Appendix

The correlation coefficients r_{P_1,P_2} and $r_{T,\frac{P_1+P_2}{2}}$ are related, especially when the correlation across all treatment arms is the same, i.e., $r = r_{T,\mathrm{P}} = r_{T,P_1} = r_{T,P_2} = r_{P_1,P_2} = \frac{\sigma_B^2}{\sigma_B^2+\sigma_W^2}$.

$$
\begin{aligned}
r_{T,\frac{P_1+P_2}{2}} &= \frac{\operatorname{cov}\left(y_T, \frac{y_{P_1}+y_{P_2}}{2}\right)}{\sqrt{\operatorname{var}(y_T)\operatorname{var}\left(\frac{y_{P_1}+y_{P_2}}{2}\right)}} \\
&= \frac{\operatorname{cov}\left(y_T, y_{P_1}\right)}{\frac{1}{2}\sqrt{\operatorname{var}(y_T)\left[2\operatorname{var}\left(y_{P_1}\right) + 2\operatorname{cov}\left(y_{P_1}, y_{P_2}\right)\right]}} \\
&= \frac{\sqrt{\operatorname{var}(y_T)\operatorname{var}\left(y_{P_1}\right)}\operatorname{cor}\left(y_T, y_{P_1}\right)}{\frac{1}{\sqrt{2}}\sqrt{\operatorname{var}(y_T)\operatorname{var}\left(y_{P_1}\right)\left[1 + \operatorname{cor}\left(y_{P_1}, y_{P_2}\right)\right]}} \\
&= \frac{\operatorname{cor}\left(y_T, y_{P_1}\right)}{\frac{1}{\sqrt{2}}\sqrt{\left[1 + \operatorname{cor}\left(y_{P_1}, y_{P_2}\right)\right]}} \\
&= \frac{r_{T,P_1}}{\sqrt{\left(1 + r_{P_1,P_2}\right)/2}}
\end{aligned}
$$

Hence

$$
\begin{aligned}
\frac{\sigma_5^2}{\sigma_4^2} &= \frac{1 + \frac{\left(1 + r_{P_1,P_2}\right)}{2} - 2\, r_{T,\frac{P_1+P2}{2}}\sqrt{\frac{\left(1 + r_{P_1,P_2}\right)}{2}}}{2\left(1 + r_{T,P}\right)} \\
&= \frac{1 + \frac{\left(1 + r_{P_1,P_2}\right)}{2} - 2\, r_{T,P_1}}{2\left(1 + r_{T,P}\right)} \\
&= \frac{\frac{3\left(1 + r_{T,P_1}\right)}{2}}{2\left(1 + r_{T,P}\right)} \\
&= \frac{3}{4}
\end{aligned}
$$

Attachment 1 to: Ring A, El Galta R. Response to commentary on “An efficient crossover design for thorough QT studies” by Chen & Weng. GMS Med Inform Biom Epidemiol. 2026;22:Doc10. DOI: 10.3205/mibe000308