

MR

-

가<sup>1</sup>

1,2 . 2 . 3 . 2 . 4

: MR

-

:

MR

20

105

41 ,

가

(social drinker)

300 g

-

43 , 300 g

9 ,

12

4

T1

MR

workstation

4

(level I), 3

(level II),

(level III), level III

4

level (level IV)

level

(level

I - IV)

가

가

:

level I - IV

 $80.31 \pm 3.73\%$ ,

-

 $79.38 \pm 4.39\%$ , $80.92 \pm 3.64\%$ , $73.48 \pm 4.42\%$ 

가

(ANOVA).

-

,

가

:

가

(social drinking)가

1999

7.5%

64.6 %

(4 - 9)

49%

가

(10). CT

(

가

CT

).

가

(4, 7, 8, 11)

(computerized tomography,

(magnetic resonance, MR)

CT)

가

(1, 2, 3) CT가

(12 - 15).

,

1

2

3

4

5

( ; social drinker)

. Cala (16, 17)

CT

가

2000

2002 7 2

2002 9 2

.

가 가

1 40 g

, Karhunen (3)

40 g

Purkinje 가

MR 가

T1 MR 가

MR 1.5T (Signa, GE Medical Systems, Milwaukee, WI, U.S.A.) repetition time (TR)/echo time (TE) 450 msec/18 msec, (number of excitation) 2, 256 × 224, 5 mm, 1.5 mm, (field of view) 22 cm

T1

2000 10 2001 9 MR 20

105

level level I 4 가

level, level II 3 level, level III

level, level IV level III 4 level

MR workstation (Advantage Workstation 4.0; GE Medical Systems, Milwaukee, WI, U.S.A.) volume analysis software

(non - drinker), (social

drinker) gram 300 g

- (mild to moderate), 300 g

(heavy) 41, - 43,

9, 12

MR

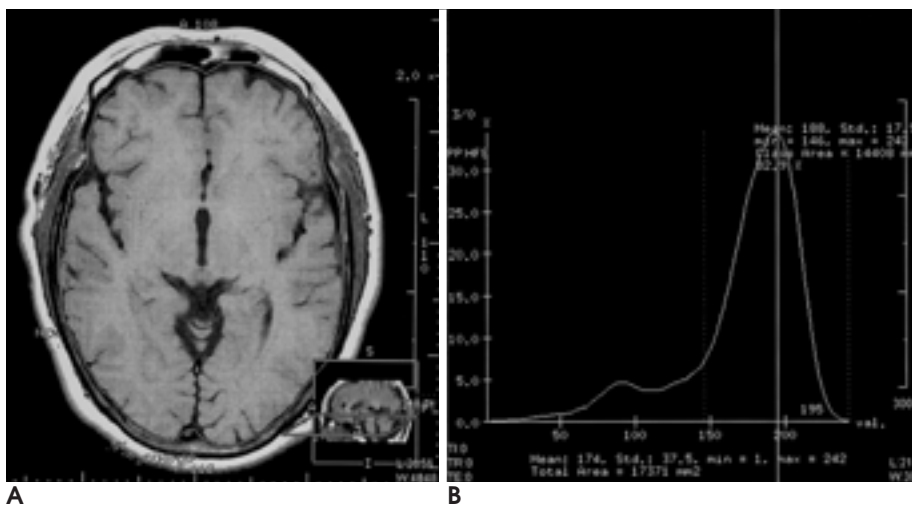
MR DSM - IV 가

voxel segmentation) (Fig. 1).

level

histogram CSF

voxel (semiautomatic



**Fig. 1.** Measurement of intracranial / parenchymal ratio at the third ventricular level (level II).

**A.** Manual segmentation of intracranial area was done by drawing a continuous line along the dura on the axial T1-weighted MR image.

**B.** By choosing the approximate signal intensity (vertical line) of the brain parenchyma on the histogram, the range of signal intensity is defined automatically with the two dotted vertical lines on the graph and the same range of signal intensity area is designated with a color shade (fine mesh on A) on the classified area of the corresponding image. Fine adjustment can be done with fitting the margin of the color shade on the image by moving the lower threshold line (left dotted vertical line in B).

