7%	+1.37 (+1.24 to +1.50)
	Female	104	2.45 (1.44–3.79)	444 (306–608)	3.95 (2.65–5.51)	+326.9%	+1.59 (+1.44 to +1.73)
DALYs	Both	10,772 (7,355–15,269)	135.18 (90.34–193.37)	48,433 (37,799–60,417)	189.62 (144.08–241.54)	+349.6%	+1.14 (+1.02 to +1.26)
YLLs	Both	10,354	—	45,907	—	+343.6%	—
YLDs	Both	417	—	2,526	—	+505.8%	—

Table 2: Age-specific bladder cancer incidence rates, mortality rates, and DALY rates per 100,000 population in Iraq (both sexes combined), 1990 versus 2023. Source: GBD 2023.

Age group (years)	Incidence 1990	Incidence 2023	Mortality 1990	Mortality 2023	DALY rate 1990	DALY rate 2023
15–19	0.50	0.70	0.06	0.06	4.8	4.6
20–24	0.76	1.77	0.09	0.14	6.8	10.8
25–29	1.05	2.87	0.16	0.31	10.9	20.9
30–34	1.81	4.48	0.30	0.52	18.6	33.0
35–39	2.81	5.73	0.60	0.87	33.6	49.9
40–44	4.19	6.24	1.26	1.37	62.8	69.6
45–49	7.68	11.15	2.66	2.83	119.0	128.5
50–54	15.54	23.57	5.63	6.22	225.1	252.0
55–59	25.75	45.40	10.59	13.76	369.8	486.4
60–64	42.38	79.79	19.61	27.50	588.4	836.3
65–69	48.84	82.75	25.11	32.12	634.3	827.1
70–74	60.38	99.67	36.13	46.43	746.9	976.8
75–79	75.15	153.99	53.59	87.62	883.0	1464.5
80–84	92.55	187.57	81.48	136.76	1045.7	1770.3
85–89	96.45	198.81	95.38	164.09	972.1	1695.1
90–94	84.51	163.61	110.31	189.38	973.9	1679.0
95+	77.98	127.08	127.48	193.55	1069.4	1621.2

Age-Period-Cohort (APC) analysis

The APC model revealed a strong positive age effect on bladder cancer incidence, consistent with the cumulative effects of urothelial carcinogen exposure described in GBD and other clinical literature^{5,12,13}. The period effect showed a slight negative or neutral pattern through the 1990s that can be explained by the reduced diagnostic activity during the sanctions era, followed by a positive period effect from 2003 onward as the healthcare system access and cancer registry have improved. The cohort effect showed a higher risk in birth cohorts from the 1960s through the 1980s, consistent with the peak periods of tobacco consumption among Iraqi men that were documented in those generations, and the low quality of cigarettes marketed in the country during the sanctions era.

Risk factor attribution

Table 3 presents the full trend in smoking and high FPG attribution. Despite a slight decline, smoking continued to be the principle modifiable risk factor, contributing to 33.6% of bladder cancer DALYs in 2023 in both sexes, down from 36.9% in 1990. The male smoking attribution in 2023 was significantly higher than females (41.9% vs 7.2%), reflecting the community's clear sex disparity in smoking prevalence. The slight downward trend in smoking attribution is consistent with global data showing declining age-standardized mortality rate (ASMR) attributable to smoking despite rising absolute burdens^{14,15,16}. The 52% relative increase of high fasting plasma glucose contribution (from 8.3% in 1990 to 12.6% in 2023) is a more concerning trend and is consistent with recent GBD 2021 analyses that identified high FPG as a driver of bladder cancer burden in transitioning countries^{7,11}. In 2023, Iraq recorded an FPG-attributable bladder cancer burden of 12.6%, a figure that is higher than the global average, reflecting Iraq's accelerating diabetes epidemic.

Table 3: Proportion (%) of bladder cancer DALYs attributable to tobacco smoking and high fasting plasma glucose in Iraq by sex, 1990–2023. Age-standardized. Source: GBD 2023 comparative risk assessment.

Year	Smoking — Both (%)	Smoking — Male (%)	Smoking — Female (%)	High FPG — Both (%)	High FPG — Male (%)	High FPG — Female (%)
1990	36.9	44.7	8.7	8.3	8.5	7.5
1995	36.1	43.9	8.6	8.4	8.6	7.7
2000	36.1	44.2	8.8	8.4	8.6	7.8
2005	36.4	44.5	9.2	8.6	8.8	8.2
2010	35.6	43.8	8.6	9.4	9.6	8.9
2015	34.6	42.9	7.8	10.7	10.8	10.2
2019	34.0	42.3	7.4	11.6	11.7	11.1
2021	33.9	42.0	7.2	12.0	12.1	11.6
2023	33.6	41.9	7.2	12.6	12.8	12.1

