Prevalence of Cardiovascular Disease Risk Factors with Stratification of Ten-Year Total Cardiovascular Risk Among the Working Adults in Brunei Darussalam.

SSL CHIEW [1] NAA TUAH, [1, 2, 3]; ASC LAI, [1, 4], A YAZDI [3], A MAJEED [3], Z WINT [1]
[1] PAPRSB Institute of Health Sciences and [2] Centre for Advanced Research, Universiti Brunei Darussalam, Brunei Darussalam, [3] Department of Primary Care and Public Health, School of Public Health, Imperial College London, United Kingdom, and [4] Occupational Health Division, Ministry of Health, Brunei Darussalam.

ABSTRACT

Background: Globally, cardiovascular diseases (CVD) are rising and Brunei Darussalam is no exception to the trend. However, information regarding CVD risk factors and cardiovascular risk assessment are limited particularly among the working adults. Therefore, this study aimed to estimate the prevalence of CVD risk factors with stratification of 10-year total cardiovascular risk among the working adults in Brunei Darussalam. **Methods**: This retrospective, cross-sectional analysis included data from a randomly selected sample of 1375 subjects aged 40-60 years from the Occupational Health Division, Ministry of Health Brunei Darussalam between 2010-2014. Prevalence of modifiable cardiovascular risk factors was determined and the ten-year cardiovascular risk of the subjects was calculated using the WHO/ISH risk prediction charts. **Results:** The prevalence of hypertension, hypercholesterolemia, obesity, smoking and diabetes was 49%, 36%, 26%, 21% and 18% respectively. Multiple logistic regression analysis showed three models were statistically significant: age with smoking and hypercholesterolemia (p=0.002 and p=0.038); gender with smoking, hypercholesterolemia and obesity (p=0.046, p<0.001 and p=0.013); and Malay ethnicity with smoking, hypercholesterolemia and obesity (p<0.001, p=0.005 and p<0.001). After adjusting for age and gender, males were 3.37 times more likely to smoke and 1.62 times more likely to have hypercholesterolemia, while females were 2.85 times more likely to be obese. The WHO/ISH risk prediction charts identified two percent of the study population as having moderate and high risks of developing CVD events in ten years. **Conclusion:**. This study indicated high prevalence of modifiable CVD risk factors particularly hypercholesterolemia and obesity among this working population which suggests routine screening with implementation of healthy lifestyle modification programmes are warranted.

Keywords: **Cardiovascular disease risk factors, Hypertension, Smoking, Obesity, Hypercholesterolemia, Diabetes, Cardiovascular risk assessment**

INTRODUCTION

Cardiovascular disease (CVD) is the global leading cause of mortality and it is projected to increase from 17.5 million to 24 million deaths by 2030.[1] Over 80% of CVD mortality occurred in developing countries, where premature deaths from heart attack and stroke were higher among those under the age of 60 years compared to the developed

Correspondence: Sally SL Chiew, BHSc MPH, PAPRSB Institute of Health Sciences, Universiti Brunei Darussalam, Jalan Tungku Link, Gadong BE1410, Brunei Darussalam. Tel: +673 8127803. Email: sallychong7803@gmail.com

countries (58% vs 20%). [2] The burden of CVD is largely caused by increasing prevalence of cardiovascular risk factors including tobacco use, hypertension, hypercholesterolemia, and diabetes.[3] The risk of CVD such as heart disease and stroke can be reduced through two approaches: the single risk factor approach in managing single risk factors i.e. hypertension, hypercholesterolemia, or the total cardiovascular risk approach.[3] The latter approach is more cost effective in low-resource settings as it estimates the individual's probability of having fatal or non-fatal cardiovascular events (heart attack and stroke) in a given period, by taking into account the presence of several predicting risk factors rather than single risk factors. [3-5]

There are several tools developed to assess the individuals' total cardiovascular risk but they were mainly derived from the Framingham study based on western population, which might not be applicable to others.[5] The World Health Organization (WHO) and International Society of Hypertension (ISH) have jointly developed the WHO/ISH risk prediction charts using data collected from the different regions of WHO sub-regions and thus, they are more appropriate in settings where refined risk prediction charts do not exist. [5,6] The WHO/ISH risk charts were initially intended for clinicians to estimate the individuals' 10-year total cardiovascular risk in low-resource settings but they are also useful for estimating and monitoring the distribution of cardiovascular risk from cross-sectional study samples. [3,7]

