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INDOOR AIR QUALITY AND ITS IMPACT ON HEALTH OF GUJJARS OF NORTH KASHMIR HIMALAYAS

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ABSTRACT

Indoor air pollution is one of the four most critical global environmental problems. It exposes more people worldwide to various air pollutants than does pollution in outdoor air. The study aims to analyze the impact of indoor air pollution on health of Gujjars of North Kashmir Himalayas. Gujjars are ethnic population settled in higher altitudes of Kashmir valley. Stratified sampling was used for the study. Findings shows that Gujjars have inadequate housing, low income and use firewood for cooking purpose. Majority of Gujjar families cook food twice a day for duration of two hours. From the finding it was also revealed that respiratory problems are very frequent in different altitudinal zones. The underlying reason may lie in the rampant use of firewood for cooking purpose.

Keywords: Disease Incidence, Gujjars, Indoor air, Stratified Random Sampling.

INTRODUCTION

Indoor air pollution can be defined as the totality of attributes of indoor air that affects a person's health and well being. Indoor air pollution is one of the four major critical global environmental problems and probably exposes more people worldwide to important air

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pollutants than does pollution in outdoor air (Park, 2005). Around 50 percent of people in developing countries rely on wood, dung and crop residues for domestic energy. Indoor air pollution , the source of pollution with the greatest health consequences, remains unseen. The sources of these indoor air pollutants are innumerable, but the most important identified source by the World Health Organization (WHO) is cooking with solid fuels (Selah, 2012). Indoor air pollution increases the risk of chronic pulmonary disease and of acute respiratory infections in childhood (Bruce, Padilla and Albalak, 2000). Biomass fuels are the source of domestic energy. But, these are important source of indoor air pollution and probably one of the most important occupational health hazards for women's health(Koning, Smith, and Last, 1985). Environment has great and obvious effects on health as poor residents are often seen at zones, which imply poor health (Olanrewanju and Akinbanigo, 2002).

The relationship between housing and health in Ladakh has shown considerable regional variation that can be attributed to fact of variation in housing environment (Rather, Dar &Bhat, 2014). Indoor air pollution level depends on factors such as cooking fuel used, level of ventilation and smoking (Rahman, 1998).

There is a need to assess the cooking energy uses, monitoring of indoor pollutant levels and make people aware of the hazardous effects on a person's health, women in particular (Jamal and Singh, 2012). According to recent findings, indoor air pollution is five times more hazardous than outdoor air pollution and the major source, the solid fuels is the second most environmental cause of disease after water-borne diseases and fourth most important in causing overall excess mortality and burden of diseases (WHO, 2002).

There are four principal sources of pollutants of indoor air, (i) Combustion, (ii) building material, (iii)the ground under the building; and (iv) Bio aerosols (Behera, 1991). The exposure to indoor smoke is particularly high among women and children because women are responsible for cooking and children often spend time with their mothers while they are engaged in cooking. Women generally begin regular cooking or start assisting in cooking around the age of 12 to 15 which leads to longer period of exposure to pollutants. Women spend between 3 to 7 hours per day near the stove for cooking food (Singh, 2010).

The indoor air pollution originates because a person normally spends nearly 16/24 hours inside the house (Singh *et.al*., 1996). So, it is the need of the hour to reflect seriously about the indoor environment and its impact on the health. The present study aims to analyse the impact of indoor air on health among Gujjars in North Kashmir Himalayas. Gujjars are native and ethnic group settled at higher altitudes of North Kashmir Himalayas and are socially, economically excluded by mainstream inhabitants of the valley. Gujjars of Kashmir valley are sedentary in nature, settled in foothills and higher reaches of mountains.

LITERATURE REVIEW

Clean air is a basic requirement of life. The quality of air inside homes, offices, schools, day care centres, public buildings, health care facilities or other private and public buildings where people spend a large part of their life is an essential determinant of healthy life and people's well-being (WHO, 2010).

Globally, almost three billion people rely on biomass (wood, charcoal, crop residues, and dung) and coal as their primary source of domestic energy. Exposure to indoor air pollution from the combustion of solid fuels has been implicated, with varying degrees of evidence, as a causal agent of disease and mortality in developing countries (Ezzati and Kammem, 2002). Bruce, Perez and Albalak (2000) carried out research on indoor air pollution in developing countries and found that there is consistent evidence that indoor air pollution increases the risk of chronic obstructive pulmonary disease and of acute respiratory infections in childhood, the most important cause of death among children under 5 years of age in developing countries.

