Why it is important nurses can understand basic statistics

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In the 21st century healthcare research has moved forward remarkably, with quantitative research methodology rapidly developed alongside that. These changes inevitably influenced the view on whether nurses should be able to understand basic statistics.

Statistical knowledge supports nurses in reading and understanding quantitative results as consumers of research, and hence improves the application of the findings into practice. Currently many nurses prefer to read qualitative papers because, anecdotally, they find quantitative ones more difficult to read and interpret [1, 2]. Being able to understand and interpret basic statistics assists nurses in updating clinical guidelines and practice as guided by research evidence, thus promoting evidence-based practice [3]. Considering the speed and volume of healthcare research generated each year, it is important for nurses to update new research evidence in timely manner.

Understanding basic statistics also advances the application of research reporting guidelines. Reporting guidelines comprise a checklist, flow diagram, or structured text to guide authors in reporting a specific type of research. The EQUATOR network is a comprehensive online resource, which contains reporting guidelines for different types of studies, such as STROBE [4] for observational studies, CONSORT [5] for randomised trials and PRISMA [6] for systematic reviews. Utilizing reporting guidelines for research article drafting has been endorsed by more and more medical journals, including *Nursing in Critical Care* [7]. In line with that, *Nursing in Critical Care* also published a document on statistical guidelines & requirement, which engages authors to follow these reporting guidelines.

Understanding basic statistics can help to avoid misinterpretation in statistical reporting. Despite the growing emphasis on reporting statistical results in an appropriate and accurate manner, certain inaccuracies and simplistic reporting still occurs in health research papers. For instance, the controversy around probability (p value) reporting in healthcare research [8, 9] is partially attributed to its practical misuse and misinterpretation. Understanding key statistical concepts can, therefore, minimise incorrect statistics and poor reporting behaviours, and increase the reproducibility and replicability in medical science.

For research active nurses who have the motivation to become research leaders and chief investigators, statistical skills are essential in designing proposals for high quality studies, such as randomised controlled trials, of which *Nursing in Critical Care* publishes several [10].

Despite this, we acknowledge that understanding statistics is neither simple nor straightforward. In some undergraduate nursing curricula, qualitative research methods are often emphasized and preferred over quantitative methods [1,2], which may not be taught in a way that facilitates understanding. Other health care professional curricula (psychology, medicine, physiotherapy, for example) tend to include more teaching around statistics and research. Nurses and nursing students appear to believe that advanced mathematical knowledge is requisite to be able to read and understand statistics. However, this is not the case. Healthcare professionals are not required to understand statistics in depth, unless they wish to; this is the remit of statisticians. Learning to understand and interpret basic statistical results, is, however, essential.

Statistics is a broad topic and medical statistics are applied to a very wide range of concepts and approaches. Therefore, it is unrealistic to expect nurses or any healthcare professional to adopt all of them. However, there are indispensable ones, such as descriptive statistics (count and percentage, mean, median, standard deviation, interquartile range etc.) and basic inferential statistics (correlation, association, and group comparison where p values and other comparative values are generated). Determining the relationship between statistical significance and confidence interval (CI) is also very useful. *Understanding statistics in medical research* by David Matthews and Vernon Farewell [11] and *An introduction to medical statistics* by Martin Bland [12], are useful reference books for nurses.

Let us look at some examples from quantitative studies published in this Journal. For reporting mean difference, one study claimed that the Braden risk assessment score for pressure injury development was 1.4 (95% CI: 0.5–2.2) points lower in the patients placed prone on assessment at ICU admission than in those never placed prone ($p < .001$) [13]. The mean difference was statistically significant because the p-value was well below 0.05. This was also confirmed by the fact that the entire range of the 95% CI (0.5 to 2.2) did not contain the value 0, which represents the point of no significant difference in risk.

For reporting odds ratio (OR), one study [14] reported that incidence of delirium was lower in the intervention group (n = 7 (26.9%) vs. n = 10 (50%)); the odds ratio was 0.37 (95% CI: 0.11-1.26; Fisher's exact test $p = .133$). This OR was not statistically significant because its p-value was greater than 0.05 ($p=0.133$) and its 95% CI (0.11-1.26) included the point of no effect, in this case an odds ratio of 1.

In terms of reporting hazard ratio (HR) in studies about survival analysis or complications prevention [15], one study showed that the comparison of overall survival between two treatment groups gave an unadjusted HR of 1.41 (95% CI: 0.79–2.52; one-sided $p=0.9$). This represents a 41% increase in risk of death when comparing two treatment groups. However, it is worth noting that this large difference didn't lead to statistical significance, because the p-value (one-sided $p=0.9$) was greater than 0.05. The width of its 95% CI also indicated no effect (0.79-2.52 contained 1).

We would recommend urgent changes to undergraduate nursing education in higher education institutions where statistics are not already taught to nurses. We need to convince nurse academics and student nurses that statistics are indeed very relevant to nursing. In fact, Florence Nightingale employed basic statistics in her sentinel work to demonstrate the effectiveness of hygiene practices in reducing infection rates and to demonstrate the type and extent of the care conditions in the Crimean War [16]. So it isn't that nurses have never used statistics, but the value placed on learning basic statistics may have been lost along the way as the curriculum becomes more diverse.

We need to ensure that the learning outcomes for nursing students are concentrated on the practical side of statistics and that staff that teach these can explain and make difficult concepts easier to understand. Essentially, nurse educators should link statistics to daily nursing practice. When seeing a patient, nurses identify, appraise, and apply the current best evidence to inform the patient's treatment and practices, many of which are at the nurse's discretion.

Nurses can choose to broaden their statistical knowledge and skills in specific statistical areas, depending on their individual research interests. For example, if they aim to develop a diagnostic tool for early detection of deterioration in severe ill children prior to paediatric intensive care unit (PICU) admission, the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and receiver operating characteristic curve (ROC curve) should be the learning focus [17],

which shall be discussed in more detail in a forthcoming editorial on reporting key statistical results for different type of studies.

Nevertheless, we should not make unrealistic expectations of nurses. If a nurse researcher plans to conduct quantitative research, it is essential to, at the very least, consult or, better, work with a statistician at the study design stage. Liaising with statisticians after data collection is completed or at the statistical analysis stage will generate very limited help, since it will not be possible to alter the study design, sample size and data collection procedures.

In summary, whilst nurses don't need to be equipped with in depth knowledge of statistical principles and formulae, understanding in basic statistics is essential, and not having this understanding places them at a disadvantage compared to other healthcare professionals such as doctors, dieticians and pharmacists. Nursing should focus on the practical aspects of statistics, i.e. correct understanding, appropriate interpretation, and critical appraisal of statistical results. Nurses are encouraged to follow reporting guidelines for reporting their own research. For those who have the intention to lead quantitative studies, it is essential to work with a statistician.

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