) level level ( $p < 0.01$ ) (Table 1).  
 100.84  $\pm$  55.27 g/week,  
 616.40  $\pm$  253.63 g/week, 1106.10  $\pm$   
 600.23 g/week (Table 1).  
 level level I - IV  
 80.31  $\pm$  3.73%,  
 3. 79.38  $\pm$  4.39%, 80.92  $\pm$  3.64 73.48  $\pm$   
 4.42% ,  
 SPSS PC 8.0 for windows  
 (one - way ANOVA) Bonferroni (post ( $p < 0.001$ ). level  
 hoc multiple comparison)  
 가 ,  
 Pearson  
 , Partial correlation (Table 2).  
 r=0.960, r=0.923  
 (multiple regression) Pearson correlation coefficients  
 가 (r = -  
 0.704 at level I - IV,  $p < 0.001$ ),  
 가  
 가  
 45.05  $\pm$  14.96 , 47.65 (Table 3). Partial correlation  
 $\pm$  15.29 , 36.67  $\pm$  11.51 ,  
 49.83  $\pm$  11.77 가  
 가  
 ( $p < 0.001$ ) (Table 3).

**Table 1.** Comparison of Demographic Characteristics and Amount of Alcohol Consumption Among Non-drinking, Mild to Moderate Social Drinking, Heavy social Drinking, and Alcoholic Groups

Drinking Variables	Non (N = 41)	Mild-moderate (N = 43)	Heavy (N = 9)	Alcoholic (N = 12)	F	p-value	post hoc
Age (yrs) (mean $\pm$ S.D.)	45.05 $\pm$ 14.96	47.65 $\pm$ 15.29	36.67 $\pm$ 11.51	49.83 $\pm$ 11.77	1.76	NS	
Education (yrs) (mean $\pm$ S.D.)	12.32 $\pm$ 2.89	11.90 $\pm$ 2.50	13.17 $\pm$ 2.18	9.25 $\pm$ 0.87	5.55	<0.01	N,M,H>A
Alcohol (g/wk) (mean $\pm$ S.D.)	0	100.84 $\pm$ 55.27	616.40 $\pm$ 253.63	1106.10 $\pm$ 600.23	96.85	<0.001	N,M<H<A

Statistics : ANOVA with Bonferroni test (0.05)

NS= Not Significant

N= Non-drinking, M= Mild to moderate social drinking, H= Heavy social drinking, A= Alcoholic

yrs= years, g/wk = gram/week, S.D. = standard deviation

**Table 2.** Comparison of Percent Parenchymal/Intracranial Area Ratio Among Non-drinking, Mild to Moderate Social Drinking, Heavy Social Drinking, and Alcoholic Groups at Each Brain Level

Drinking Level	Non (N = 41)	Mild-moderate (N = 50)	Heavy (N = 9)	Alcoholic (N = 12)	F	p-value	post hoc
I	77.33 $\pm$ 5.83	76.36 $\pm$ 6.03	79.51 $\pm$ 2.89	71.59 $\pm$ 5.91	4.03	<0.01	N,M,H>A
II	83.86 $\pm$ 3.62	83.36 $\pm$ 3.97	83.04 $\pm$ 5.25	77.25 $\pm$ 3.62	9.33	<0.001	N,M,H>A
III	82.77 $\pm$ 4.39	81.82 $\pm$ 4.77	82.37 $\pm$ 5.20	75.19 $\pm$ 4.80	8.50	<0.001	N,M,H>A
IV	73.23 $\pm$ 5.61	73.22 $\pm$ 5.85	76.44 $\pm$ 3.44	66.60 $\pm$ 6.38	6.19	<0.01	N,M,H>A
I - IV	80.31 $\pm$ 3.73	79.38 $\pm$ 4.39	80.92 $\pm$ 3.64	73.48 $\pm$ 4.42	9.42	<0.001	N,M,H>A

Statistics : ANOVA, with Bonferroni test (0.05)

N= Non-drinking, M= Mild to moderate social drinking, H= Heavy social drinking, A= Alcoholic

Alzheimer

가 (19-24).

가 (Table MR

4).

가

CT MR

가

가

MR

1 mm

2

3

(19, 23, 24).

가

MR

(sulcus)

가

MR

가

(vertex)

가

가 (6, 8, 18).