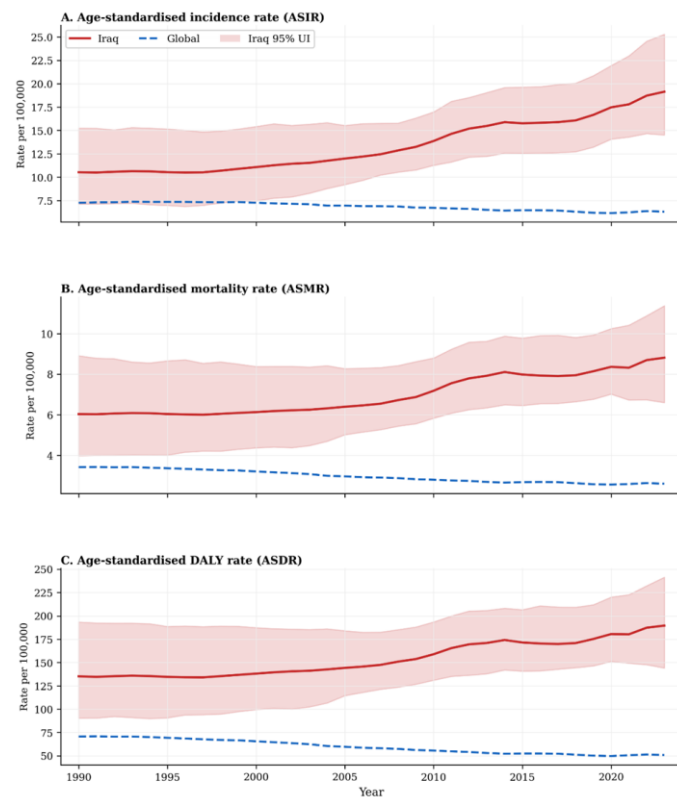


Figure 1: Age-standardized bladder cancer rates in Iraq versus global, 1990-2023. Shaded area = 95% uncertainty interval. GBD 2023.

Projections to 2035

Applying joinpoint-derived trend parameters to UN WPP 2024 male and female population forecasts, incident bladder cancer cases in Iraq are projected to reach approximately 8,400 by 2035, almost doubling from the 2023 figure of 4,866 over 12 years. Deaths are projected to approach 3,400 by 2035, and DALYs to exceed 85,000. Even under a rate-stabilization scenario where age-specific incidence

rates stop rising from 2024 onward, absolute case numbers would still reach approximately 6,500 by 2035 according to the current Iraq's demographic momentum.

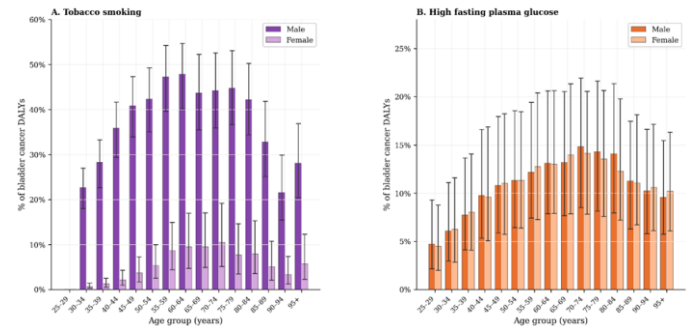


Figure 2: Proportion of bladder cancer DALYs attributable to tobacco smoking (A) and high fasting plasma glucose (B) in Iraq by age group and sex in 2023, with 95% uncertainty intervals. Source: GBD 2023.

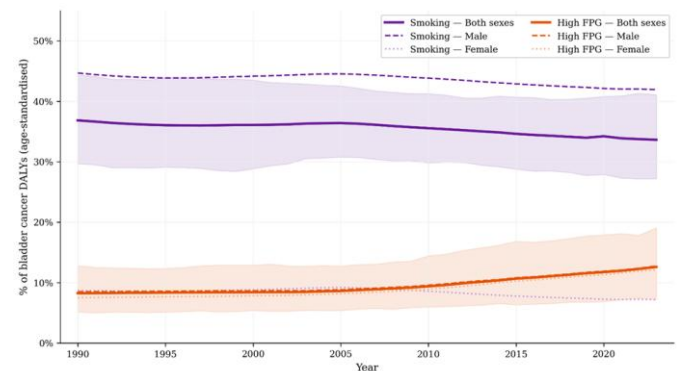


Figure 3: Temporal trends in the proportion of bladder cancer DALYs attributable to smoking and high fasting plasma glucose in Iraq (age-standardized, both sexes), 1990–2023. Source: GBD 2023.

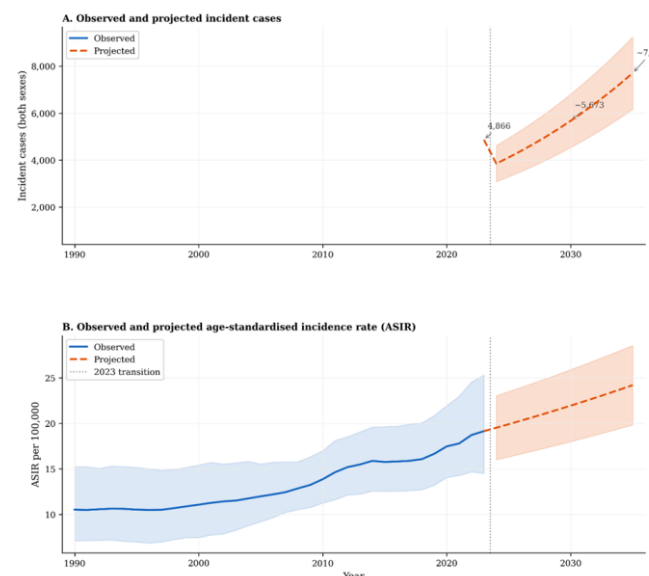


Figure 4: Observed and projected bladder cancer incidence cases (A) and ASIR (B) in Iraq, 1990–2035. Projections from joinpoint regression × UN WPP 2024 Medium variant. Source: GBD 2023.

