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Observational Study

Health behaviors of Korean adults with hepatitis B: Findings of the 2016 Korean National Health and Nutrition Examination Survey

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Abstract

AIM

To assess the frequencies of five health-related behaviors (smoking, alcohol consumption, body weight, sleep dura-

tion, and physical activity) in Korean adults with chronic hepatitis B.

METHODS

Data were obtained from the 2016 Korean National Health and Nutrition Examination Survey. In total, 5887 subjects (2568 males, 3319 females) over 19 years old were enrolled in this study. Interviews were performed to obtain information on demographic characteristics and medical conditions. A self-administered questionnaire and medical examination were used to assess the smoking history, alcohol use, physical activity, sleep duration, and body weight of the subjects. Chronic hepatitis B was diagnosed based on detection of hepatitis B surface antigen (HBsAg). The subjects were categorized into HBsAg positive and negative groups, and a complex sampling analysis was conducted to compare the health behaviors between these groups.

RESULTS

Among males, the current smoking rate in the HBsAg positive group was higher than that in the negative group (45.5% *vs* 38.5%). In the positive group, the rates of monthly and high-risk alcohol use were 70.4% and 17.6% in males and 45.9% and 3.8% in females, respectively. The rate of alcohol use was similar between the two groups [$P = 0.455$ (males) and $P = 0.476$ (females)]. In the HBsAg positive group, 32.3% and 49.9% of males and 26.5% and 49.6% of females were overweight and physically inactive, respectively. High-risk alcohol consumption and physical inactivity were significantly associated with self-perceived health status.

CONCLUSION

Our data demonstrate that a large proportion of Korean adults with chronic hepatitis B have poor health behaviors. Further studies are needed to confirm our results.

Key words: Health behavior; Self-perceived health status; Hepatitis; Health risk behavior; Health status

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Core tip: A large proportion of Korean adults with chronic hepatitis B have poor health behaviors, particularly in terms of smoking and alcohol consumption. High-risk alcohol consumption and physical inactivity are significantly associated with self-perceived health status. Because it is a risk factor for hepatocellular carcinoma, individuals with chronic hepatitis B should maintain a healthy lifestyle. They should be encouraged to improve their health behaviors and participate in appropriate education programs.

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INTRODUCTION

Hepatitis B is an important public health issue in the Asia-Pacific region. It is estimated that 240 million people are infected with hepatitis B virus (HBV)^[1]. Chronic HBV infection may cause premature death from uncompensated liver cirrhosis and hepatocellular carcinoma (HCC). Primary liver cancer is the second leading cause of cancer-related mortality^[2]. Chronic HBV infection, cirrhosis, and hepatitis C viral infection are established risk factors for HCC^[2]. The modifiable risk factors for HCC include lifetime alcohol consumption^[3,4], tobacco smoking^[5], obesity^[6], diabetes^[6], nonalcoholic fatty liver disease^[7], and socioeconomic status^[3]. Indeed, lifetime moderate alcohol use may cause HCC in older people, and diabetes may increase the risk of HCC independently of cirrhosis^[8,9].

Health-related behaviors such as tobacco smoking, alcohol consumption, body weight status, sleep duration, and physical activity are important for the management of chronic medical conditions^[10,11]. Smoking, physical activity, and alcohol consumption are the most critical behavioral determinants of health^[12]. Furthermore, health behaviors are important following the onset of disease, because they can reduce disease severity and risk of recurrence and increase survival duration^[12]. Modification of health behaviors is a particularly important intervention for patients with chronic hepatitis B.

High-quality chronic-care systems that include preventive management of health behaviors are needed to improve the quality of life of patients with chronic conditions^[13]. Subjective awareness of health status can be used to evaluate one's own health and the prognosis of various chronic diseases^[14]. To our knowledge, little is known about the relationships between health behaviors and subjective health status.

In this study, we evaluated the frequencies of five health-related behaviors (smoking, alcohol consumption, body weight, sleep duration, and physical activity) in Korean adults with hepatitis B. We also examined the association between these health behaviors and self-perceived health status.

