

**Title:** Establishment of newborn reference range for complete blood counts in Hong Kong

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**Background:** Currently in Hong Kong, clinical pediatric reference ranges rely mainly on ranges previously established in textbooks, clinical journals or provided by the manufacturers. For healthy term neonates, precise reference ranges are even more insufficient especially for Complete Blood Counts (also known as CBC) which is routinely ordered for clinical diagnostics and monitoring. The test mainly includes counts for white blood cells (WBC), red blood cells (RBC), platelets (PLT), hemoglobin concentrations (HGB), hematocrit (HCT), red cell indices and also white cell differential counts.

**Objective:** This abstract briefly outlined the ranges and values of normal full-term Chinese newborn (<5 days of age) CBC measurements. The measurements that the present study focused on are WBC, RBC, PLT, mean corpuscular hemoglobin (MCH) and mean corpuscular volume (MCV).

**Methods:** A minimum of 300µl of peripheral blood were collected from newborn individuals undergoing baby routine tests by heel prick method. The sample was processed by Sysmex XN-3100 automated cell counter. As samples were collected in EDTA micro-containers, manual sampling mode was selected along with CBC, DIFF and PLT orders. Platelet count enumeration was performed by fluorescence method. All reported results were recorded in excel spreadsheet after phone verification of inclusion criteria with ward nurses. For this study, only full-term healthy newborns with local Chinese parents were included. Outliers were identified by the Tucker method and cleaned data were imported into EP Evaluator 11 for normality test and range establishments following CLSI C28-A2 guidelines. Further statistical analysis was carried out using PRISM 7 for significance calculations.

**Results:**

Present Study												
	Overall				Male				Female			
	5th - 97.5th percentile	Median	Mean	N	5th - 97.5th percentile	Median	Mean	N	5th - 97.5th percentile	Median	Mean	N
HCT (%)	38.6 - 60.3	49.3	49.19	123	39.5 - 59.3	49.65	49.39	62	37.8 - 60.1	48.5	49	61
HGB (g/dL)	13.4 - 21.7	17.6	17.6	123	14.0 - 21.2	17.65	17.6	62	13.6 - 21.7	17.5	17.6	61
MCV (fL)	91.0 - 106.3	99.5	99.4	120	92.3 - 106.2	99.2	99.3	60	92.3 - 106.8	100	99.6	60
MCH (pg)	31.9 - 37.7	35.5	32.5	120	32.9 - 37.8	35.6	35.4	60	32.9 - 38.1	35.4	35.5	60
PLT (10 <sup>3</sup> /µL)	181 - 414	296	297.3	123	180 - 421	292	300.6	61	160 - 428	304	294	62
RBC (10 <sup>6</sup> /µL)	3.7 - 6.2	5	5	124	3.9 - 6.1	5.1	5	62	3.7 - 6.2	5	5	62
WBC (10 <sup>3</sup> /µL)	9.2 - 30.4	19.2	19.4	125	5.2 - 31.9	17.6	18.6	62	9.16 - 31.2	20.5	20.2	63

Table 1: CBC parameters of local Chinese neonates. Non-parametric method was chosen by EP Evaluator 11 to define "Overall" group following CLSI C28-A2 protocol. Due to sample limitations, "Male" and "Female" subgroups were done by parametric method. Mann-Whitney U Test showed no significance differences between gender populations for all measurements (P>0.05).

Study Comparisons				
	Chen et al., <i>Arch Pathol Lab Med</i> (2021); 145: 66-74	Smit et al., <i>Blood</i> (2018); 132(Supplement 1): 5821	Cui et al., <i>BMC Pediatrics</i> (2020); Preprint	Han et al., <i>Fetal and Neonatal Haematology</i> (1991); chapter 2: 29-50
	7.5th percentile (n=120)	Lower limit (n=20)	7.5th percentile (n=594)	Adapted from various studies
HCT (%)	N/A	30.5 - 57.2	N/A	N/A
HGB (g/dL)	13.6 - 19.8 (mean = 16.8)	10 - 20		19 ± 2.2 SD
MCV (fL)	N/A	85 - 126		119 ± 9.4 SD
MCH (pg)		29.9 - 36.4		N/A
PLT (10 <sup>3</sup> /uL)	160 - 406 (mean = 277)	95 - 586	152 - 464	
RBC (10 <sup>6</sup> /uL)	N/A	3.16 - 5.74	N/A	5.1 ± 0.7 SD
WBC (10 <sup>3</sup> /uL)	11.5 - 29.4 (median = 20.4)	5.86 - 16.69		0hrs: 10 - 26; 12hrs 13.5 - 31
<b>Analyzer</b>	Sysmex XN-1000	Beckman Coulter DxH-520	Sysmex XN-9000	N/A

Table 2: Comparison of our data with previous studies. Despite the variations of study methods, we observed that our findings were similar with other publications.

**Conclusion:** Here we provided a newly established reference range of CBC measurements for local healthy newborns within 5 days of age in our hospital. By reviewing our findings with other publications, we observed that the reference intervals were highly comparable. Due to the sample size limitations, statistical reference interval verification was not performed, suggesting the need of a more comprehensive and full spectrum pediatric study in the future. This will include a smear review for WBC differentials, age stratification and nucleated red blood cell (NRBC) counts.