There are many sources of indoor air pollution in any home. These include combustion sources such as oil, gas, kerosene, coal, wood, and tobacco products (Central Pollution Control Board, 2014). Singh and Jamal's study(2013) focuses on experimental study of indoor air quality regarding PM_{10}, $PM_{2.5}$, CO, CO_2, NO, NO_2, SO_2 in selected differently used areas. Cooking places (kitchen) at different locations using different types of cooking fuel used and living room were selected for the purpose of the measurements. For the purpose of pollutant monitoring 20 households for each having different types of kitchen using biomass fuels and LPG were selected. The indoor air quality of the living room of those households was also assessed for the purpose of comparison. The indoor environment was measured with handy portable samplers.

Rather, Dar and Bhat (2013) studied various aspects of residential environment and related health problems in high altitude cold desert of Ladakh. The investigation reveals that traditional residential adjustment because of harsh climatic conditions leads to various aspects of poor housing such as overcrowding, bad sanitation and inadequate maintenance that in turn have been identified as contributing to the impact of housing on health. Majority of households are lacking behind in all recommended housing standards and are suffering from both respiratory and infectious diseases. The present study seeks to assess and quantify the health impact of housing conditions and attempts to formulate a planning strategy that shall be helpful for future health care planning.

STUDY AREA

North Kashmir Himalayas **(Fig.1)** is a part of Great Kashmir Himalayas which lies between $34^0 16' - 34^0 40'$ North Latitude and $73^0 45' - 75^0 35'$ East Longitude. The mountainous

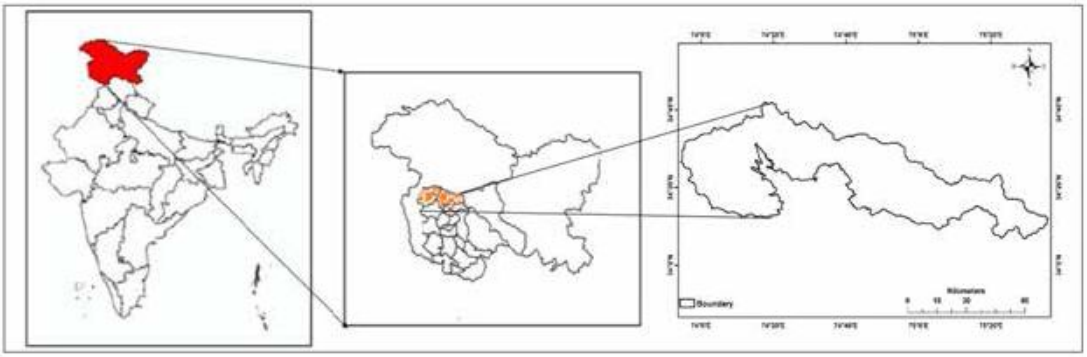

Figure 1: Study Area

range has an average altitude of 2324 meters and stretches over an area of 3934.5 Km^2. North Kashmir Himalayas take a bend towards the southwest near Zojila to Kazinag. North Kashmir Range acts as a water divide between Jhelum in Kashmir valley and Kishanganga of Gurez valley (Raza *et al*., 1978).

DATA BASE AND METHODOLOGY

The study is based on both primary and secondary data sources. The data related to selected parameters like housing, income, education, fuelwood used for cooking, duration of electricity and satisfaction level was generated by schedule method using stratified random sampling. A sample size of 20 percent of the total Gujjar villages and 8 percent of the households was selected for the sample survey. The Gujjar villages having population of 200 persons were not taken into consideration as most of the villages have mixed population of Kashmiri and Gujjars. The sample households were selected from different altitudinal zones based on the concentration of Gujjar villages in different altitudinal zones **(Table 1).**Therefore a Household survey of 557 sample households was carried out to study the impact of indoor air on health of ethnic inhabitants in North Kashmir Himalayas. Various diseases were identified during the primary surveylike respiratory diseases, cardiac diseases, renal problems, gastric diseases, jaundice and thyroid.

