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Helicobacter Pylori Infection in Relation to Anthropometric Indices among Young Population in Iran

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ABSTRACT

Background: Previous researches reported inconclusive findings on the interaction of Helicobacter pylori (*H.pylori*) infection with body indices, although, most of these studies used body mass index (BMI) to assess such an association. The aim of this study was to investigate the association of *H.pylori* seropositivity with anthropometric indices as well as blood pressure (BP) among a group of young population in Zahedan, a city in south-east of Iran. **Methods**: A total of 363 undergraduate students participated in this cross-sectional study, in 2014. Serum IgG antibodies against *H.pylori* were measured and the cut-off level of antibody titers more than or equal to 20 was considered as *H.pylori* positive. Anthropometric indices and BP were measured using standard protocols. **Results**: Data analysis indicated that *H.pylori* seropositivity was equal to 45.7% . *H.pylori* positive participants had significantly lower mean values of BMI (P = 0.01), waist circumference (WC), and waist to height ratio (WHtR) which was marginally significant (P = 0.05) compared to *H.pylori* negative participants. No significant differences were found in waist to hip ratio (WHpR), as well as systolic blood pressure (SBP) and diastolic blood pressure (DBP) between the two groups. Although, after adjustment for confounding factors, higher values of BMI (OR = 1.12, 95% CI = 1.003-3.2) and WHtR (OR = 1.04, 95% CI = 1.001-2.71) were positively correlated with higher odds of *H.pylori* positivity. **Conclusions:** *H.pylori* positivity was correlated with higher BMI and WHtR after adjusting for other variables, but no correlation was observed for WC, WHpR, or BP among a group of young undergraduate students in south-east of Iran.

Keywords: *Helicobacter pylori; Anthropometric indices; Blood pressure; Young population; Iran*

Introduction

Helicobacter pylori (*H.pylori*), has infected almost half of the population throughout the world. The prevalence rate differs considerably from country to country, but it is less frequent in developed countries than developing ones

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(Hussain and Hamid, 2014, Whalen and Massidda, 2015). In addition to gastro duodenal disorders including gastritis, gastric or duodenal ulcers, and gastric cancer, a strong link was also determined between *H.pylori* and idiopathic thrombocytopenic purpura as well as iron deficiency anemia (Eusebi *et al.*, 2014, Wong *et al.*, 2014). However, some new evidences were reported on *H.pylori* contribution to development of obesity and hypertension (Vahdat *et al.*, 2013, Zhang *et al.*, 2015).

Previous reports have shown a positive correlation between *H.pylori* infection and obesity indices including body mass index (BMI) and waist circumference (WC) (Chen *et al.*, 2015b, Xu *et al.*, 2014). Similarly, higher prevalence of *H.pylori* infection was found in obese individuals than those with normal weight (Arslan *et al.*, 2009). However, other studies reported conflicting findings (Vo *et al.*, 2015). The possible interaction between *H.pylori* and body weight might be mediated by releasing pro-inflammatory cytokines, inflammation of gastric mucosa, disrupted secretion of gastric appetite-regulated hormones, impaired immune functions, and immunologic cross-reactivity (Vo *et al.*, 2015, Zhang *et al.*, 2015). Similarly, there are contradictory findings on the effect of *H.pylori* infection on blood pressure (BP) as a component of cardiometabolic health. Some authors have considered *H.pylori* as a risk factor for development of hypertension which might be theoretically attributed to its involvement in inducing chronic atrophic gastritis and chronic inflammation (Vijayvergiya and Vadivelu, 2015). But, some other studies didn't confirm this association (Naja *et al.*, 2012).

Despite the high prevalence of *H.pylori* infection, obesity, and hypertension in Iran, there is limited data on the interrelation among them (Rahmani *et al.*, 2015, Sayehmiri *et al.*, 2014, Sepanlou *et al.*, 2015). In a recent study conducted among elderly individuals in the northern part of Iran no correlation was reported between *H.pylori* infection with obesity and hypertension (Sotuneh *et al.*, 2014). Regarding the data scarcity and controversy, this study targeted at determining the association of *H.pylori* infection with anthropometric indices and BP among a group of young population in south-east of Iran.

