# CAN HEAVY MEALS AND BREAKFAST PREDISPOSE HEART ATTACK ?

***Chibisov Sergey M (1), RK Agarval (2), R B Singh(3), Viola Vargova (4), Daniel Pella (4), Kuniaki Otsuka (6).***

*(1)Department of Pathological Physiology, People,s Friendship University of Russia, Moscow, Russia.*
*(2)Network of Young Doctors and Health Administrators, Moscow, Russia.*
*(3)Halberg Hospital and Research Institute, Moradabad, India,*
*(4) Faculty of Medicine, Safaric University, Kosice, Slovakia,*
*(5)Tokyo Womens Medical University Medical Centre, Tokyo, Japan.*

Correspondence: Dr R B Singh Halberg Hospital and Research Institute Civil Lines, Moradabad-10(UP) 244001, India Emails; icn2005@sancharnet.in, drkk@dataone.in

**ABSTRACT:**

Acute myocardial infarction (AMI) is a highly dynamic event, which is associated with marked neuroendocrinological dysfunction apart form heart damage. The immediate trigger for heart attack is not known exactly. There is a marked increase in sympathetic activity, oxidative stress and deficiency of minerals as well as antioxidants, during heart attack. Clinical studies have reported an increased incidence of reinfarction, sudden death, coronary constriction, myocardial ischaemia and angina, during first quarter of the day when there is rapid withdrawal of vagal activity and increase in sympathetic tone. In one case control study, among 202 patients of heart attack, there was a significant ($P<0.02$) increase in cardiac events in the second quarter of the day (6-12hours) compared to other quarters respectively (16.8%, 41.0%, 13.8%, 28.2%). This characteristic remained common in both men and women and among patients with and without known heart attack (n=52), diabetes (n=53) and hypertension (n=75). Triggers of heart attack were noted among 162 (82.2%) of the patients. Brain related and psychological mechanisms were; emotional stress (45.5%) , sleep deprivation (27.7%), cold climate (29.2%), hot climate (24.7%), large meals (47.5%) and physical exertion (31.2%). These triggering factors are known to enhance sympathetic activity and decrease vagal tone, resulting into increased secretion of plasma cortisol, noradrenaline, aldosterone, angiotension converting enzyme, interleukin-1,2,6,18 and tumor necrosis factor-alpha, that are pro-inflammatory. There is also a deficinency in the serum levels of vitamin A, E, C, coenzyme Q10 and magnesium, potassium, melatonin, interleukin-10 (anti-inflammatory) and increase in TBARS, MDA and diene conjugates, TNF-alpha and IL-6 which are indictors of oxidative damage and pro-inflammatory respectively. It is not clear whether the predisposition of ACS is due to size of the meals or proinflammatory content of meals.

Keywords: Large meals, breakfast, trans fatty acids, cytokines, lipoproteins, glucose.

## INTRODUCTION:

The exact mechanism and the immediate triggers for acute heart attack and brain attacks are not known. Clinical manifestations of these attacks also do not occur at random times but according to a time structure (1-7). It is possible that certain external activities, known as triggers, play a major role in the occurrence of these attacks. In one study (5), half of all heart attack patients reported a temporal relationship between characteristic activities and occurrence of the attack. Emotional stress, sleep deprivation, large meals, mild and heavy physical exertion were the most frequently reported triggering factors of heart attacks in various studies (1-7,11-13).

There appears to be a powerful evidence of a link between these triggers and the sequences of cellular and pathophysiological events that are postulated as being responsible for poor supply of blood in the heart. The morning increase in platelet aggregability is a most frequent trigger of heart attack, which may be the result of increased secretion of cortisol, aldosterone, catecholamines, angiotensin, free fatty acids, triglycerides (7-

11) and decreased vagal tone that are known to be enhanced by food and benefited by fasting. Apart from above triggers, presence of risk factors of low heart rate variability, such as excess fat, more insulin resistant, obesity and pollution may also act by enhancing triggers and trigger-induced brain-related and hormonal mechanisms in the development of poor supply of blood to heart (1). Both clinical and biochemical factors may be related to a molecular clock present in the brains suprachiasmatic nucleus.

