Journal of Physiotherapy 62 (2016) 171

Journal of PHYSIOTHERAPY

journal homepage: www.elsevier.com/locate/jphys

Appraisal Clinimetrics

Charlson Comorbidities Index

Summary

Description: The Charlson Comorbidity Index (CCI) was developed and validated as a measure of 1-year mortality risk and burden of disease.[1–4] To account for age being an independent predictor of mortality, a Combined Age-CCI (CA-CCI) score can be generated.[1–3] The CCI has been extensively used in clinical research to address the confounding influence of comorbidities, predict outcomes, standardise comorbidities abstracted from medical records or administrative databases and for self report of comorbidities.[1,3,5–9] In clinical practice, the CCI reduces comorbidities into a single numeric score that may assist health professionals with stratifying patients into subgroups based on disease severity, developing targeted models of care and resource allocation.[3,8]

The CCI consists of 17 comorbidities, with two subcategories for diabetes and liver disease.[1–3] Comorbidities are weighted from 1 to 6 for mortality risk and disease severity, and then summed to form the total CCI score.[1–3] The CA-CCI is generated by adding 1 point to the CCI score for each decade of age over 40 years.[1–3] The CCI and CA-CCI require minimal training and are freely available for researchers and health professionals, with guidelines reported in Charlson et al.[1] To enable rapid electronic calculation of the CCI and CA-CCI, a Microsoft excel spreadsheet has been developed.[3] The CCI has been modified, with adaptations to comorbidities, administration and scoring.[3–7,9] The Self Reported-CCI (SR-CCI) can be self-administered or performed as a 10-minute interview.[6,7] The SR-CCI uses the same scoring algorithm as the CCI, except presence of liver disease is scored as 2 points.[6,7]

Psychometric properties: The CCI is reliable and valid for diverse clinical cohorts (eg, cancer, amputation and arthritis) in a variety of healthcare settings.[3,4,8,9] Charlson Comorbidity Index scores $\geq$ 5 have been associated with a 1-year mortality of 85%, while 10-year survival for a CA-CCI of 5 was 34%.[1] Charlson Comorbidity Index scores $>$ 8 have not been well studied.[1,3,10] Due to advances in disease management, the CCI was updated using International Classification of Diseases 10 codes and validated in six nations, including Australia.[4] The updated CCI and original CCI demonstrated similar levels of discrimination for in-hospital mortality with C statistics of 0.727 to 0.878 and 0.723 to 0.882, respectively.[4]

The CCI has moderate to good inter-rater reliability of 0.74 to 0.945 in older cohorts with cancer.[3,9] The CCI and SR-CCI have high test re-test reliability with intraclass correlation coefficients of 0.92 ($p < 0.0001$) and 0.91 ($p < 0.0001$), respectively.[7] A moderate level of agreement was identified between the SR-CCI and CCI, with most items having Kappa statistics (K) ranging from 0.433 to 0.541 ($p < 0.0001$), while diabetes had a high level of agreement ($K = 0.764$; $p < 0.0001$).[6] Spearman correlations up to 0.63 have been reported between the SR-CCI and CCI.[6,7]

The CCI has content validity, as the diseases and severity weights were statistically derived from relative risks of a proportional regression model to predict mortality.[1,9–11] One weakness that has been reported for the CCI is omission of diseases (eg, anaemia, mental illness), which are present in other indices.[3,11,12] However, the updated CCI retained 12 comorbidities, and prediction of mortality remained high. Increased number of comorbidities in indices (ie, 30 in the Elixhauser Comorbidity Measure versus 17 in the CCI) also potentially reduces utility.[4,11]

Traditional construct validity using the known groups method is rarely tested in comorbidity indices.[10,11] Poorer utilisation of cancer screening in patients with high CCI scores is an example of construct validity for the CCI.[10,11] There is no gold standard measure for comorbidity, so criterion validity (which encompasses concurrent and predictive validity) has been demonstrated for the CCI through comparison to other comorbidity indices and prediction of outcomes.[1,5,8–11] The CCI has moderate to good correlation (> 0.4) with other comorbidity indices and predictive validity for criterion such as mortality, readmission, disability and length of stay.[3,7,9,11]

Commentary

Comorbidity, which impacts on contemporary clinical practice and research, is a major consideration in health systems reform and funding models.[8] However, there is a lack of consensus on the most effective method for measuring comorbidity.[3,8–12] To ensure implementation of a comorbidity index that is sensitive, it is important to determine if the outcome of interest is mortality or function.[9,12] The CCI has utility due to low cost, ease of administration and interpretation in efficient timeframes.[3,7–9] The CCI is feasible in various healthcare settings, including those with limited access to medical records (eg, primary care, outreach).[9] The CCI can be incorporated into electronic medical record and data collection systems.[3] The SR-CCI has the potential to be biased by the client's medical knowledge, recall or literacy.[6,7,9] Depending on primary diagnosis and comorbidities being investigated, the CCI score may differ between studies (eg, in a client with leukaemia, COPD and myocardial infarction, the CCI score can be 2 or 3).[3] To enable standardised comparison of healthcare outcomes between different cohorts and centres, further research on measurement of comorbidity is warranted.

Provenance: Invited. Not peer reviewed.

Caroline E Roffman[a,b], John Buchanan[a,b] and Garry T Allison[a,b]

[a]*School of Physiotherapy & Exercise Science, Faculty of Health Sciences, Curtin University*

[b]*Royal Perth Hospital, Perth, Australia*

References

1. Charlson ME, et al. *J Chron Dis.* 1987;40:373–383.
2. Charlson ME, et al. *J Clin Epidemiol.* 1994;47:1245–1251.
3. Hall WH, et al. *BMC Cancer.* 2004;4:1471–2407.
4. Quan H, et al. *Am J Epidemiol.* 2011;173:676–682.
5. Amusat N, et al. *J Physiother.* 2014;60:217–223.
6. Ng X, et al. *Rheumatol Int.* 2015;35:2005–2011.
7. Katz JN, et al. *Med Care.* 1996;34:73–84.
8. Roffman CE, et al. *J Physiother.* 2014;60:224–231.
9. de Groot V, et al. *J Clin Epidemiol.* 2003;56:221–229.
10. Hall SF. *J Clin Epidemiol.* 2006;59:849–855.
11. Moltó A, et al. *Clin Exp Rheumatol.* 2014;32:S131–S134.
12. Groll DL, et al. *J Clin Epidemiol.* 2005;58:595–602.

http://dx.doi.org/10.1016/j.jphys.2016.05.008