Materials and Methods

Study design and participants: This cross-sectional study was conducted on undergraduate students of Zahedan University of Medical Sciences in 2014. The university is located in city of Zahedan, at the center of Sistan & Baluchestan province, South-east of Iran. Students who were not in the age range of 18-24 years, were taking medications for any serious disease, or had *H.pylori* eradication therapy in the past were excluded.

*Measurements***:** Information including age, gender, family history of peptic ulcers or gastric cancer, and presence of dyspeptic symptoms for the past month was collected at the baseline of study by a self-questionnaire. BMI was recorded as weight (kg) divided by the height squared (m). WC was measured at the approximate midpoint between the costal margin and iliac crest. Hip circumference was measured at the widest part of the buttocks. These measurements were used to calculate waist to hip ratio (WHpR) and waist to height ratio (WHtR). All measurements were performed by a trained staff with calibrated instruments in agreement with WHO criteria (WHO, 2011). BP was measured using an automatic sphygmomanometer, in sitting position after a 5-minute rest. According to the standard guidelines, SBP and DBP were measured twice on the left upper arm and the average of these two measurements was used for analysis (Mancia *et al.*, 2013).

Blood samples were collected from participants by taking 5 ml of venous blood after an overnight fast. For detection of *H.pylori* positivity, specific IgG antibody titers against *H.pylori* were measured using an enzyme-linked immunosorbent assay (ELISA) method (Pishtazteb kits, Tehran, Iran). A cut-off level of antibody titers more than or equal to 20 was considered as positive.

Data analysis: Data analysis was performed using Stata.12 software. In bivariate analysis, the

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χ2 test was applied for comparison of categorical variables between *H.pylori* positive and *H.pylori* negative groups. Likewise, use of *t*-test or Mann-Whitney U test was appropriate for comparing the continuous variables of the two groups. Moreover, a multiple logistic regression was used to assess the adjusted association of *H.pylori* infection as a dependent variable with other variables. To evaluate the goodness-of-fit of the logistic regression model, the Hosmer & Lemeshow test was applied. The results were presented as mean ± standard deviation and percentage. A p-value of less than 0.05 was regarded as statistically significant.

Ethical considerations: The study was approved by Ethics Committee of Zahedan University of Medical Sciences and Research Center for Children and Adolescent Health, Zahedan, Islamic Republic of Iran. All of the participants filled out the written informed consent.

Results

The total number of 363 participants with the mean age of 21.9 ± 2.12 year (192 males, 171 females) participated in the study, among them, 166 (45.7%) had positive *H.pylori* and 89 had a family member with peptic ulcer and/or gastric cancer. Almost more than half of the participants reported no complaint about dyspeptic symptoms in the past one month. The χ2 test didn't show any statistically significant difference in variables between *H.pylori* positive participants and *H.pylori* negative ones (**Table 1**).

Table 1. Bivariate and univariate analysis of the demographic characteristics (as Independent Variables) and *H.pylori*

Independent Variables	Helicobacter pylori status			P- value	Univariate OR (%95 CI)
	Total n = 363	Positive n = 166	Negative n = 197		
Age (years)					
< 20	147 (40)[a]	61 (41.5)	86 (58.5)	0.18	0.75 (0.49-1.14)
≥ 20 [b]	216 (59.5)	105 (48.6)	111 (51.4)		1
Gender					
Male	192 (52.9)	95 (49.5)	97 (50.5)	0.12	1.4 (1.05-2.67)[c]
Female [b]	171 (47.1)	71 (41.5)	100 (58.5)		1
Family history peptic ulcers					
Yes	66 (18.2)	31 (47.0)	35 (53.0)	0.82	1.06 (0.62-1.81)
No [b]	297 (81.8)	135 (45.5)	162 (54.5)		1
Family history gastric cancer					
Yes	23 (6.3)	9 (39.1)	14 (60.9)	0.51	0.74 (0.31-1.77)
No [b]	340 (93.7)	157 (46.2)	183 (53.8)		1
Having dyspepsia symptoms For the last one month					
None	212 (58.4)	98 (46.2)	114 (53.8)	0.99	0.77 (0.30-1.97)
Stomachache	61 (16.8)	29 (47.5)	32 (52.5)		0.73 (0.26- 2.05)
Lack of appetite	22 (6.1)	10 (45.5)	12 (54.5)		0.80 (0.25-3.08)
Nausea	21 (5.8)	9 (42.9)	12 (57.1)		0.88 (0.23-2.72)
Sour stomach	14 (3.9)	6 (42.9)	8 (57.1)		0.88 (0.22-3.55)
Vomiting	9 (2.5)	4 (44.4)	5 (55.6)		0.83 (0.17-4.08)
Early satiety	4 (1.1)	2 (50.0)	2 (50.0)		0.66 (0.07-5.74)
Abdominal Bloating [b]	20 (5.5)	8 (40.0)	12 (60.0)		1

