Simplified estimation of Widmark "r" values by the method of Forrest

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To simplify blood alcohol calculations, tables are presented giving Widmark 'r' values estimated by the method of ARW Forrest (Journal of the Forensic Science Society 1986; 27: 249–252).

Pour simplifier le calcul des taux d'alcoolémie dans le sang, des tables sont présentées qui donnent les valeurs 'r' de Widmark estimées par la méthode de ARW Forrest (Journal of the Forensic Science Society 1986; 27: 249–252).

Um die Berechnung von Blutalkoholkonzentrationen zu vereinfachen, werden Tabellen präsentiert, welche die nach der Methode von ARW Forrest abgeschätzten Widmark 'r' Werte enthalten (Journal of the Forensic Science Society 1986; 27: 249–252).

Con el fin de simplificar los cálculos de alcohol en sangre, se presentan unas tablas con los valores de la 'r' de Widmark estimados por el método d ARW Forrest (JFSS 1986; 27: 249–252).

Introduction

The mathematical method propounded by Professor Dr EMP Widmark [1,2] for estimation of blood alcohol levels from consumption and vice versa has proven robust and continues in general use after the passage of more than seventy years, despite the development of other, arguably more exact, approaches such as that of Watson [3].

Widmark's "reduced body mass" or "r" value represents that proportion of the body available for the distribution of alcohol, and is an important part of the calculation. The average "r" values reported by Widmark (male average 0.68, standard deviation 0.085; female average 0.55, standard deviation 0.055) are often used as defaults, but they are open to question on several grounds:

They are based on very small series (20 men and 10 women), so significant statistical variation due to non-random selection is quite possible;

Widmark did not claim that the range of values in his subjects was representative of humans in general; and several more modern studies report higher average figures, although the observed ranges generally overlap Widmark's experimental results [4,5].

It is an inconvenient fact that the specific Widmark "r" value for an individual can be known with certainty only by experiment, and furthermore that it can change with the passage of time. It is possible, however, to make a reasonable estimate of the "r" value at the time of interest;

several methods have been proposed for this. Notable among such methods is that of Forrest [6], which is based upon the Body Mass Index (BMI; weight divided by height squared).

The procedure set out in Forrest's paper for the calculation is rather onerous if done by hand, and the BASIC computer program offered by the author is no longer available (Forrest ARW, personal communication). The tables were calculated by Forrest's method and are offered here as a simplification; the uncertainties in interpolated numbers are negligible (Table 1).

While the values in Table 1 are applicable to a wide range of body types, like all other methods of estimation they will fail for extreme body types, such as the highly muscular (e.g., bodybuilders), the emaciated, those in an advanced stage of pregnancy, and those suffering from morbid obesity. This has been partly dealt with by limiting the range of BMI over which the tables are calculated. Even for normal individuals there is some inherent mathematical uncertainty in the estimates, but a critical evaluation of its magnitude is beyond the scope of this technical note.

BASIC and QBASIC versions of computer programs for the calculation of Widmark "r" values by Forrest's method are available from the author by E-mail to abarbour@lightspeed.net.

Acknowledgements

References

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5. Cowan JM et al. Determination of Volume of Distribution for Ethanol in Male and Female Subjects. Journal of Analytical Toxicology 1996; 20: 287–290.
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TABLE 1 Widmark 'r' values by the method of Forrest [6].

Males, Body Mass Index 15-30

Wt, lbs	99	110	121	132	143	154	165	176	187	198	209	220	231	242	253		
Wt, Kg	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	Ht, cm	Ht, ft,in
	0.78	0.75	0.72	0.69	0.67											150	4'11"
	0.79	0.77	0.74	0.71	0.69	0.66										155	5'1"
	0.80	0.78	0.76	0.73	0.71	0.69	0.66									160	5'3"
	0.82	0.80	0.77	0.75	0.73	0.71	0.68	0.66								165	5'5"
	0.83	0.81	0.79	0.77	0.75	0.72	0.70	0.68	0.66							170	5'7"
		0.82	0.80	0.78	0.76	0.74	0.72	0.70	0.68	0.66						175	5'9"
		0.83	0.81	0.79	0.77	0.76	0.74	0.72	0.70	0.68	0.66					180	5'11"
			0.82	0.81	0.79	0.77	0.75	0.73	0.72	0.70	0.68	0.66				185	6'1"
			0.83	0.82	0.80	0.78	0.77	0.75	0.73	0.72	0.70	0.68	0.67			190	6'3"
				0.83	0.81	0.79	0.78	0.76	0.75	0.73	0.71	0.70	0.68	0.67		195	6'5"
				0.84	0.82	0.81	0.79	0.78	0.76	0.74	0.73	0.71	0.70	0.68	0.67	200	6'7"
					0.83	0.82	0.80	0.79	0.77	0.76	0.74	0.73	0.71	0.70	0.69	205	6'9"

Females, Body Mass Index 15-30

Wt, lbs	99	110	121	132	143	154	165	176	187	198	209	220	231	242	253		
Wt, Kg	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	Ht, cm	Ht, ft,in
	0.69	0.66	0.63	0.61	0.58											150	4'11"
	0.70	0.68	0.65	0.63	0.60	0.57										155	5'1"
	0.72	0.69	0.67	0.65	0.62	0.60	0.57									160	5'3"
	0.73	0.71	0.69	0.66	0.64	0.62	0.59	0.57								165	5'5"
	0.74	0.72	0.70	0.68	0.66	0.64	0.61	0.59	0.57							170	5'7"
		0.73	0.71	0.69	0.67	0.65	0.63	0.61	0.59	0.57						175	5'9"
		0.74	0.73	0.71	0.69	0.67	0.65	0.63	0.61	0.59	0.57					180	5'11"
			0.74	0.72	0.70	0.68	0.66	0.65	0.63	0.61	0.59	0.57				185	6'1"
			0.75	0.73	0.71	0.70	0.68	0.66	0.64	0.63	0.61	0.59	0.58			190	6'3"
				0.74	0.72	0.71	0.69	0.68	0.66	0.64	0.63	0.61	0.59	0.58		195	6'5"
				0.75	0.73	0.72	0.70	0.69	0.67	0.66	0.64	0.63	0.61	0.60	0.58	200	6'7"
					0.74	0.73	0.71	0.70	0.69	0.67	0.66	0.64	0.63	0.61	0.60	205	6'9"