MATERIALS AND METHODS

Data resources

Data were obtained from the 2016 Korean National Health and Nutrition Examination Survey (KNHANES). The KNHANES is a nationwide representative cross-sectional survey conducted by the Korea Center for Disease Control and Prevention (KCDC) beginning in 1998. The KNHANES is an ongoing survey that assesses the health status of Koreans and monitors the trends in health risk factors and the prevalence of major chronic diseases in Korea^[15]. The KNHANES comprises a

Table 1 Demographic and clinical characteristics of the participants in the 2016 Korean National Health and Nutrition Examination Survey (*n* = 5887)

Variable	Sample size	Mean/proportion	95%CI
Demographics			
Age (yr)	5887	46.7	46.0-47.5
Male (%)	2568	50.3	49.1-50.5
Low income level (%)	1129	16.2	13.7-18.4
Presence of spouse (%)	4970	77.3	75.4-79.1
Education \geq 10 yr (%)	3839	75.8	71.3-80.3
Current medical history			
Hypertension	1387	18.9	17.6-20.4
Diabetes mellitus	575	7.8	7.0-8.7
Dyslipidemia	799	11.3	10.3-12.4
Depression	166	2.6	2.1-3.1
Liver cirrhosis	12	0.2	0.1-0.3
Hepatitis B	192	3.4	2.9-4.0
Anthropometric measurements			
BMI (kg/m^2)		24.0	23.9-24.1
Abdominal circumference (cm)		82.9	82.4-83.3
Systolic BP (mm Hg)		117.9	117.3-118.5
AST (IU/L)		22.7	22.2-23.2
ALT (IU/L)		22.7	22.2-23.3
Fasting plasma glucose (mg/dL)		100.4	99.6-101.3
HbA1c (%)		5.6	5.6-5.7
Total cholesterol (mg/dL)		193.1	191.9-194.4
Triglycerides (mg/dL)		144.8	139.3-150.4
LDL-cholesterol (mg/dL)		117.4	114.9-119.8
hs-CRP (mg/L)		1.23	1.17-1.29

BMI: Body mass index; BP: Blood pressure; AST: Aspartate transferase; ALT: Alanine transferase; HbA1c: Hemoglobin A1c; LDL: Low-density lipoprotein; hs-CRP: High-sensitivity C reactive protein.

complex, stratified, multistage sample in which household units are selected according to geographic area, sex, and age group. Informed consent was obtained from all of the subjects. The 2016 KNHANES response rate was 72.2% for the interview and health examination. This study involved 5887 subjects (2568 males, 3319 females) over 19 years of age.

Measures

The interview and health examinations were performed by a trained interviewer and medical staff using calibrated equipment according to a standardized protocol. The interviewer collected demographic characteristics including housing characteristics, medical conditions, socioeconomic status, and education levels. The self-administered questionnaire included questions on smoking status, alcohol use, physical activity, sleep health, and weight control. The health examination was conducted in a mobile examination center and consisted of a physical examination, anthropometric measurements, and blood and urine laboratory tests. Height and weight were measured to the nearest 0.1 cm and 0.1 kg, respectively, using a standard protocol. Body mass index (BMI) was calculated as body weight (kg) divided by height in meters squared (m^2). Waist circumference was measured at the end of a normal expiration of breath and to the nearest 0.1 cm. Blood pressure was measured using an automated blood pressure measurement device. Blood

and urine samples were subsequently analyzed at a certified laboratory. The performance of this laboratory analysis was monitored by a laboratory data quality-control program to ensure that the data met the accuracy standard^[15]. Hepatitis B surface antigen (HBsAg) levels were measured using Elecsys HBsAg II (Roche/Germany) electrochemiluminescence immunoassay (ELICA). Subjects were classified as HBsAg positive or negative (hereafter, the negative and positive groups) according to their serology results.

Definitions of health behaviors

Current cigarette smoking was defined as smoking at least 100 cigarettes over a lifetime and currently smoking cigarettes everyday (daily) or on some days (nondaily)^[16]. No alcohol consumption was defined as lifetime abstention and consumption of < 1 drink per month for the past year. Monthly alcohol use was defined as consumption of \geq 1 alcoholic drink per month for the past year. High-risk alcohol use was defined as consumption of \geq 7 (males) or \geq 5 (females) alcoholic drinks more than twice a week^[17]. Body weight was classified as underweight (BMI < 18.5 kg/m^2), normal weight (BMI: 18.5-25.0 kg/m^2), or overweight (BMI > 25.0 kg/m^2)^[18]. Adequate sleep was defined as self-reported \geq 7 h per night of sleep^[19]. Sufficient physical activity was defined as performance of moderate-to-vigorous physical activity (MVPA) for \geq 150 min per week^[20].