Table 1: Sample Frame

Altitudinal Zone (in mtr)	**Total Households**	**Total Population (Persons)**	**Household Sample Size**
Zone A (1600-1800)	1543	10053	125
Zone B (1800-2000)	2291	17022	184
Zone C (2000- 2200)	1983	14208	159
Zone D (2200-2400)	421	3096	33
Zone E (2400 and above)	703	6381	56
Total	6941	50760	557

(*Source:* Census, 2011)

RESULTS AND DISCUSSIONS

Kitchen Facility, Frequency And Duration Of Cooking

Kitchen work includes various processes that are involved before and after cooking such as marketing, cutting of vegetables, kneading the flour, grinding the spices, cleaning grains, serving food to family members and feeding young ones, washing utensils, cleaning kitchen etc. The number of meals cooked determines the total exposure. From the Table 2, it is seen that 90 percent households have separate kitchens. About 87.5 percent households cook food twice a day. The highest percentage of cooking twice a day was found in Zone D (93.9 percent). Most of the zones have two hour duration of cooking. About 73 percent households in Zone E have 2 hour duration of cooking followed by Zone A (71.2 percent).

Table 2:Kitchen Facility, Frequency and Duration of Cooking

Altitudinal Zone in (mtr)	Sample Village	Sample households	Place of cooking food		Frequency of cooking		Duration of cooking	
			Separate kitchens	Rooms	Two times	Three times	1 hour	2 hours
Zone A (1600-1800)	Gund Saderkoot, Aloosa, Ahmi Sharief, Chitibandi	125	124 (99.2)	1 (0.8)	99 (79.2)	26 (20.8)	36 (28.8)	89 (71.2)
Zone B (1800-2000)	Muqam, Malangam, Kalrooch, Manigam, Shiltra, Kuligam, Sumlar, Akhal, Hayan	184	175 (95.1)	9 (4.9)	163 (88.6)	21 (11.4)	84 (45.7)	100 (54.3)
Zone C (2000-2200)	Chunt Waliwar, Khurhama, Chuntmullah, Wangat, Chatargul	159	141 (88.7)	18 (11.3)	140 (88.1)	19 (11.9)	73 (45.9)	86 (54.1)
Zone D (2200-2400)	Farkhan, Erin Dardpora, Kolan	33	28 (84.8)	5 (15.2)	31 (93.9)	2 (6.1)	18 (54.5)	15 (45.5)
Zone E (2400-5300)	Gagangeer, Ganiwan	56	46 (82.1)	10 (17.9)	49 (87.5)	7 (12.5)	15 (26.8)	41 (73.2)
	TOTAL	557	514 (90.0)	43 (10.0)	482 (87.5)	75 (12.5)	226 (40.3)	331 (59.7)

(*Source:* Sample Survey, 2016)

Note: Figures in parenthesis represent percentage to total

Fuel Used for Cooking

Cooking fuel is the basic need of each and every household, but the difference lies in their types whether traditional or modern or combination of both is utilized for cooking. In North Kashmir Himalayas it was found that traditional fuel is mostly used. From the Table 3, it is evident that 100 percent households were using firewood in all altitudinal zones. In Zone D, about 93.9 percent households are using cow dung for cooking purpose. The usage of gas is very less in all the zones (11.4 percent). Zone A (14.4 percent) and Zone B (13.6 percent) has highest percentage of households using gas for cooking purpose. Kerosene is not regularly used for cooking purpose because it is not easily available and many of Gujjar families are unaware about the distribution system.

The average household consumption of firewood in all altitudinal zones was found to be 16.8 kg/day/household. The firewood is used in different ways like cooking food and charcoal for warmth in winters. The highest firewood consumption was found in Zone D and E (19kg/day and 18kg/day) and lowest consumption was found in Zone A (14kg/day).