[a:] n (%);[b:]: Reference group, [c]: Significant at level P<0.05,

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Table 2 compared anthropometric indices and BP between the two groups. The mean values of anthropometric indices were lower among *H.pylori*-positive participants compared to H.pylori negative ones. This trend was significant for BMI (P = 0.01) as well as marginally significant for WC and WHtR (P = 0.05). SBP and DBP were almost similar between the two groups. No significant relationship was found between *H.pylori*-positivity and BP.

Variance inflation factor (VIF) was used to examine the multicollinearity and there was co-linearity between BMI and WC (VIF = 2.23). Therefore, WC was not entered to the final multiple logistic regression model. However, the other anthropometric indices and other explanatory variable did not have co-linearity (VIF < 1.91). It was found that higher values of BMI (OR = 1.12, 95% CI = 1.003-3.2) and WHtR (OR = 1.04, 95% CI = 1.001-2.71) were positively correlated with higher odds of *H.pylori* positivity. Although, male gender was significantly associated with higher odds of infection in univariate analysis (**Table 1**), this association disappeared in the multiple regression analysis (**Table 3**).

Table 2. Comparison of mean (± SD) of anthropometric indices and blood pressure between *H.pylori*- positive and *H.pylori*- negative participants

Variables	Total n = 363	*H.pylori*-positive n = 166	*H.pylori*-negative n = 197	P- value
Body mass index (kg/m²)	21.68 ± 3.51	21.23 ± 3.39	22.06 ± 3.57	0.01[a]
Waist circumference (cm)	72.22 ± 6.43	71.11 ± 6.90	72.55 ± 7.02	0.05 [a]
Waist to hip ratio	0.76 ± 0.72	0.76 ± 0.06	0.77 ± 0.08	0.40 [a]
Waist to height ratio	0.42 ± 0.47	0.41 ± 0.15	0.44 ± 0.13	0.05 [a]
Systolic blood pressure (mmHg)	112.7 ± 14.5	112.61 ± 15.41	112.88 ± 13.73	0.86[b]
Diastolic blood pressure (mmHg)	72.5 ± 11.5	72.35 ± 13.35	72.79 ± 9.82	0.71 [b]

[a]: Mann-Whitney U test; [b]: Independent *t*-test.

Table 3. Association of Demographic variables, anthropometric indices, and blood pressure with *H.pylori*- in multiple logistic regression model based on Hosmer-Lemeshow method

Variables	B	Adjusted OR (95% CI)[a]
Age (years)		
< 20	0.30	1.35 (0.89-3.76)
≥ 20 [b]		1
Sex		
Male	-0.50	0.60 (0.35-2.65)
Female [b]		1
Family history peptic ulcers		
Yes	-0.08	0.92 (0.64-3.89)
No[2]		1
Family history gastric cancer		
Yes	0.20	1.22 (0.88-4.01)
No[2]		1
Having dyspepsia symptoms For the last one month		
None	-0.29	0.74 (0.50-1.99)
Stomachache	-0.37	0.68 (0.43-2.09)
Lack of appetite	-0.27	0.76 (0.51-2.11)