Similarly, Brunei Darussalam is also burdened with high CVD related mortality. Heart disease, cerebrovascular disease and hypertensive diseases are the top causes of deaths in 2015 and they accounted for 32.1% of total deaths in the country.[8] The rise in the prevalence of non-communicable disease risk factors among the adult population in Brunei Darussalam is alarming. [9] Among the workforce in Brunei Darussalam, the civil servants were reported to suffer from high blood pressure (38%), obesity (28%), high fasting blood cholesterol level (25%) and high fasting blood glucose (11%). [10] This has significant public health implications as the burden of CVD may affect the economically productive workforce in the future. Despite these concerns, information regarding CVD risk factors among the working adults in Brunei Darussalam is very limited and their 10-year total cardiovascular risk has not been previously studied. Therefore, this study aimed to estimate the prevalence of modifiable CVD risk factors with stratification of 10-year cardiovascular risk among the working adults in Brunei Darussalam.

METHODS

Study population and setting

The study design was cross sectional using data collected retrospectively at the Occupational Health Division (OHD), Ministry of Health Brunei Darussalam. The subjects were employees from both government and private organizations who had attended medical fitness assessment at OHD from 2010 to 2014. Study inclusion criteria were working adults aged 40–60 years. Those with recorded past medical history of cardiovascular diseases were excluded from the study.

Sample size and sampling technique

As a priori, based on a study power of 80%, the sample size required for the study was 1274 at 95% Confidence Interval (CI) and a precision of 0.025 using the sample size calculator for prevalence studies by Naing et al. [11] Including an anticipated 30% exclusion rate, the total sample size required for the study was 1819. As shown in Figure 1, 1819 subjects were randomly selected from within the sample frame of 2999 working adults registered at OHD. After excluding subjects with history of CVD (n=21) and missing data (n=423), a final sample of 1375 was used for

analysis, which was within the study required sample size of 1274. Based on the final sample (n=1375), the study achieved a statistical power of 84% with a precision of 0.05.[12]

Ethics consideration

Permission to conduct the study was given by the Medical Superintendent of Public Health and Head of OHD. Ethical approval for the study was obtained from the Medical and Health Research and Ethics Committee, Ministry of Health Brunei Darussalam and the Institute of Health Sciences Research and Ethics Committee (MHREC and IHSREC Ethics Approval Reference: UBD/HIS/B3/8). To maintain confidentiality of all subjects, no identifiable data such as name or national identification numbers were collected.

Data collection

Subjects' medical history and medical fitness assessment were conducted by medical doctors and nurses at OHD and recorded in OHD patients' database. For anthropometric assessment, a stadiometer (model 'Meter O Health') was used to measure weight and height in kilograms (kg) and centimeters (cm) respectively. Body mass index (BMI) was calculated according to the formula: weight in kg /height in meter^2. Blood pressure assessment was conducted manually using a sphygmomanometer with a stethoscope; the systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured in mmHg. Blood samples such as fasting blood glucose (FBG) and full lipid profile (total cholesterol, triglyceride, HDL and LDL-cholesterol levels) were taken according to the Ministry of Health (MOH) standard operating procedure. The blood results were subsequently analyzed and reported by the MOH scientific laboratory with ISO accreditation. All data were later extracted from OHD patients' database and entered into the study electronic data entry form created using Microsoft Access version 2016 (Microsoft Office Access 2016, USA), which was tested for reliability and reproducibility by two investigators (SC and AO) who performed the data entry during pilot testing. The inter-rater agreement was Kappa 0.68 indicating fair to good agreement according to Fleiss. [3]

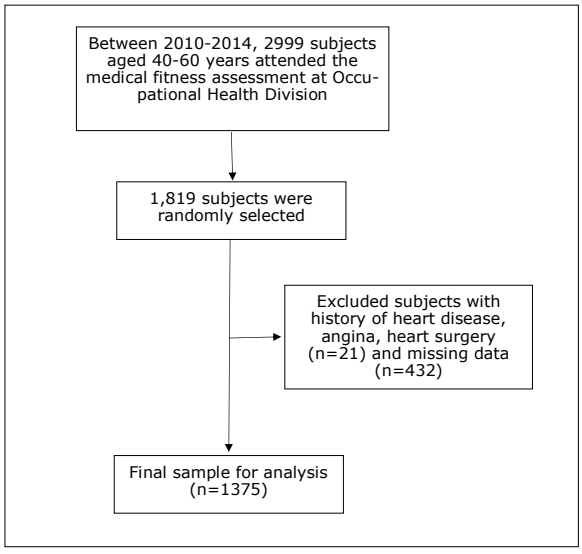

Figure 1: The sampling technique of the study.