Table 3: Fuel Used for Cooking

Altitude Zone in (mts)	Sample Village	Sample households	Fuel used for cooking			
			Firewood	Cow dung	Gas	Kerosene
Zone A (1600-1800)	Gund Saderkoot, Aloosa, Ahmi Sharief, Chitibandi	125	125 (100)	107 (85.6)	18 (14.4)	54 (43.2)
Zone B (1800-2000)	Muqam, Malangam, Kalrooch, Manigam, Shiltra, Kuligam, Sumlar, Akhal, Hayan	184	184 (100)	159 (86.4)	25 (13.6)	76 (41.3)
Zone C (2000-2200)	Chunt Waliwar, Khurhama, Chunt-mullah, Wangat, Chatargul	159	159 (100)	142 (89.3)	17 (10.7)	63 (39.6)
Zone D (2200-2400)	Farkhan, Erin Dard-pora, Kolan	33	33 (100)	31 (93.9)	2 (6.1)	12 (36.4)
Zone E (2400-5300)	Gagangeer, Ganiwan	56	56 (100)	49 (87.5)	7 (12.5)	21 (37.5)
	TOTAL	557	557 (100)	488 (88.6)	69 (11.4)	226 (39.6)

(*Source:* Sample Survey, 2016)
Note: Figures in parenthesis represent percentage to total

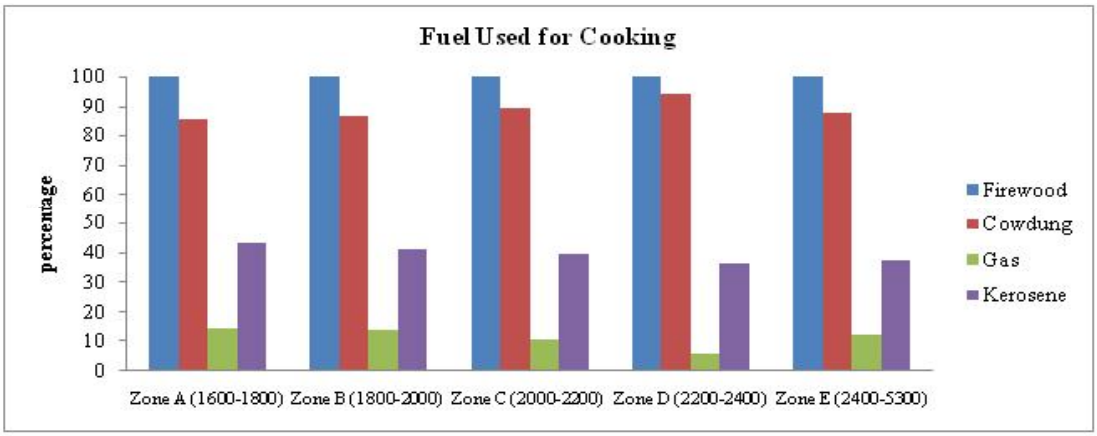

Figure 2: Distribution of Fuel used for Cooking

Heating Arrangements

Heating arrangements like kangri and wood burning bukhari are also sources of indoor air pollution especially in North Kashmir Himalayas. From the Table 4, it is known that about 78.6 percent households in Zone E are using bukhari followed by Zone C (43.4 percent). Kangri is mostly used in Zone A (74.4 percent) followed by Zone B (70.7 percent).

Table 4: Heating Arrangements

Altitude Zone in (mtr)	Sample Village	Sample House-holds	Heating arrangement	
			Bukhari	Kangri
Zone A (1600-1800)	Gund Saderkoot, Aloosa, Ahmi Sharief, Chitibandi	125	32 (25.6)	93 (74.4)
Zone B (1800-2000)	Muqam, Malangam, Kalrooch, Mani-gam, Shiltra, Kuligam, Sumlar, Akhal, Hayan	184	54 (29.3)	130 (70.7)
Zone C (2000-2200)	Chunt Waliwar, Khurhama, Chuntmul-lah, Wangat, Chatargul	159	69 (43.4)	90 (56.6)
Zone D (2200-2400)	Farkhan, Erin Dardpora, Kolan	33	14 (42.2)	19 (57.6)
Zone E (2400-5300)	Gagangeer, Ganiwan	56	44 (78.6)	12 (21.4)
	TOTAL	557	213 (43.9)	344 (56.1)

(*Source:* Sample Survey, 2016)

Note: Figures in parenthesis represent percentage to total

Figure 3: Bukhari & Kangri

HIGH ALTITUDE RESIDENTIAL ENVIRONMENT DISEASES

There is a direct relationship between housing and health. Health statistics in some of the western cities and metropolitan areas indicate that poor health is one of the essential by-products of defective or deteriorated housing (Smith, 1966). Singh *etal.* (1996) found that increased urban population in the developing countries has created a serious threat to environmental conditions within living areas. They concluded that income, housing and health are closely related with each other. The study was based on primary data and random sampling was used to collect information of households categorized on the basis of income.