MR

가

MR

(brain volumetry)

가

Alzheimer

가

level

가

**Table 3.** Pearson's Correlation Coefficients Among Amount, Duration of Alcohol Drinking and Parenchymal Ratio of the Brain

	Age	Education (Years)	Duration (Years)	Amount of Alcohol (g of ethanol / week)
Age	1.000	- 0.359***	0.407***	- 0.033
Education	- 0.359***	1.000	- 0.145	- 0.259**
Duration	0.407***	- 0.145	1.000	0.181
Amount	- 0.033	- 0.259**	0.181	1.000
I - IV	- 0.704***	0.338***	- 0.369***	- 0.343***
I - IV†	-	-	- 0.120	- 0.536***

† Partial correlation with age control

\*\*\* Correlation is significant at the 0.001 level (2-tailed).

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

**Table 4.** Regression Coefficients for Age and Group from Multiple Regression Models of Parenchymal Ratio of the Brain

Level I - IV	Coef.	Std. Err.	t	P >  t	[95% Conf. Interval]	
Age	- 0.2087	0.0188	- 11.12	0.000	- 0.2462	- 0.1717
Group 2	- 0.3821	0.6012	- 0.64	0.526	- 1.5748	0.8106
Group 3	- 1.1367	1.0226	- 1.11	0.269	- 3.1656	0.8921
Group 4	- 5.8325	0.9054	- 6.44	0.000	- 7.6287	- 4.0362

Coef. = coefficient, Std. Err. = standard error,

Group 2 = dummy variable for mild to moderate social drinkers,

Group 3 = dummy variable for heavy social drinkers,

Group 4 = dummy variables for alcoholics.

가  
(25).  
T1 partial correlation  
가  
T2 Pearson  
가 partial correlation  
(19). T1 workstation  
voxel ( ) Ron (5)  
histogram 가 Nicolas  
(9) 가  
(Fig. 1B)  
(Fig. 1A).  
가 가  
가  
level  
level  
가 (correlation coefficient  $r = -$   
0.704) 가  
MR 4 level  
가  
( $p = 0.001$ ). Cala (16, 17), Kubota (26)  
가 Cala CT 가  
Kubota MR 가  
가 가 가  
가  
Cala , Kubota

1. Harper CG, Blumvergs PC. Brain weights in alcoholics. *J Neurol Neurosurg Psychiatry* 1982;45:838-840
2. Harper C, Kril J. Brain atrophy in chronic alcoholic patients: a quantitative pathological study. *J Neurol Neurosurg Psychiatry* 1985; 48:211-217
3. Karhunen PJ, Erkinjuntti T, Laippala P. Moderate alcohol con-



## Influence of Alcohol on Brain Volume in Social Drinkers: Evaluation with MR-Based Intracranial-Parenchymal Ratio<sup>1</sup>

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**Purpose:** To determine, by measuring the intracranial-parenchymal ratio at MR imaging, whether alcohol induces brain damage in social drinkers.

**Materials and Methods:** One hundred and five male adults aged 20 or over were selected for this study. They included 41 non-drinkers, 43 mild to moderate social drinkers, nine heavy social drinkers and 12 alcoholics. Using a workstation, the intracranial-parenchymal ratio was measured at four levels of T1-weighted MR images: the fourth, third and lateral ventricle, and the level of the centrum semiovale. The mean ratios of all four levels (I - IV) were also calculated. Parenchymal ratios were compared between the four groups, and correlation between the amount of alcohol ingestion and the parenchymal ratio was also determined.

**Results:** The parenchymal ratio at levels I - IV was  $80.31 \pm 3.73\%$  in non-drinkers,  $79.38 \pm 4.39\%$  in mild to moderate social drinkers,  $80.92 \pm 3.64\%$  in heavy social drinkers and  $73.48 \pm 4.42\%$  in alcoholics. The difference between alcoholics and the other three groups was statistically significant, but between non-drinkers and social drinkers was insignificant (ANOVA). Multiple regression analysis with control of the age factor revealed a decreased parenchymal ratio in mild to moderate and heavy social drinkers compared with non-drinkers, but without statistical significance. There was significant negative correlation between parenchymal ratio and amount of alcohol ingestion (Pearson correlation).

**Conclusion:** There was significant brain atrophy in alcoholics, but no significant difference between non-drinkers and social drinkers. We thus conclude that social drinking does not induce significant alcohol-related brain atrophy.

**Index words :** Brain, atrophy  
Magnetic, resonance (MR)  
Alcoholism

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