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Nausea	-0.07	0.93 (0.71-3.09)
Sour stomach	-0.35	0.69 (0.49-2.29)
Vomiting	-0.33	0.71 (0.44-2.01)
Early satiety	-0.10	0.90 (0.77-3.003)
Abdominal bloating[b]		1
Body mass index (kg/m²)	0.120	1.12 (1.003-3.20) [c]
Waist to hip ratio	0.009	1.009 (0.79-2.01)
Waist to height ratio	0.029	1.04 (1.001-2.71) [c]
Systolic blood pressure (mmHg)	0.003	1.003 (0.68-3.10)
Diastolic blood pressure (mmHg)	0.005	1.005 (0.57-2.99)

[a:] Adjusted Odds Ratio, each variable adjusted for the other variables based on Hosmer-Lemeshow method to model building, [b]: Reference group, [c]:Significant at level P<0.05,

Discussion

In the present study, it was found that *H.pylori* positivity was significantly associated with higher BMI and WHtR after adjusting for other study variables. While in the bivariate analysis, *H.pylori* positive participants had lower mean levels of BMI and WHtR compared to negative ones. This might be due to the negative effect of cofounding adjusted variables such an association in the multivariate model. So, findings of the current research were interpreted based on the results of multivariate analysis model.

In terms of *H.pylori* infection and obesity, studies have reported contradictory results. Consistent with our findings, some studies reported a positive correlation of *H.pylori* infection with BMI. It is hypothesized that *H.pylori* infection induces a chronic low grade inflammation due to its stimulatory effect on releasing of pro-inflammatory cytokines such as interleukins (IL-1, IL-6, IL-8), and tumor necrosis factor-α (TNF-α). As a result, it leads to insulin resistance and consequently causes overweight and obesity (Xu *et al.*, 2014, Zhang *et al.*, 2015). Besides, a case-control study by Arslan et al. demonstrated that obese patients have a higher prevalence rate of *H.pylori* infection compared to the control group. They supposed that immune function has been deteriorated in obese individuals by multiple ways, such as reducing :1) macrophages derived from maturation of monocytes, 2) the bactericidal capacity of polymorphonuclears (PMNs), and 3) natural killer (NK) cells' activity. Thus, obese individuals might have an increased susceptibility to chronic inflammation such as *H.pylori* infection (Arslan *et al.*, 2009). Recent epidemiological studies have reported a positive link between obesity and *H.pylori*-related gastrointestinal disorders such as peptic ulcers and gastric cancer (Boylan *et al.*, 2014, Felley *et al.*, 2012). Therefore, these evidences might provide clue for future researches to elucidate the interaction between obesity and above-mentioned disorders as well as whether this interaction is mediated by *H.pylori* or not.

In contrast with the above-discussed studies, other researchers found an inverse correlation between *H.pylori* infection and BMI. They suggested that it might be the result of inhibitory effect of *H.pylori* on gherlin secretion as well as post-prandial pain caused by gastric mucosa inflammation which might reduce appetite and food intake (Lender *et al.*, 2014, Tan and Goh, 2012, Vo *et al.*, 2015). The conflicting findings reported by researchers might be explained by differences in their methodology including study population, the number of study participants, different diagnostic tests for measurement of *H.pylori*, and definition of obesity based on BMI classification.

Up to now, few studies have investigated the correlation of *H.pylori* infection with central obesity indices. In the present study, it was observed that higher WHtR was significantly associated with higher odds of infection, but the correlation of *H.pylori* seropositivity with WC and

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WHpR was not significant. The findings of two meta-analysis studies showed that WHtR was significantly better than BMI or even WC on predicting the risk of obesity, cardiovascular diseases, and diabetes. Besides more sensitivity, the boundary values of WHtR are independent from age, gender, and ethnic group, which have made them a more advantageous tool compared with BMI or WC in prediction of health outcomes (Ashwell *et al.*, 2012, Browning *et al.*, 2010). In this regard, measuring WHtR along with other diagnostic tools might be helpful to assess the risk of cardio-metabolic outcomes in *H.pylori* infected individuals. In terms of *H.pylori* infection and WC, some studies reported that *H.pylori* infected patients have a higher WC, as a determinant of metabolic syndrome than healthy participants (Chen *et al.*, 2015b, Xu *et al.*, 2014), while, others did not find any association between *H.pylori* infection and WC (Chen *et al.*, 2015a, Naja *et al.*, 2012). Due to the limited evidences, it is impossible to elucidate an epidemiological link between *H.pylori* infection and WC, as well as WHpR and WHtR. Further researches in this regard are warranted.