Self-perceived health status

The subjective health status of the subjects was evaluated using a Likert-scale-based questionnaire. The question "How is your health in general?" was used to assess self-perceived health status, and the possible responses ranged from 1 (very good) to 5 (very poor).

Statistical analysis

Data were subjected to a weighted complex sampling analysis. Demographic and clinical characteristics are shown as numbers, means, and 95% confidence intervals (95%CI). A chi-squared test was performed for comparisons of health behaviors between the two groups. A *t*-test using a general linear model was used to compare self-perceived health status between the two groups. A multivariate linear regression analysis was performed to examine the associations between the health behaviors and self-perceived health status. A value of $P < 0.05$ was considered indicative of statistical significance. Statistical analyses were performed using IBM® SPSS® Statistics, version 23.0, for Windows™.

RESULTS

Demographic and clinical characteristics of the subjects

This study involved 5887 subjects, of whom 2568 (50.3%) were males and 3319 (49.7%) were females. Table 1 shows the demographic and clinical characteristics of the subjects. The mean age of the subjects was 46.7

Table 2 Health behaviors and self-perceived health status in Korean adult males according to hepatitis B surface antigen status (*n* = 2568)

Variable	Total (<i>n</i> = 2568)	HBsAg negative (<i>n</i> = 2481)	HBsAg positive (<i>n</i> = 87)	<i>P</i> value ¹
	Mean ± SE	Mean ± SE	Mean ± SE	
Health behavior				
Current cigarette smoker	38.6 ± 1.3	38.5 ± 1.3	41.5 ± 5.7	0.591
Alcohol use				0.455
Non-drinker	25.2 ± 1.1	25.1 ± 1.1	29.6 ± 5.9	
Monthly	74.8 ± 1.1	74.9 ± 1.1	70.4 ± 5.9	
High risk	21.1 ± 1.0	21.3 ± 1.0	17.6 ± 4.5	
Body weight status				0.071
Underweight	2.6 ± 0.4	2.7 ± 0.4	0.8 ± 0.8	
Normal	55.5 ± 1.2	55.5 ± 1.2	66.9 ± 5.4	
Overweight	41.9 ± 1.3	42.2 ± 1.3	32.3 ± 5.4	
Sleep duration				0.962
Short	37.9 ± 1.2	37.9 ± 1.2	37.6 ± 5.9	
Adequate	62.1 ± 1.2	62.1 ± 1.2	62.4 ± 5.9	
MVPA				0.840
Inactive	48.6 ± 1.4	48.6 ± 1.4	49.9 ± 6.4	
Sufficiently active	51.4 ± 1.4	51.4 ± 1.4	50.1 ± 6.4	
Self-perceived health status (range 1-5)	3.12 ± 0.04	3.13 ± 0.04	2.97 ± 0.10	0.146

¹Chi-squared test, except for self-perceived health status (general linear model by complex sampling analysis). Current cigarette smoker: Smoked at least 100 cigarettes in their lifetime and currently smoked cigarettes every day (daily) or on some days (nondaily). Monthly alcohol use: Consumption of more than 1 drink per month in the past year. Non-drinker: Lifetime abstainer and subjects who drank less than 1 drink per month in the past year. High-risk alcohol use: Consumption of at least 7 (males) or 5 (females) alcoholic drinks more than two times per week. Adequate sleep: ≥ 7 h per night of self-reported sleep. MVPA: Sufficiently active was defined as ≥ 150 min/wk of moderate-to-vigorous physical activity. HBsAg: Hepatitis B surface antigen.