Variables collected for the study were: socio-demographic variables (age; gender; ethnicity; organizations), medical history (smoking status; history of hypertension and diabetes; the use of anti-hypertensive, diabetes/insulin and cholesterol lowering medications), physical measurement variables (height; weight; BMI; SBP and DBP) and biochemistry measurement variables (FBG level in mmol/l; total cholesterol level in mmol/l; triglyceride level in mmol/l; HDL-cholesterol level in mmol/l and LDL-cholesterol level in mmol/l).

WHO/ISH risk prediction chart

The current study utilized the WHO/ISH risk prediction chart for Western Pacific Region A (WPRA) to estimate the total 10-year CVD risk (defined as the risk of suffering fatal or non-fatal CVD events such as myocardial infarction or stroke in the next 10 years). It is the only prescribed algorithm for CVD risk assessment in Brunei Darussalam and other countries like Australia, Japan, New Zealand and Singapore.[14] According to Brunei Darussalam Multisectoral action plan for the prevention and

control of non-communicable disease (BruMap-NCD) 2013-2018 (Annex 3, page 76), WHO/ISH risk chart was also advocated as a tool for assessing CVD risk of the individuals.[9] In this study, the chart for settings with blood cholesterol was used and it is designed for people above 40 years, the subjects included were aged 40 years to 60 years (the official retirement age). The variables for CVD risk prediction were gender, age, systolic blood pressure (SBP), presence or absence of diabetes, total cholesterol level (mmol/l) and smoking status. The WHO/ISH risk chart categorizes individuals into different risk levels: <10%, 10%-<20%, 20-<30%, 30-<40% and >40%. [14]

Definitions of variables

For assessment of the prevalence of CVD risk factors, smoking was defined as the use of any smoke form of tobacco product (cigarettes, cigars or pipe tobacco) in the last one year.[14] Hypertension was defined as systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg, or taking antihypertensive medications.[15] Hypercholesterolemia was defined as total cholesterol level ≥6.2 mmol/l (240 mg/dl) or taking cholesterol-lowering medications.[16] Diabetes was defined as FBG level ≥7mmol or taking insulin or hypoglycemic medications.[14] Subjects with BMI ≥30 kg/m2 were classified as obesity.[17] The 10-year total cardiovascular risks were stratified into low risk (WHO/ISH risk:<10%), moderate risk (WHO/ISH risk:10-20%) and high risk (WHO/ISH risk: >20%).[7]

Statistical analysis

Continuous data were presented as mean (standard deviation (SD)) and categorical data as number and percentage. Data analysis was performed using IBM SPSS Statistics 21.0 software (SPSS Inc., IBM, USA). In simple logistic regression (SLR), odds ratio (OR) and 95% confidence interval (CI) were used and results were considered significant at p value of <0.05. Multiple logistic regression (MLR) analysis was subsequently applied to determine CVD risk factors after adjusting for confounders (adjusted OR and 95% CI). The proportions of total cardiovascular risk among subjects were reported as number and percentage after the application of WHO/ISH risk charts.

RESULTS

The mean age of the study sample was 48.0 (5.55) years of which 76.1% were male and 23.9% were female (Table 1). The majority of the subjects were employees from the government sector (81.8%) and of Malay ethnicity (79.6%). The mean body mass index (BMI) was 27.6 (4.40) kg/m². The systolic and diastolic blood pressure mean was 126.8 (15.15) and 81.9 (9.37) respectively. Mean fasting total cholesterol (TC) and LDL-cholesterol were 5.3 (1.07) mmol/L and 3.37 (0.95) mmol/L respectively.