The association of *H.pylori* infection with BP is still unclear. Some studies have reported a positive correlation between *H.pylori* infection and BP (Chen *et al.*, 2015a, Xu *et al.*, 2014). It is hypothesized that chronic *H.pylori* infection could cause vasoconstriction and arterial stiffness by pro-inflammatory cytokines' action. Moreover, *H.pylori* can inhibit the absorption of folate and vitamin B12 as a result of atrophic gastritis and increase serum homocysteine concentrations. Homocysteine is suggested as a risk factor for hypertension because of its oxidative effects which decreases vasodilators and thus leads to endothelial dysfunction and arterial stiffness (Vijayvergiya and Vadivelu, 2015, Wang *et al.*, 2014). Findings of this study are in consistent with the findings of Sotuneh et al. and Zhang et al. stating that there are no significant differences in BP levels among *H.pylori* positive and negative participants (Sotuneh *et al.*, 2014, Zhang *et al.*, 2015). Therefore, inconsistency might be justified by multifactorial etiology of hypertension which dietary habits and lifestyle factors could have a potential role in development of it (Shrivastava *et al.*, 2014). So, these factors should be considered while interpreting the results.

To the best of our knowledge, this is the first study which has investigated the relationship between *H.pylori*-positivity and all general and central obesity indices. However, some limitations of this study should be admitted. First, because of the cross-sectional design, the relationship of *H.pylori* seropositivity with anthropometric indices and blood pressure could not be conclusively answered by this study. Second, the small sample size in this study might be a possible reason for the insignificant results observed in most variables. Third, the effect of some confounding factors in relation to body weight and blood pressure has not been adjusted in this study. It is possible that dietary intakes, socio-economic status, as well as lifestyle factors such as physical activity and smoking could potentially affect the interpretation of study results.

Conclusions

H.pylori seropositivity was significantly associated with higher BMI and WHtR after adjusting for other variables. However, no significant association was observed for *H.pylori* with WC, WHpR, or BP among a group of young undergraduate students in south-east of Iran. Further researches, especially longitudinal studies with large sample sizes are needed to clarify the association of *H.pylori* infection with body weight and BP. For better understanding of this interaction, future studies by more specialized tools, such as bioelectrical impedance analysis which evaluates fat mass and fat-free mass separately, in addition to anthropometric indices are recommended.

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Author contributions

Shahraki M: Designed the study, Eslami O: Collected the data and wrote the original manuscript; Shahraki T helped in writing of paper. All authors read and approved the final manuscript.

Conflicts of Interests

None

References

Arslan E, Atilgan H & Yavasoglu I 2009. The prevalence of Helicobacter pylori in obese subjects. *European journal of internal medicine.* **20 (7)**: 695-697.

Ashwell M, Gunn P & Gibson S 2012. Waist-to-height ratio is a better screening tool than waist circumference and BMI for adult cardiometabolic risk factors: systematic review and meta-analysis. *Obesity reviews : an official journal of the International Association for the Study of Obesity.* **13 (3)**: 275-286.

Boylan MR, Khalili H, Huang ES & Chan AT 2014. Measures of adiposity are associated with increased risk of peptic ulcer. *Clinical gastroenterology and hepatology : the official clinical practice journal of the American Gastroenterological Association.* **12 (10)**: 1688-1694.

Browning LM, Hsieh SD & Ashwell M 2010. A systematic review of waist-to-height ratio as a screening tool for the prediction of cardiovascular disease and diabetes: 0.5 could be a suitable global boundary value. *Nutrition research reviews.* **23 (2)**: 247-269.

Chen LW, et al. 2015a. Helicobacter pylori Infection Increases Insulin Resistance and Metabolic Syndrome in Residents Younger than 50 Years Old: A Community-Based Study. *PloS one.* **10 (5)**: e0128671.

Chen TP, et al. 2015b. Helicobacter Pylori Infection is Positively Associated with Metabolic Syndrome in Taiwanese Adults: a Cross-Sectional Study. *Helicobacter.* **20 (3)**: 184-191.