The parameters used were housing conditions, bathroom facility, sanitation facility, water supply, indoor air and noise pollution. An attempt has been made to investigate the health implications of poor housing conditions in Srinagar city by Singh and Baba (2015). Various housing indicators were identified and correlation was established between housing conditions and diseases. The study revealed that there is a positive relationship between the socio-economic conditions of households and frequent occurrence of air borne diseases. Drinking water is a major source of microbial pathogens in developing regions, although poor sanitation and food sources are integral to enteric pathogen exposure. Gastrointestinal disease outcomes are also more severe, due to under-nutrition and lack of intervention strategies in these regions. Poor water quality, sanitation and hygiene account for some 1.7 million deaths a year world-wide mainly through infectious diarrhoa. Nine out of 10 such deaths are in children and virtually all of the deaths are in developing countries (Ashbolt, 2004).

In North Kashmir Himalayas, drinking water quality is good except in Zone A and E. Parameters like suspended solids and coliform are above the standard limits in all zones. Coliform bacteria may not cause disease, but are one of the indicators of pathogenic contamination that can cause diseases such as intestinal infections, dysentery, hepatitis, typhoid fever, jaundice, cholera and other illnesses (Emmanuel *et al*., 2009). Out of the total sample population the number of persons suffering from diseases was found to be 756 (26.3 percent). During the survey, nine diseases were found prevalent among the Gujjars of North Kashmir Himalayas namely asthma, tuberculosis, diarrhea, jaundice, typhoid, gastric, skin infections, thyroid and cardiac problem. Out of these nine diseases, respiratory infections (asthma and tuberculosis) were most frequent in each altitudinal zone. The reason clearly lies in the use of firewood for cooking. The highest incidence of diseases was found in Zone D (43.7 percent) followed by Zone C (38.3 percent) as shown in Table 5. The lowest incidence of diseases was found in Zone A (9.3 percent) followed by Zone E (16.6). Gastric problem was also found in Zone D (15.2 percent). The reason could be bad housing, poor water quality, low income, primary occupation and poor standard of living.

Table 5: Incidence of Residential Environment Disease among Gujjars of North Kashmir Himalayas

Altitudinal Zone (mts)	Sample Village	Total Reported Cases	**Diseases**								
			Asthma	**T.B**	**Diarrhea**	**Jaundice**	**Typhoid**	**Gastric**	**Skin Infections**	**Thyroid**	**Cardiac**
Zone A (1600-1800)	Gund Saderkoot, Aloosa, Ahmi Sharief, Chitibandi	79 (9.3)	12 (15.2)	13 (16.5)	9 (11.4)	9 (11.4)	7 (8.9)	10 (12.7)	4 (5.1)	4 (5.1)	11 (13.9)
Zone B (1800-2000)	Muqam, Malangam, Kalrooch, Manigam, Shiltra, Kuligam, Sumlar, Akhal, Hayan	262 (26.7)	45 (17.2)	51 (19.5)	23 (8.8)	31 (11.8)	25 (9.5)	34 (13.0)	9 (3.4)	11 (4.2)	33 (12.6)
Zone C (2000-2200)	Chunt Waliwar, Khurhama, Chuntmullah, Wangat, Chatargul	301 (38.3)	51 (16.9)	61 (20.3)	29 (9.6)	34 (11.3)	30 (10.0)	45 (15.0)	10 (3.3)	10 (3.3)	31 (10.3)
Zone D (2200-2400)	Farkhan, Erin Dardpora, Kolan	66 (43.7)	14 (21.2)	11 (16.7)	10 (15.2)	9 (13.6)	7 (10.6)	10 (15.2)	1 (1.5)	2 (3.0)	2 (3.0)
Zone E (2400-5300)	Gagangeer, Ganiwan	48 (16.6)	9 (18.8)	7 (14.6)	5 (10.4)	6 (12.5)	5 (10.4)	7 (14.6)	2 (4.2)	3 (6.3)	4 (8.3)
Total Average		**756 (26.9)**	**131 (17.9)**	**143 (17.5)**	**76 (11.1)**	**89 (12.1)**	**74 (9.9)**	**106 (14.1)**	**26 (3.5)**	**30 (4.4)**	**81 (9.6)**