In Table 2, among the modifiable CVD risk factors studied, the prevalence of hypertension was 49% (95% CI: 46%, 52%) and followed by hypercholesterolemia 36% (95% CI: 33, 38), obesity 26% (95% CI: 24%, 29%), smoking 21% (95% CI: 18%, 23%) and diabetes mellitus 18% (95% CI: 16%, 20%). In comparison to female, males had a higher prevalence in smoking, hypertension and hypercholesterolemia (27% vs 4%; 49% vs 47%; 37% vs 31%) except for obesity and diabetes mellitus (24% vs 35%; 17% vs 19%) which is higher in females.

The associations between socio-demographic characteristics and smoking, hypercholesterolemia and obesity are shown in Table 3. The results of SLR showed significant associations in smoking and hypercholesterolemia according to age (p<0.001 and p<0.001 respectively), gender (p<0.001 and p=0.045 respectively) and ethnicity (p<0.001 and p=0.017 respectively). In obesity, the associations were only significant according to

Table 1: The general characteristics of the study sample (n=1375)

Variables	n (%)	Mean (SD)
Social Demographics		
Age (Yrs)		48.0 (5.55)
Gender		
Male	1046 (76.1)	
Female	329 (23.9)	
Ethnicity		
Malays	1094 (79.6)	
Indians	73 (5.3)	
Chinese	39 (2.8)	
Others	169 (12.3)	
Organisations		
Government	1125 (81.8)	
Private	250 (18.2)	
Medical History		
History of smoking	283 (21.0)	
Use of antihypertensive medications	395 (28.7)	
Use of Diabetic medicatons	178 (12.9)	
Use of Cholesterol medications	315 (22.9)	
Physical Measurements		
Height (cm)		161.5 (7.74)
Weight (Kg)		72.3 (12.71)
BMI (Kg/m^2)		27.6 (4.37)
SBP (mmHg)		126.8 (15.15)
DBP (mmHg)		81.9 (9.37)
Biochemistry Measurements		
FBG (mmol/L)		5.7 (2.19)
TC (mmol/L)		5.3 (1.07)
TG (mmol/L)		1.54 (1.02)
HDL-C (mmol/L)		1.32 (3.94)
LDL-C (mmol/L)		3.37 (0.95)

SD=Standard deviation, Yrs=Years, BMI=body mass index, SBP=Systolic blood pressure, DBP=Diastolic blood pressure, FBG=fasting blood glucose, TC=total cholesterol, TG=triglyceride, HDL-C=HDL-cholesterol, LDL-C=LDL-cholesterol.

gender and ethnicity (p<0.001 and p=0.002). MLR analysis showed three models were statistically significant: age with smoking and hypercholesterolemia (p=0.002 and p=0.038 respectively); gender with smoking, hypercholesterolemia and obesity (p=0.046, p<0.001 and p=0.013 respectively); and Malay ethnicity with smoking, hypercholesterolemia and obesity (p<0.001, p=0.005 and p<0.001 respectively). After adjusting for age and gender, males were 3.37 times more likely to smoke (adjusted OR 3.37, 95% CI 1.31, 8.70) and 1.62 times more likely to have hypercholesterolemia (adjusted OR 1.62, 95% CI 1.13, 2.31) where as females were 2.85 times more likely to be obese compared to males (adjusted OR 2.85, 95% CI 1.81, 4.49).

Applying the WHO/ISH risk charts, 98% of the subjects were stratified into low-risk group (<10%), 1.5% were in moderate-risk group (10%-<20%) and 0.5% in high-risk group (>20%) respectively.

DISCUSSION

The findings showed that modifiable CVD risk factors were prevalent among the study population, more specifically smoking, hypercholesterolemia and obesity after adjusting for confounders.

It is well recognized that tobacco smoking increases the risk of CVD mortality and other chronic diseases such as chronic obstructive pulmonary disease and cancer.[18] In our study, the overall prevalence of smok-

Table 2: Prevalence of cardiovascular risk factors of the study sample.

