

## C.1 ROC Curves

**In view of inadequacy of SPSS for ROC curves, this problem is solved here with the help of MedCalc. All others have been solved with SPSS and we also provide the SYNTAX.**

Studies have established that visceral adiposity is a strong determinant of growth hormone (GH) secretion. GH deficiency is associated with increased body fat and decreased lean body mass. However, visceral adiposity is difficult to evaluate as it requires CT scan. A study was carried out to find if high body fat itself can be a good indicator of GH deficiency opposed to visceral adiposity. Largest waist circumference was used as a surrogate for body fat. The data were obtained from 60 subjects: 28 with GH deficiency and 32 without this deficiency.

The following results are from MedCalc software for largest waist circumference.

Variable	Largest_waist_circumference__Cms_ Largest waist circumference (Cms)	
Classification variable	Deficiency	
Select	1	

Sample size		60
Positive group :	GHDeficiency = 1	28
Negative group :	GHDeficiency = 0	32

Disease prevalence (%)	unknown
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Area under the ROC curve (AUC)	0.865
Standard Error <sup>a</sup>	0.0450
95% Confidence Interval <sup>b</sup>	0.752 to 0.939
z statistic	8.113
Significance level P (Area=0.5)	<0.0001

<sup>a</sup> DeLong et al., 1988

<sup>b</sup> Binomial exact. This gives different result than obtained by R in the book

### **Criterion values and coordinates of the ROC curve**

Criterion	Sensitivity	95% CI	Specificity	95% CI
>=84	100.00	87.7 - 100.0	0.00	0.0 - 10.9
>98	100.00	87.7 - 100.0	53.13	34.7 - 70.9
>99 *	89.29	71.8 - 97.7	65.62	46.8 - 81.4
>100	75.00	55.1 - 89.3	71.87	53.3 - 86.3
>101	64.29	44.1 - 81.4	84.37	67.2 - 94.7
>102	50.00	30.6 - 69.4	96.87	83.8 - 99.9
>104	21.43	8.3 - 41.0	96.87	83.8 - 99.9
>105	14.29	4.0 - 32.7	100.00	89.1 - 100.0
>107	0.00	0.0 - 12.3	100.00	89.1 - 100.0

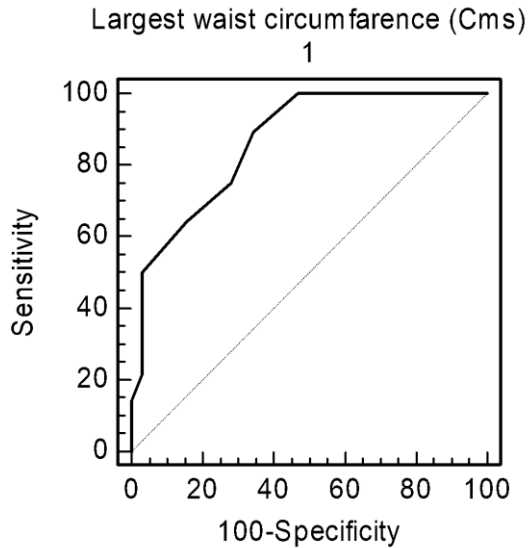


FIGURE C.1(a) ROC curve for largest waist circumference

The best cut-off for largest-waist circumference is 99 cms (marked by asterisk sign in the table). The sensitivity and specificity at this cut-off are 89% and 66%, respectively. The area under the curve (AUC) for largest-waist-circumference is 0.865. The ROC curve is in Figure C.1(a).

The following output shows for visceral-adiposity that the best cut-off is 9960 with sensitivity = 89% and specificity = 91%. Thus visceral-adiposity is more specific (gives negative result when GH deficiency not present). The area under the ROC curve (Figure C.1(b)) for visceral-adiposity is 0.904. Apparently it is higher for visceral-adiposity as expected.

Variable	Visceral_adiposity__mm2_ Visceral adiposity (mm2)
Classification variable	GH Deficiency
Select	1

Sample size		60
Positive group :	GHDeficiency = 1	28
Negative group :	GHDeficiency = 0	32

Disease prevalence (%)	unknown
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Area under the ROC curve (AUC)	0.904
Standard Error <sup>a</sup>	0.0455
95% Confidence Interval <sup>b</sup>	0.800 to 0.965
z statistic	8.876
Significance level P (Area=0.5)	<0.0001

<sup>a</sup> DeLong et al., 1988

<sup>b</sup> Binomial exact. This gives different result than obtained by R in the book