Eusebi LH, Zagari RM & Bazzoli F 2014. Epidemiology of Helicobacter pylori infection. *Helicobacter.* **19 Suppl 1**: 1-5.

Felley C, et al. 2012. Age, smoking and overweight contribute to the development of intestinal metaplasia of the cardia. *World journal of gastroenterology.* **18 (17)**: 2076-2083.

Hussain SA & Hamid S 2014. Helicobacter pylori in humans: Where are we now? *Advanced biomedical research.* **3**: 63.

Lender N, et al. 2014. Review article: Associations between Helicobacter pylori and obesity--an ecological study. *Alimentary pharmacology & therapeutics.* **40 (1)**: 24-31.

Mancia G, et al. 2013. 2013 ESH/ESC Guidelines for the management of arterial hypertension: the Task Force for the management of arterial hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). *Journal of hypertension.* **31 (7)**: 1281-1357.

Naja F, et al. 2012. Association of H. pylori infection with insulin resistance and metabolic syndrome among Lebanese adults. *Helicobacter.* **17 (6)**: 444-451.

Rahmani A, et al. 2015. Investigation of the Prevalence of Obesity in Iran: a Systematic Review and Meta-Analysis Study. *Acta medica Iranica.* **53 (10)**: 596-607.

Sayehmiri F, et al. 2014. A Systematic Review and Meta-Analysis Study to Investigate the Prevalence of Helicobacter pylori and the Sensitivity of its Diagnostic Methods in Iran. *Iranian Red Crescent medical journal.* **16 (6)**: e12581.

[DOR: 20.1001.1.24767417.2017.2.1.5.9]

Sepanlou SG, et al. 2015. Cardiovascular disease mortality and years of life lost attributable to non-optimal systolic blood pressure and hypertension in northeastern Iran. *Archives of Iranian medicine*. **18 (3)**: 144-152.

Shrivastava SR, Shrivastava PS & Ramasamy J 2014. The determinants and scope of public health interventions to tackle the global problem of hypertension. *International journal of preventive medicine.* **5 (7)**: 807-812.

Sotuneh N, Hosseini SR, Shokri-Shirvani J, Bijani A & Ghadimi R 2014. Helicobacter pylori infection and metabolic parameters: is there an association in elderly population? *International journal of preventive medicine.* **5 (12)**: 1537-1542.

Tan HJ & Goh KL 2012. Extragastrointestinal manifestations of Helicobacter pylori infection: facts or myth? A critical review. *Journal of digestive diseases.* **13 (7)**: 342-349.

Vahdat K, et al. 2013. Association of pathogen burden and hypertension: the Persian Gulf Healthy Heart Study. *American journal of hypertension.* **26 (9)**: 1140-1147.

Vijayvergiya R & Vadivelu R 2015. Role of Helicobacter pylori infection in pathogenesis of atherosclerosis. *World journal of cardiology.* **7 (3)**: 134-143.

Vo HD, et al. 2015. Inverse correlation between Helicobacter pylori colonization and obesity in a cohort of inner city children. *Helicobacter*. **20 (1)**: 64-68.

Wang Y, et al. 2014. Homocysteine as a risk factor for hypertension: a 2-year follow-up study. *PloS one.* **9 (10)**: e108223.

Whalen MB & Massidda O 2015. Helicobacter pylori: enemy, commensal or, sometimes, friend? *Journal of infection in developing countries.* **9 (6)**: 674-678.

WHO 2011. World Health Organization. Waist circumference and waist–hip ratio: report of a WHO expert consultation, Geneva, 8–11 December 2008. .

Wong F, Rayner-Hartley E & Byrne MF 2014. Extraintestinal manifestations of Helicobacter pylori: a concise review. *World journal of gastroenterology.* **20 (34)**: 11950-11961.

Xu C, et al. 2014. Prevalence of Helicobacter pylori infection and its relation with body mass index in a Chinese population. *Helicobacter.* **19 (6)**: 437-442.

Zhang Y, et al. 2015. Association between Helicobacter pylori infection and overweight or obesity in a Chinese population. *Journal of infection in developing countries.* **9 (9)**: 945-953.

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