Semen analysis including concentration, motility, and morphology remains the cornerstone of assessing male fertility potential. The World Health Organization (WHO) has published manuals in 1980, 1987, 1992, and 1999 with the objective to standardize the practice of andrology laboratories worldwide when assessing these criteria. The purpose of this study was to evaluate the appropriateness of the reference limits in a large infertility program in a teaching hospital. Sixty two semen samples from 47 healthy donors with proven natural fertility and single ejaculates of 406 patients evaluated for infertility were assessed using the 1999 WHO standards. The third percentile values of sperm concentration, motility, and morphology were calculated for the fertile donors. These values are traditionally used as cut-off points of normality in a biological system. The normality of all semen samples studied was reclassified using these derived values. Applying the 1999 WHO standards, 30 (48%) fertile donors and 331 (81.5%) men assessed for infertility had one or more abnormal sperm parameters. The third percentile values for sperm concentration, motility, and normal morphology in fertile semen samples were 11x10^6/mL, 27%, and 12%, respectively. The application of these values has resulted in a significant reduction in the number of samples diagnosed with abnormal semen parameter(s) among fertile donors (19% vs. 48%, \( \chi^2 = 17.6, P < 0.0001 \)) and men assessed for infertility (45% vs. 81.5%, \( \chi^2 = 28.7, P < 0.0001 \)). The results of this study demonstrate that, traditionally, assessed sperm parameters are not a reliable indicator of fertility potential even among a fertile population. The reference values set by the WHO need to be constantly revised in order to enhance its predictive power. Fertility laboratories may utilize the 3rd percentile values of semen variables from a fertile population as an alternative reliable method to evaluate the status of male fertility. This may be further validated by wider multicenter studies.