(*Source:* Sample Survey, 2016)

Note: Figures in parenthesis represent percentage to total

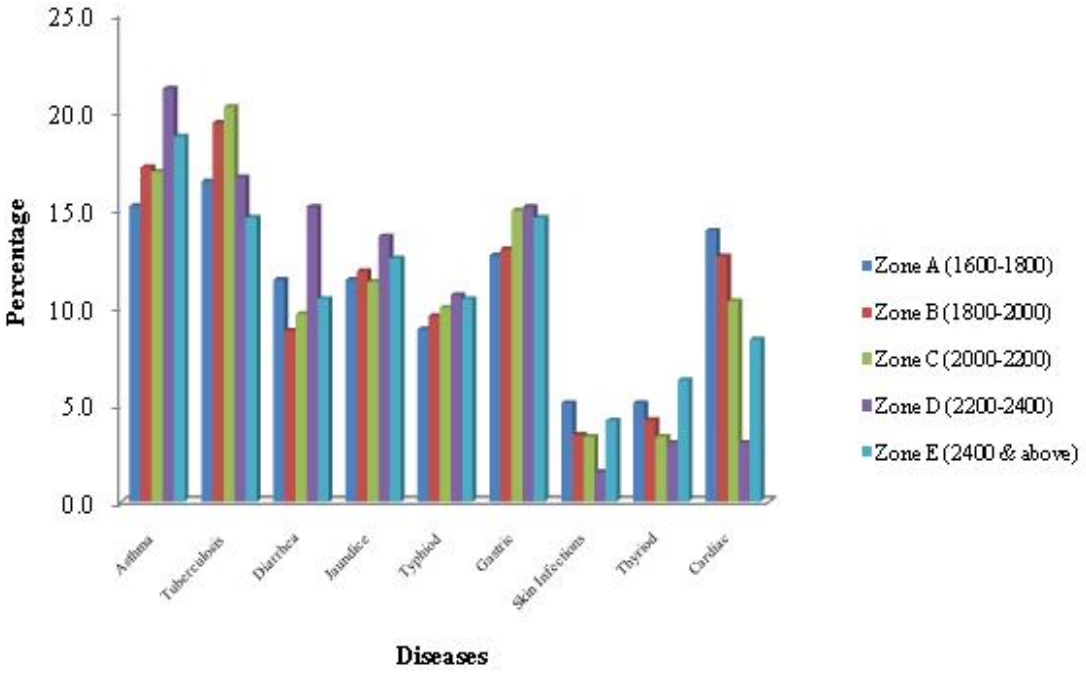

Figure 4: Incidence of Residential Environment Disease among Gujjars

CONCLUSION

The present study was conducted on impact of indoor air on health of Gujjars in North Kashmir Himalayas. The study found that in different altitude zones, traditional methods of cooking is done. The duration and frequency of cooking was found very high. Respiratory diseases are also found in all altitude zones. About 87.5 percent households cook food twice a day. The highest percentage of cooking twice a day was found in Zone D (93.9 percent). The average household consumption of fuel wood used was found to be 16.8 kg/day/household. The usage of gas is very less in all zones (11.4 percent). Zone A (14.4 percent) and Zone B (13.6 percent) has highest percentage of households using gas for cooking purpose. Kerosene is not regularly used for cooking purpose because it is not easily available. About 78.6 percent households in Zone E are using bukhari followed by Zone C (43.4 percent). Kangri is mostly used in Zone A (74.4 percent) followed by Zone B (70.7 percent). The total reported percentage of disease incidence was found to be 26.3 percent. The highest incidence of diseases was found in Zone D (43.7 percent) followed by Zone C (38.3 percent). Zone D has the highest incidence of respiratory problems among all altitude zones. The underlying reason of prevalent respiratory disease in North Kashmir Himalayas could be inhalation of bad air quality. Other diseases may be caused due to open defecation, unsanitary and unhygienic condition, unsafe drinking water and dietary habits.

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