years (95%CI: 46.0-47.5 years), and 3839 (75.8%) had ≥ 10 years of education. The chronic medical conditions were hypertension (*n* = 1387; 18.9%, 95%CI: 17.6%-20.4%), diabetes (*n* = 575; 7.8% 95%CI: 7.0%-8.7%), dyslipidemia (*n* = 799; 11.3%, 95%CI: 10.3%-12.4%), depression (*n* = 166; 2.6%, 95%CI: 2.1%-3.1%), liver cirrhosis (*n* = 12; 0.2%, 95%CI: 0.1%-0.3%), and hepatitis B (*n* = 192; 3.4%, 95%CI: 2.9%-4.0%), respectively. The mean BMI and abdominal circumference of the subjects were 24.0 (95%CI: 23.9-24.1) kg/m² and 82.9 (95%CI: 82.4-83.3) cm, respectively. The fasting plasma glucose and hemoglobin A1c (HbA1c) levels were 100.4 (95%CI: 99.6-101.3) mg/dL and 5.6% (95%CI: 5.6%-5.7%), respectively. The total cholesterol and low-density lipoprotein (LDL)-cholesterol levels of the subjects were 193.1 (95%CI: 191.9-194.4) and 117.4 (95%CI: 114.9-119.8) mg/dL, respectively. The mean high-sensitivity C-reactive protein (hs-CRP) level was 1.23 (95%CI: 1.17-1.29) mg/L.

Health behaviors and self-perceived health status

The health behaviors and self-perceived health status of the subjects are shown in Tables 2 and 3. The current cigarette smoking rate in males was non-significantly higher in the positive group than the negative group (41.5% vs 38.5%; *P* = 0.591). In the positive group, the rates of monthly and high-risk alcohol use were 70.4% and 17.6% in males and 45.9% and 3.8% in females, respectively [*P* = 0.455 (males) and *P* = 0.476 (females)]. More males had a normal body weight in the positive group than the negative group (*P* = 0.071). More females reported an adequate sleep duration in the

negative group than the positive group (*P* = 0.452). The rate of sufficient physical activity was similar between the positive and negative groups among males but higher in the positive group than the negative group among females (*P* = 0.288). The self-perceived health status was similar between the positive and negative groups among males and females.

Associations between health behaviors and self-perceived health status

High-risk alcohol consumption (β = -0.605, *P* = 0.020) and physical inactivity (β = 0.348, *P* = 0.013) were significantly associated with self-perceived health status in the positive group (Table 4). Current smoking (*P* = 0.078), body weight (*P* = 0.410), and inadequate sleep (*P* = 0.315) were not associated with self-perceived health status. LDL-cholesterol (*P* = 0.017) and hs-CRP (*P* = 0.001) levels were significantly associated with self-perceived health status after adjusting for age, systolic blood pressure, waist circumference, and HbA1c level.

DISCUSSION

In the present study, the rates of five health-related behaviors did not differ according to HBsAg positivity. Among males, current smoking rates were higher in the positive group, but there were no significant differences in alcohol use, body weight status, sleep duration, or physical activity between the two groups. In the positive group, the rates of high-risk alcohol use were 17.6% in males and 3.8% in females. High-risk alcohol consumption and physical inactivity were significantly

Table 3 Health behaviors and self-perceived health status in Korean adult females according to hepatitis B surface antigen status (*n* = 3319)

Variable	Total (<i>n</i> = 3319)	HBsAg negative (<i>n</i> = 3214)	HBsAg positive (<i>n</i> = 105)	<i>P</i> value ¹
	Mean ± SE	Mean ± SE	Mean ± SE	
Health behavior				
Current cigarette smoker	6.1 ± 0.6	6.2 ± 0.6	3.2 ± 1.9	0.260
Alcohol use				0.476
Non-drinker	54.9 ± 1.1	54.9 ± 1.1	54.1 ± 5.3	
Monthly	45.1 ± 1.1	45.1 ± 1.1	45.9 ± 5.3	
High risk	5.3 ± 0.5	5.3 ± 0.5	3.8 ± 1.8	
Body weight status				0.858
Underweight	5.6 ± 0.6	5.6 ± 0.6	5.5 ± 3.2	
Normal	65.1 ± 1.0	65.0 ± 1.0	68.0 ± 5.0	
Obese	29.3 ± 1.0	29.4 ± 1.1	26.5 ± 4.8	
Sleep duration				0.452
Short	38.1 ± 1.0	37.9 ± 1.2	37.6 ± 5.9	
Adequate	61.9 ± 1.0	62.0 ± 1.0	58.0 ± 5.3	
MVPA				0.288
Inactive	55.8 ± 1.2	56.0 ± 1.2	49.6 ± 6.0	
Sufficiently active	44.2 ± 1.2	44.0 ± 1.2	50.4 ± 6.0	
Self-perceived health status (range 1-5)	3.15 ± 0.04	3.15 ± 0.04	3.15 ± 0.14	0.992