Variables	Male (n=1046)		Female (n=3290		All (n=1375)	
	n (%)	95% CI	n (%)	95% CI	n (%)	95% CI
Smoking	279 (27)	24, 29	4 (1.0)	0.0, 2.0	283 (21)	18, 23
Obesity	249 (24)	21, 26	114 (35)	29, 40	363 (26)	24, 29
Hypertension	517 (49)	46, 52	155 (47)	42, 53	672 (49)	46, 52
Diabetes Mellitus	181 (17)	15, 20	62 (19)	15, 23	243 (18)	16, 20
Hypercholesteraemia	388 (37)	34, 40	102 (31)	26, 36	490 (36)	33, 38

Smoking was defined as the use of any smoke form of tobacco product (cigarettes, cigars or pipe tobacco) in the last one year; Obesity was defined as BMI ≥30kg/m^2; Hypertension was defined as use of antihypertensive medications or SBP ≥140mmHg or DBP ≥90mmHg; Diabetes mellitus was defined as use of diabetic medications or fasting blood glucose ≥7mmols/l; Hypercholesterolemia was defined as use of lipid lowering medications or Total Cholesterol ≥6.2mmol/l.

Table 3: The association between socio-demographic characteristics, smoking, hypercholesterolemia & obesity in Crude OR & Adjusted OR.

SMOKING			**SLR**			**MLR**	
Variables		**Crude OR (95% CI)**	***p* Value**	**SE**	**Adj OR (95% CI)**	***p* Value**	**SE**
Age (yrs)	40-50	2.44 (1.78, 3.35)	<0.001	0.161	0.19 (0.04, 0.97)	0.046	0.847
	51-60	1.00			1.00		
Gender	Male	16.25 (7.59, 34.79)	<0.001	0.388	3.37 (1.31, 8.70)	0.012	0.484
	Female	1.00			1.00		
Ethnicity	Malays	4.32 (2.66, 7.02)	<0.001	0.248	3.72 (2.26, 6.13)	<0.001	0.254
	Others	1.00			1.00		
HYPERCHOLESTEROLEMIA			**SLR**			**MLR**	
Variables		**Crude OR (95% CI)**	***p* Value**	**SE**	**Adj OR (95% CI)**	***p* Value**	**SE**
Age (yrs)	40-50	1.00			1.00		
	51-60	1.68 (1.34, 2.11)	<0.001	0.117	2.76 (1.70, 4.50)	<0.001	0.245
Gender	Male	1.31 (1.01, 1.71)	0.045	0.135	1.62 (1.13, 2.31)	0.008	0.18
	Female	1.00			1.00		
Ethnicity	Malays	1.41 (1.06, 1.88)	0.017	0.145	1.52 (1.13, 2.03)	0.005	0.149
	Others	1.00			1.00		
OBESITY			**SLR**			**MLR**	
Variables		**Crude OR (95% CI)**	***p* Value**	**SE**	**Adj OR (95% CI)**	***p* Value**	**SE**
Age (yrs)	40-50	1.04 (0.81, 1.34)	0.778	0.129	1.21 (0.89, 1.65)	0.216	0.157
	51-60	1.00			1.00		
Gender	Male	1.00			1.00		
	Female	1.70 (1.30, 2.22)	<0.001	0.137	2.85 (1.81, 4.49)	<0.001	0.232
Ethnicity	Malays	1.66 (1.20, 2.26)	0.002	0.166	1.82 (1.30, 2.54)	<0.001	0.170
	Others	1.00			1.00		

SLR=Simple logistic regression, MLR=Multiple logistic regression, Crude OR=Crude odds ratio, Adj OR=Adjusted odds ratio, SE=Standard errors, Yrs=Years

ing was 21%. According to the 2nd National Health and Nutrition Status Survey (NHANSS) 2009-2011, the prevalence of smoking among the Bruneian adults (aged >19 years) was 17%. [9] However, in a similar study by Otgontuya et al., the prevalence of smoking in Malaysia was 23.6% and 31.7% in both Cambodia and Mongolia, which was higher compared to our study.[7] In addition, our study has shown smoking to be higher among males compared to females (27% vs 1%) and this was also reflected in the general adult population (32.8% in male smokers vs 3.7% in female smokers) in Brunei Darussalam. [9] This finding was further supported by another study which suggested males were significant-

Table 4: The proportion of total cardiovascular risk among the subject sample (n=1375)

Risk Levels	**n**	**%**
Low risk (<10%)	1348	98
Moderate risk (10-<20%)	20	1.5
High risk (>20%)*	7	0.5
Total	1375	100

*High risk includes WHO/ISH risks: 20% to <30%, 30% to <40% and ≥40%.

ly more likely to smoke than females in Asian culture.[19] The lower prevalence of smoking in this study may be due to the implementation of Tobacco Order 2005 and Tobacco regulations in Brunei Darussalam, which prohibits smoking in all workplaces and public areas.

