

# Personalised assessment of fracture risk

## Which tool?

[AUTHOR: Suggest expanding: 'Which tool should be used?']

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**OSTEOPOROSIS** and its consequence of fragility fracture impose a significant public health burden and primary health problem in Australia. It is not widely appreciated that patients with a fragility fracture, especially hip fracture, have an increased risk of premature mortality.<sup>1</sup> Primary care physicians play a key part in the treatment and prevention of fracture and thereby save lives by assessing and managing high-risk individuals.

We have developed and implemented the world's first tool for personalised assessment of fracture risk, called the Garvan Fracture Risk Calculator (hereby 'Garvan').<sup>2</sup> In subsequent years, the Fracture Risk Assessment Tool (FRAX) was developed and implemented for clinical use.<sup>3</sup> Currently, The Royal Australian College of General Practitioners (RACGP) recommends that either Garvan or FRAX can be used for assessing fracture risk for treatment decision.

However, in a recent analysis,<sup>4</sup> Stuckey et al have pointed out that there is discrepancy in fracture risk estimates between Garvan and FRAX. As stated by Stuckey et al, the discrepancy could affect treatment decision: 'there are many instances when treatment may be recommended, as per the RACGP and Osteoporosis Australia guidelines, if the

Garvan risk calculator is used but not if the FRAX calculator is used'. Here, we offer some explanations for the discrepancy and propose a solution going forward.

First, some discrepancy is expected, because the input risk factors in Garvan and FRAX differ. FRAX includes rheumatoid arthritis and glucocorticosteroid use as predictors, whereas Garvan does not, because these factors are correlated with bone mineral density. Garvan takes into account the number of falls – a key risk factor for hip fractures – in the prediction of risk; FRAX does not currently take falls into account. Garvan considers prior fracture as a quantitative variable (ie number of fractures), whereas FRAX considers prior fracture as a binary variable (ie yes/no). Thus, for an individual with two (or more) prior fractures, Garvan would predict a higher risk of subsequent fracture than for an individual with one prior fracture. By contrast, FRAX treats the two individuals as having equal risk.

FRAX was developed using multiple cohorts with different durations of follow-up, and not all cohorts had mortality data. FRAX's predicted risk is adjusted for competing risk of mortality, but how the adjustment is made has not been published. Garvan was developed using data from the Dubbo Osteoporosis Epidemiology Study, where the sequential events of fracture, refracture and death

for every individual have been directly monitored. Hence, the predicted risk inherently represents the probability of sustaining fracture among those at risk during their specific remaining lifetime.

Second, the Garvan model's predicted risk is more consistent with actual risk than FRAX's. In the Geelong Osteoporosis Study, Garvan underestimated fracture risk by approximately 25% in women and 19% in men, and FRAX underestimated it by 55% in women and 66% in men.<sup>5</sup> In the New Zealand cohort, Garvan predicted almost 100% of fracture cases, but overpredicted hip fracture risk by 50%, while FRAX underestimated fracture risk by 50% (Table 1).<sup>6</sup> In the Canadian Multicentre Osteoporosis Study, the Garvan model's predicted risk closely matched that observed in the population over time.<sup>7</sup> As high-risk individuals would be recommended for treatment under any circumstance, the overestimation by Garvan has no negative clinical impact.

Third, the Garvan model's predicted risk is consistent with clinical decision. In an Australian cohort of 531 individuals aged 70 years and older, Garvan correctly identified who would be indicated for treatment or required a dual-energy X-ray absorptiometry scan in 88% of the cases,<sup>8</sup> which is slightly higher than FRAX (83–84%). In a Polish cohort of 218 men with a prior fracture, Garvan identified 82% as 'high risk' for treatment, whereas

**Table 1. Comparison of predicted fractures between the Garvan Fracture Risk Calculator ('Garvan') and Fracture Risk Assessment Tool (FRAX) models in Australian and New Zealand populations, and discrimination in two Polish cohorts**

Study	Predicted/observed any fractures*		Predicted/observed hip fractures*	
	Garvan	FRAX	Garvan	FRAX
<b>Holloway-Kew et al<sup>5</sup></b>				
Women	139/184 (0.75)	52/115 (0.45)	50/42 (1.19)	20/42 (0.48)
Men	88/109 (0.81)	26/73 (0.36)	21/17 (1.23)	10/17 (0.59)
<b>Bolland et al<sup>6</sup></b>				
Women	276/279 (0.99)	121/229 (0.53)	86/57 (1.51)	43/57 (0.75)

\*Numbers in parentheses represent the ratio of predicted values over observed values

**Table 2. Comparison of consistency with clinical decision between the Garvan Fracture Risk Calculator ('Garvan') and Fracture Risk Assessment Tool (FRAX) models**

Study	Consistency with clinical decision	
	Garvan	FRAX
<b>Inderjeeth et al<sup>8</sup></b>		
	88%	83–84%
<b>Pluskiewicz et al<sup>10</sup></b>		
Prior fracture	93%	72%
<b>Pluskiewicz et al<sup>9</sup></b>		
Prior fracture	82%	8%
Osteoporosis	74%	9.5%

FRAX identified only 8%.<sup>9</sup> Moreover, among 251 men with osteoporosis, Garvan would recommend 74% for treatment, but FRAX would recommend only 9.5%.<sup>9</sup> The same trend was observed in women (Table 2).<sup>10</sup>

At present, Australian primary care physicians are faced with the question of which fracture risk assessment tool should be used. As Carl Sagan [AUTHOR: Should this be 'As Segal's law states'?] states, 'A man with a watch knows what time it is; a man with two watches is never sure'. We should not burden doctors with two fracture risk assessment models. Given the aforementioned findings, it could be argued that the Garvan model is more clinically relevant for primary care physicians for personalised assessment of fracture risk.

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