¹Chi-squared test (except for self-perceived health status: General linear model by complex sampling analysis). Current cigarette smoker: smoked at least 100 cigarettes in their lifetime and currently smoked cigarettes every day (daily) or on some days (nondaily). Monthly alcohol use: Consumption of > 1 drink per month in the past year. Non-drinker: lifetime abstainer and < 1 drink per month in the past year. High-risk alcohol use: Consumption of ≥ 7 (males) or ≥ 5 (females) alcoholic drinks more than twice a week. Adequate sleep: ≥ 7 h per night of self-reported sleep. MVPA: Sufficiently active was defined as ≥ 150 min/wk of moderate-to-vigorous physical activity. HBsAg: Hepatitis B surface antigen.

Table 4 Associations between health behaviors and self-perceived health status among Hepatitis B surface antigen positive adults in the 2016 Korean National Health and Nutrition Examination Survey

Variable	Self-perceived health status		<i>P</i> value ¹
	β	95%CI	
Health behavior			
Current cigarette smoker	0.569	-0.077, 1.215	0.078
Overweight	0.244	-0.388, 0.875	0.410
Sleeps less than 7 h	-0.281	-0.873, 0.311	0.315
High-risk alcohol use	-0.605	-1.092, -0.118	0.020
Physically inactive	0.348	0.089, 0.608	0.013
Covariates			
Age (yr)	0.003	-0.018, 0.024	0.778
SBP	0.015	-0.017, 0.047	0.331
WC	0.005	-0.067, 0.076	0.890
HbA1c	-0.279	-1.000, 0.442	0.409
LDL	0.012	0.003, 0.021	0.017
hs-CRP	-0.097	-0.144, -0.050	0.001

¹Multivariate linear regression analysis. CI: Confidence interval; SBP: Systolic blood pressure; WC: Waist circumference; HbA1c: Hemoglobin A1c; LDL: Low-density lipoprotein; hs-CRP: High-sensitivity C-reactive protein.

associated with self-perceived health status in the positive group. These results may imply that a large proportion of hepatitis B patients have poor health behaviors, particularly related to smoking and alcohol consumption. Alcohol consumption and tobacco smoking are modifiable risk factors for HCC. Also, because chronic hepatitis B is an established risk factor for HCC, modification of health behaviors is a particularly important intervention for patients with chronic hepatitis B.

In males, the current smoking rate in the positive group was 41.5%, which is higher than the 23% rate in Organization for Economic Co-operation and Development (OECD) member countries^[21]. In most OECD countries, the rate of daily smoking has been reduced by various measures, including stringent policies to reduce smoking and increased taxes on tobacco^[21,22]. The World Health Organization estimates that smoking kills 7 million people worldwide annually, and it is the leading cause of death, illness, and impoverishment^[21,23]. Nevertheless, over 60% of smokers do not quit after being diagnosed with a chronic illness for which smoking is an important prognostic factor^[24]. Current smokers are at an increased risk of HCC^[5]. Furthermore, there is a causal association between smoking and primary liver cancer, according to the International Agency for Research on Cancer^[25]. Therefore, healthcare providers should pay more attention to the smoking habits of patients with hepatitis B. Tobacco smoking may increase the risk of HCC in several ways. First, numerous compounds in tobacco are metabolized to carcinogens in the liver. Second, tobacco smoking and chronic hepatitis B exert a synergistic effect on the risk of HCC^[26]. In addition, levels of polycyclic aromatic hydrocarbons in HCC tissue are increased^[27,28].

In this study, the rates of monthly and high-risk alcohol use among males were 70.4% and 17.6%, respectively, in the positive group. Heavy alcohol consumption is reportedly associated with HCC risk, although the threshold quantity/frequency is unknown^[29,30]. Moreover, heavy alcohol consumption is associated with an 87% increase in the risk of HCC compared to that of non-drinkers^[5]. Alcohol may contribute to hepatic

carcinogenesis *via* acetaldehyde metabolism. Acetaldehyde, the product of ethanol oxidation, may interfere with DNA synthesis and repair and increase the level of reactive oxygen species^[31]. Therefore, strict abstinence should be recommended for most patients with chronic hepatitis B^[29]. In addition, high-risk alcohol consumption was significantly associated with self-perceived health status in the positive group. Thus, high-risk alcohol drinkers may have a better perception of their subjective health, as reported previously^[32]. Alternatively, there may be a discrepancy between the actual and perceived quantity and frequency of alcohol consumption. Further studies should investigate the relationships of these discrepancies with alcohol consumption behaviors and sex differences. Our findings imply that a meaningful proportion of patients with chronic hepatitis B consume high-risk amounts of alcohol.