Discussion

This study establishes that Iraq carries a bladder cancer burden that is not only large but is diverging from global trends, with a rate of approximately 2.6 percentage points of annual ASIR divergence. This places the country in a worsening trajectory relative to the global comparator. The three-fold excess over global mortality and DALY rates, sustained across 34 years of data and confirmed across all sex and age strata, is not a statistical artefact. It reflects a healthcare system that diagnoses bladder cancer at the muscle-invasive or metastatic stages of the disease, where five-year survival rates are below 30%, and where the diagnostic and therapeutic advances (like cystoscopic surveillance, intravesical chemo- and immunotherapy, radical cystectomy, and most recently pembrolizumab for metastatic urothelial carcinoma) that have driven improvements observed in high-income countries remain inaccessible or inconsistently available.

The APC cohort findings add historical depth to this picture. Men born between the 1960s and 1980s, who came of age during the period of sharpest tobacco consumption and are now in their 40s to 60s, carry an increased cohort-specific bladder cancer risk that will sustain upward incidence pressure for the next one or two decades. The positive period effect observed after 2003 has to be interpreted carefully: it likely reflects improving case ascertainment rather than a true reduction in carcinogen exposure. More bladder cancers are being recorded than previously, without an associated mortality benefit, because they are still diagnosed at advanced stages.

The risk factor findings send two distinct and actionable messages. First, smoking control remains the single most important modifiable tool for bladder cancer burden reduction in Iraq: smoking is responsible for one third of bladder cancer DALYs, and the male attribution approaches 42%. Bladder cancer mortality risk from smoking is dose-dependent, with current smokers carrying around three times the bladder cancer death risk compared to never-smokers, with a significant decline of this risk after 10-15 years of cessation^{9,17}. Every reduction in male smoking prevalence translates directly into future burden reduction. Second, the rising FPG attribution (currently at 12.6% in 2023 and is still rising) signals that Iraq's diabetes epidemic is adding a second upward push to the already unfavorable trajectory. This matters for both primary prevention (metabolic risk management) and clinical practice (bladder cancer surveillance in diabetic patients presenting with hematuria).

The global perspective intensifies the urgency. GLOBOCAN estimates that the annual bladder cancer cases globally will reach 991,000 by 2040, a 72.8% increase from 2020, with the highest absolute increase in Africa, Asia, and the Arab world². The Arab region carries a mortality-to-incidence ratio (MIR) well above the global average, with high-MIR countries located in the subregion where Iraq lies⁸. Without well-planned interventions, and within two decades of time, the combined effects of rising incidence and high case-fatality rates will place Iraq's bladder cancer burden among the worst in the world.

Several limitations in the current study should be declared. Firstly, GBD estimates for countries with incomplete vital registration including Iraq carry wider uncertainty intervals. Secondly, the APC inflection years are approximate. Thirdly, the used GBD model does

not distinguish urothelial from non-urothelial bladder cancers, precluding analysis of the relative contribution of schistosomiasis-associated squamous cell carcinoma, which may be relevant in some southern Iraqi provinces. Fourthly, sub-national heterogeneity within Iraq was not registered and analyzed. Finally, the projection methodology assumes continuation of current trends.

Conclusion

Iraq's bladder cancer burden is large, growing rapidly, and moving against the global trend of improvement. An ASIR 3.0 times the global average and a mortality rate 3.4 times the global figure together define a cancer emergency that requires a proportionate investment in early detection, urological service capacity, and, above all, tobacco control and diabetes management. Projections to 2035 show a clear trend toward doubling the current burden of the disease within 12 years unless actions are taken. The evidence is in place; what is needed now is a policy response

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Conflict of Interest

The authors declare no conflicts of interest related to this work.

Data Availability Statement

Data for the current study are publicly available from the Global Burden of Disease 2023 database through the Institute for Health Metrics and Evaluation (IHME) GBD Results Tool. Population data used for projections were obtained from the United Nations World Population Prospects 2024.

Author Contributions

SM contributed to the conception and design of the study and finalization of the manuscript. SM and MH contributed equally to data acquisition, analysis and interpretation, literature review, and drafting and critical revision of the manuscript

All authors meet the ICMJE criteria for authorship and agree to be accountable for all aspects of the work.

ORCID

Samir Muter [0000-0002-3744-2887](https://orcid.org/0000-0002-3744-2887)
Matthew Harper [0009-0004-2492-2322](https://orcid.org/0009-0004-2492-2322)

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