**Criterion values and coordinates of the ROC curve**

Criterion	Sensitivity	95% CI	Specificity	95% CI
>=8259	100.00	87.7 - 100.0	0.00	0.0 - 10.9

>8886	100.00	87.7 - 100.0	9.38	2.0 - 25.0
>9017	96.43	81.7 - 99.9	9.38	2.0 - 25.0
>9485	96.43	81.7 - 99.9	25.00	11.5 - 43.4
>9528	92.86	76.5 - 99.1	25.00	11.5 - 43.4
>9785	92.86	76.5 - 99.1	53.13	34.7 - 70.9
>9794	89.29	71.8 - 97.7	53.13	34.7 - 70.9
>9960 *	89.29	71.8 - 97.7	90.62	75.0 - 98.0
>9994	78.57	59.0 - 91.7	90.62	75.0 - 98.0
>10004	78.57	59.0 - 91.7	93.75	79.2 - 99.2
>10089	71.43	51.3 - 86.8	93.75	79.2 - 99.2
>10148	71.43	51.3 - 86.8	96.87	83.8 - 99.9
>10289	53.57	33.9 - 72.5	96.87	83.8 - 99.9
>10295	53.57	33.9 - 72.5	100.00	89.1 - 100.0
>11714	0.00	0.0 - 12.3	100.00	89.1 - 100.0

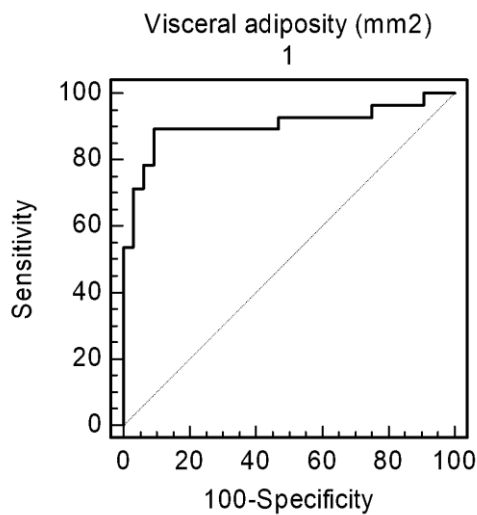


FIGURE C.1(b) ROC curve for visceral adiposity

The output below gives test of significance of difference between AUC for largest waist circumference and visceral adiposity (Figure C.1(c)). The *P*-value is 0.387 and the difference is not statistically significant. Thus these data do not provide evidence of one being better than the other for assessing growth hormone deficiency. Note that despite failing to reject the null of equality, we cannot say that largest waist circumference is as good—only that these data could not say that these two indices have differential performance.

Variable 1	Largest_waist_circumference__Cms_ Largest waist circumference (Cms)
Variable 2	Visceral_adiposity__mm2_ Visceral adiposity (mm2)
Classification variable	GH Deficiency
Select	1

Sample size	60
Positive group :	GHDeficiency = 1 28

Negative group :	GHDeficiency = 0	32	
	AUC	SE <sup>a</sup>	95% CI <sup>b</sup>
Largest_waist_circumference__Cms_	0.865	0.0450	0.752 to 0.939
Visceral_adiposity__mm2_	0.904	0.0455	0.800 to 0.965

<sup>a</sup> DeLong et al., 1988

<sup>b</sup> Binomial exact

**Pairwise comparison of ROC curves**

Largest_waist_circumference__Cms_ ~ Visceral_adiposity__mm2_	
Difference between areas	0.0391
Standard Error <sup>c</sup>	0.0451
95% Confidence Interval	-0.0494 to 0.127
z statistic	0.866
Significance level	P = 0.387

<sup>c</sup> DeLong et al., 1988

— Largest waist circumference (Cms)  
 - - - - Visceral adiposity (mm2)

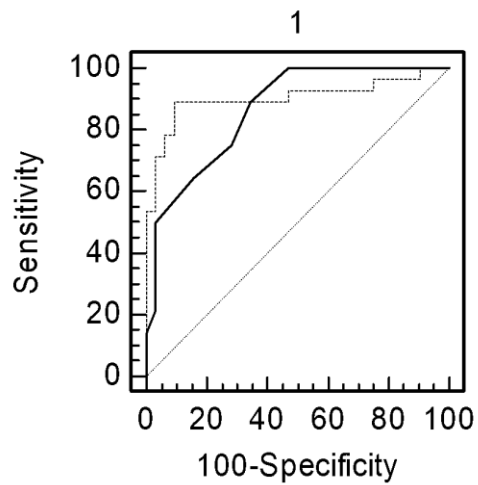


FIGURE C.1(c) Comparison of ROCs by the two methods