In this study, hypercholesterolemia has shown to affect more than one third of the subjects (36%) and it was reported as 11.6% among the adult population in Brunei Darussalam.[9] This finding was higher in comparison to a similar study conducted in Cambodia, Malaysia and Mongolia where it was 14.1%, 3.3% and 23.6% respectively.[7] In our study, hypercholesterolemia was significantly higher in males compared to females which was supported by other studies.[20, 21] Hypercholesterolemia is a major risk factor of CVD and it is related to other lifestyle factors such as smoking, physical inactivity, unhealthy diet and obesity.[6] This stresses the importance of lipids screening for all workers in the detection and the management of hypercholesterolemia. In addition to pharmacological treatment, lifestyle intervention programs such as smoking cessation, healthy diet and physical activity have also shown to be effective in reducing total cholesterol level.[6]

In the current study, the overall prevalence of obesity was 26%. According to the 2nd NHANSS 2009-2011, obesity was 27% among the adult population in Brunei Darussalam.[9] However, in Malaysia, obesity was 11.2% among the population aged between 30-65 years, which was lower compared to our study.[22] Our study also reported higher prevalence of obesity in female compared to male, which is in line with the report in the 2nd NHANSS 2009-2011.[9] A study by Linhart et al., also reported that women had a higher BMI compared to men.[23] Additionally, in our study, obesity was significantly higher in females aged 51-60 years and this could be explained by weight gain following menopause, lower metabolic rate and the decrease in the level of physical activity with age.[24] Weight gain has been associated with chronic diseases such as diabetes, cardiovascular disease and cancers, which imposes an enormous health, social and economic burden.[25] Therefore, these findings suggest there is scope for targeted interventions to prevent obesity in this demographic.

Finally, utilizing WHO/ISH risk prediction charts, 0.5% of the subjects in our study were at high risk of developing cardiovascular events in ten years. This proportion of high-risk group is lower in our study compared to that of the study conducted in Cambodia (1.3%), Malaysia (2.3%) and Mongolian (6%).[7] Another study had similar heterogeneous results in different countries (China 1.1%, Iran 1.7%, Sri Lanka 2.2%, Cuba 2.8%, Nigeria 5.0%, Georgia 9.6%, Pakistan 10.0%)[3]. The lower proportion of 10-year total cardiovascular risk in our study may be partly due to the treatment effect.[26] As explained by Liew et al., treatment effect occurred because cardiovascular risk scores did not account for the individuals whose risk was lowered as a result of treatment for hypertension, and in our study, 28% the subjects were on treatment with anti-hypertensive medications.[26] The WHO/ISH risk prediction charts have also published with guidance that recognized cardiovascualr risk might be lower in subjects already on hypertensive therapy.[14]

Study Limitation

To our knowledge, this is the first study that attempted to stratify the 10-year total cardiovascular risk among the adults working in Brunei Darussalam and the prevalence of some of the modifiable CVD risk factors. Nevertheless, there are some limitations. This study was conducted at OHD where only employees who required medical fitness assessment were registered and therefore, it may not be representative of the whole working population in Brunei Darussalam. Another limitation is the WHO/ISH risk chart for WPRA

has not been validated in Brunei Darussalam due to the absence of prospective cohort studies. This risk prediction chart might have underestimated the total cardiovascular risk due to anti-hypertensive therapy, which is noted in the WHO/ISH risk charts guidelines. However, the WHO/ISH risk prediction charts have been identified as a key tool in the successful implementation of action plan for the prevention of non-communicable diseases in developing countries where CVD prediction models were non-existent. [2]

CONCLUSION

Although the majority of the subjects in our study were stratified as low risk of developing cardiovascular events in ten years, low risk does not equate to 'no risk'. The high prevalence of modifiable CVD risk factors such as hypercholesterolemia and obesity in our study suggests increased future burden of CVD. The findings of this study may be useful for public health practitioners, policy makers or researchers for the planning of health promotion programme with health screening at workplaces and also as baseline data to measure temporal changes.

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