

## SH12: What is the association between HbA1c and shoulder PJI?

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**Response:** Although the literature on this topic is limited, there is evidence that Hemoglobin A1c (HbA1c) greater than 8 mg/dL may be associated with developing shoulder PJI.

**Strength of Recommendation:** Limited

**Delegate Vote:** 34 (69%) agree; 11 (22%) disagree; 4 (8%) abstain

**Rationale:** A comprehensive literature review was performed to identify all studies that quest association between HbA1c levels and shoulder PJI. Searches for the terms “Hemoglobin A1c”, “glycated hemoglobin”, “shoulder arthroplasty”, “periprosthetic joint infection”, “surgical site infection”, “deep infection,” “surgical wound infection” were performed using the search engines PubMed, Scopus and Google Scholar which were searched through December 2024. Inclusion criteria for our systematic review were all English studies (Level I-IV evidence) published between 1996 and 2024 that included patients undergoing shoulder arthroplasty (primary or revision), reported on periprosthetic joint infections (PJI) specifically in the shoulder joint, included data on HbA1c levels or glycemic control measures, evaluated the risk, incidence, or association of HbA1c with PJI or infection rates related to glycemic control, and utilized clinical study designs (cohort, case-control, cross-sectional studies), meta-analyses, or systematic reviews. Exclusion criteria were non-English language articles, nonhuman studies, case reports, editorials, opinion pieces, studies without HbA1c data or clinical follow-up/infection rates, studies unrelated to shoulder arthroplasty or PJI (e.g., focusing on other joint surgeries without stratification for the shoulder), and technique papers without patient data. We identified 3 articles from PubMed, 4 articles from Scopus and 8 articles from Scholar that met all criteria.

After removing duplicate papers, eight papers matching the search criteria were reviewed. All studies were retrospective. Only two of these nine studies examined an association between HbA1c levels and shoulder periprosthetic joint infection (PJI). A table summarizing these eight studies can be found below.

Authors	Sample Size	Patients	Follow-up	Statistics	Conclusion
Cancienne et al. (1)	18,729	Primary shoulder arthroplasty, Anatomic TSA, Reverse TSA, Shoulder Hemiarthroplasty	6 months for Superficial (wound) complications, 1 year for Deep infection	DM vs. Non-DM, OR: For patients with HbA1c > 8.0 mg/dL (compared to those below 8.0 mg/dL): Wound complications: OR = 3.97; P < 0.0001 Deep infection requiring surgery: OR = 2.39; P = 0.007	Positive association
McElvany et al. (2)	8,819	Hemiarthroplasty, TSA, rTSA	Elective Shoulder	RR for deep infections	No association

			Arthroplasty: 42 months (IQR 19-72), Traumatic Shoulder Arthroplasty: 47 months (IQR 22-76)	(HgbA1c $\geq 7$ ): 0.8 CI 95% (0.3–2.3), $p=0.731$	
Fu et al. (3)	5,918	TSA (both anatomic and reverse)	30-day postoperative	NIDDM vs Non-DM OR = 1.26 (95% CI, 0.30–5.33), $p=0.753$ ; IDDM vs Non-DM OR = 2.82 (95% CI, 0.77–10.34), $p=0.118$ for wound complications	No association
Duey et al. (4)	113,713	anatomic total shoulder arthroplasty (aTSA) or reverse total shoulder arthroplasty (rTSA)	90 days	OR for surgical site/joint infection = 1.21 CI 95% (1.06–1.38), $p=0.005$	Positive association
Rao et al. (5)	1,074	TSA or RTSA	at least 90 days (median 239 days)	First Postoperative Glucose: Median of 128 mg/dL in the non-infection group vs. 167.5 mg/dL in the infection group $p = 0.01$ )	Positive association
Morris et al. (6)	301	Reverse Shoulder Arthroplasty (RSA)	Minimum 12 months (12–111 months)	OR for diabetes: 1.34 CI 95%(0.23–5.23), $p=0.877$	No association
Ponce et al. (7)	66,485	Total Shoulder Arthroplasty (TSA), Hemiarthroplasty, Reverse Shoulder Arthroplasty (RSA)	In-hospital days only	OR for infection in diabetes vs non-diabetes: 0.90 CI 95% (0.61–1.3), $p=0.62$	No association

<b>Richards et al. (8)</b>	<b>4,528</b>	<b>Total Shoulder Arthroplasty (TSA, Hemiarthroplasty, Reverse Total Shoulder Arthroplasty, Elective procedures, Traumatic procedures)</b>	<b>Mean 2.7 years (1 day–7 years)</b>	<b>Hazard ratio for diabetes = 1.11 CI 95% (0.58–2.12), p=0.747</b>	<b>No association</b>
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Cancienne et al. (1) found a positive association between HbA1c $\geq$ 8 and wound complications within 6 months and deep infection requiring surgery within 1 year. On the other hand, McElvany et al. (2) found no association for HbA1c $\geq$ 7.

The remaining six studies did not investigate HbA1c specifically but rather diabetes status (yes/no). Since elevated HgA1c is an indicator of uncontrolled diabetes, it should be considered separately from simply evaluating patients on a diabetes/non-diabetes basis. Nevertheless Duey et al. (4) found a positive association between surgical site/joint infection and diabetes. Rao et al. (5) also found a positive association between preoperative diabetes and a first in-hospital glucose reading >140 mg/dL regarding infection status. The remaining four studies did not find any association. Cancienne et al. (1) noted that although they observed a positive association, they could not control certain variables, such as cement use and surgical time, in their multivariable analysis. These factors may introduce confounding and lead to statistical deviation in the results. Duey et al. (4) had limited access to operative information (antibiotic prophylaxis, surgical times), the severity of diabetes, or inpatient glycemic control. As a result, statistical deviations could also occur. Rao et al. (5) failed to apply a standardized approach for key variables, such as insulin or steroid use, which could affect glycemic management and thus confound the outcomes.

Studies finding no association also suffered from several limitations. McElvany et al. (2) focused on a single integrated system, so their results may not be generalizable to centers without Kaiser Permanente's infrastructure. Fu et al. (3) had a short follow-up of only 30 days, and the cohort included patients from institutions participating in NSQIP, which may introduce selection bias. Morris et al. (6) suffered from a small PJI group (only 15 patients). Ponce et al. (7) demonstrated heterogeneous follow-up, having only in-hospital data. So, they may fail to detect infections appearing after discharge. The lack of adequate follow-up appears to be the main limitation of these studies, given that most shoulder PJI infections can be occur in the late period. Richards et al. (8) did not control for confounders such as antibiotic cement use, procedure time, prior shoulder surgery, or surgeon volume and faced low infection frequency (45 infections among >4500 patients).

For the reasons mentioned above, there is limited evidence to make a solid conclusion in terms of the association between HbA1c levels and shoulder PJI. While some studies demonstrate an association, others do not, and all studies have important limitations due to their retrospective nature, statistical drawbacks, and study design. Although the literature is controversial, there is limited evidence to suggest that HbA1C >8>mg\vdL may be associated with postoperative shoulder PJI.

## References

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