HCC is being increasingly diagnosed in obese and physically inactive individuals. The development of obesity-associated HCC involves chronic inflammation induced by adipose tissue remodeling and pro-inflammatory adipokine secretion, lipotoxicity, alterations in the gut microbiota, and insulin resistance^[33]. In this study, the rate of a normal body weight was high among males in the positive group. However, 32.3% of males and 26.5% of females in the positive group were obese. Physical inactivity is also associated with self-perceived health status. Obesity in patients with chronic liver disease may accelerate the development of HCC; therefore, strategies to control body weight in such patients may reduce the incidence of HCC^[32].

Strengths and weaknesses of the study

The first strength of this study was its representative population, which increases the validity of our findings compared with those from hospital- or institution-based populations. Second, our findings may be helpful in the management of patients with chronic hepatitis B, because few studies have described the health habits of chronic hepatitis B patients. However, this study also had several limitations. Its cross-sectional nature prevented determination of causal relationships. In addition, our results cannot be generalized to other ethnic groups, because all of the subjects in this study were ethnic Koreans. Finally, we diagnosed hepatitis B based on the HBsAg level only, and thus repeat HBsAg testing and determination of plasma HBV DNA levels are needed to confirm the HBV infection status of the subjects.

Conclusions

In conclusion, a large percentage of Korean adults with chronic hepatitis B have poor health behaviors, particularly regarding smoking and alcohol consumption. These individuals must be encouraged to improve their health behaviors and to participate in appropriate education programs. Our findings will facilitate the development of alternative strategies to prevent HCC in patients with chronic hepatitis B.

ARTICLE HIGHLIGHTS

Research background

Chronic viral hepatitis B (CHB) is popular chronic condition in Asia-Pacific region. CHB is established risk factor of primary liver cancer that is second leading cause of cancer-related death. Health-related behaviors like as smoking, alcohol, body weight and physical activity are critical determinants of chronic illness. Most hepatitis B patients perceive that they are healthy because of asymptomatic and nonspecific nature of CHB. Such misunderstanding may cause inappropriate health behavior.

Research motivation

For the prevention of liver cancer, it seems important to manage these modifiable health behaviors. But few studies have described the health-related behaviors of chronic hepatitis B patients.

Research objectives

Our study evaluated the frequencies of five health-related behaviors (smoking, alcohol consumption, body weight, sleep duration, and physical activity) in Korean adults with CHB and association between these health behaviors and subjective health status.

Research methods

Data were obtained from 5887 subjects (2568 males, 3319 females) over 19 years old enrolled in the 2016 Korean National Health and Nutrition Examination Survey. A self-administered questionnaire and medical examination were performed to assess health-related behaviors. A chi-squared test was performed for comparisons of health behaviors between the CHB and negative groups. A *t*-test using a general linear model was used to compare self-perceived health status between the two groups.

Research results

Among males, the current smoking rate in the HBsAg positive group was higher than that in the negative group (45.5% vs 38.5%). In the positive group, the rates of monthly and high-risk alcohol use were 70.4% and 17.6% in males and 45.9% and 3.8% in females, respectively. The rate of alcohol use was similar between the two groups. In the HBsAg positive group, 32.3% and 49.9% of males and 26.5% and 49.6% of females were overweight and physically inactive, respectively. High-risk alcohol consumption and physical inactivity were significantly associated with self-perceived health status.

Research conclusions

Our study revealed that a large-percentage of Korean adults with chronic hepatitis B have poor health behaviors, particularly regarding tobacco smoking and alcohol consumption. These individuals must be encouraged to improve their health behaviors and to participate in appropriate education programs.

Research perspectives

These findings will facilitate the development of alternative strategies to prevent liver cancer in patients with chronic hepatitis B. Future prospective study is required to confirm our findings.

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