**THE TRIGGERS OF ACUTE CORONARY SYNDROMES:**

Heart attack is a highly dynamic event, which is associated with marked neuroendocrinological dysfunction apart form heart damage. The immediate trigger for heart attack is not known exactly. Studies conducted by various investigators(2-7, 11-13), have demonstrated, a marked increase in sympathetic activity, oxidative stress and a decrease in parasympathetic activity in association with increase in catecholamines, cortosol and decrease in 1). melatonin (1) (Table). In one case control study by Singh etal (5), among 202 patients of ACS, brain related and psychological mechanisms were observed as given : emotional stress (45.5%) , sleep deprivation (27.7%), cold climate (29.2%), hot climate (24.7%), large meals (47.5%) and physical exertion (31.2%).These triggering factors are known to enhance sympathetic activity and decrease vagal tone, resulting into adverse biochemical environment in the body tissues. In another study,by Singh et al, among 54 patients, that were included in this study, 41 patients had full heart attack, 5 patients possible 2$^{nd}$ stage, 8 cases first stage.The control subjects (n=85) were randomly selected from the population of the city of Moradabad drawn from a similar aqe range of subjects after exclusion of heart attack (n=9), diabetes(n=6) and excess intake of trans fatty acids (n=20). Large breakfast was a predisposing factor of heart events in the second quarter of the day and it was significantly associated with metabolic reactions.The findings indicate that acute reactions as a result or as circadian rhythms appear to be important in the pathogenesis of complications in heart attack and that a large breakfast in association with nitrite deficiency, may further trigger the circadian rhythms.However more studies in a large number of subjects would be necessary to confirm our findings. The TRIMM (6) and the MILIS study (3) also showed that large meals is a trigger for ACS.

**CIRCADIAN RHYTHMICITY:**

Clinical studies have reported an increased incidence of attacks, sudden death and poor blood supply to heart, during first quarter of the day when there is rapid withdrawal of vagal activity and increase in sympathetic tone. In one case control study by Singh etal (5), among 202 patients of heart attack, there was a significant ($P<0.02$) increase in cardiac events in the second quarter of the day(6-12hours) compared to other quarters respectively (16.8%, **41.0%,** 13.8%, 28.2%). This characteristic remained common in both men and women and among patients with and without known heart attack (n=52), diabetes (n=53) and hypertension (n=75). In another study, by Singh et al (4) among 54 patients with ACS, there was a significant greater incidence of cardiovascular events in the second quarter of the day (6.00AM to 12.00noon) compared to 3$^{rd}$ quarter. In another study, by Singh et al (4) among 54 patients with ACS. Circadian rhythmicity of cardiovascular events have also been reported in the TRIMM study as well as in the MILIS Study.

**BIOCHEMICAL MECHANISMS:**

There is evidence that there is increased secretion of plasma cortisol, noradrenaline, aldosterone, angiotension converting enzyme, interleukin-1,2,6,18 and tumor necrosis factor-alpha, that are pro-inflammatory during ACS (1-7). There is also a deficinency in the serum levels of vitamin A, E, C, coenzyme Q and magnesium, potassium, melatonin, interleukin-10 (anti-inflammatory) (4,5,12,13). In our studies (4,5,7), we found a decrease in magnesium, potassium, vitamin A, E, C and beta carotene and increase in TBARS, MDA and diene conjugates, TNF-alpha and IL-6 which are indictors of oxidative damage and pro-inflammatory, respectively. Mean lipoprotein(a), total cholesterol and triqlycerides were significantly higher and mean nitrite level, lower in the ACS group, compared to control group (5). Lp(a), triglycerides, blood glucose, plasma insulin, malondialdehyde, diene conjugates, TBARS and TNF-alpha

and IL-6 which were significantly greater during acute phase, showed a significant decline, and serum nitrite and coenzyme Q, an increase, at 4 weeks of follow up, when the acute reactions evoked by ACS, were controlled (4).

**LARGE MEALS AND ACUTE CORONARY SYNDROMES:**

There is little information on the role of nutrition in the onset of acute reactions and ACS. Several workers observed that subjects consuming large breakfast and meals especially dinner were more common victims of attacks, compared to apparently healthy subjects of same age and sex (2-6). Higher intake of hydrogenated fat was also more common among ACS patients in one study which is known to have adverse effects of lipids and inflammation(4) (Table 2-4). It is known that different types of fatty acids and refined carbohydrates in the diet, influence different physiologically relevant mechanisms ,especially those concerned with haemostasis and inflammation in the body (19-21). As the role of various factors, influencing clot formation in the coronary artery and thrombosis on risk of heart and stroke are more firmly established, our knowledge concerning the effects of different types of nutrients on these factors remains limited. A recent study, showed that postprandial leptin response was lower after a carbohydrate meal in obese women, than in lean controls, suggesting an impairment of such response of leptin regulation due to obesity. It is known that postprandial leptin changes are higher after carbohydrate meal than after a fat meal similar to insulin changes.

We found that consumption of a large breakfast was associated with greater proinflammatory cytokines; TNF-alpha and IL-6, than in subjects consuming low energy breakfast(Table 3,4).Increased levels of TNF-alpha and IL-6 have been observed in patients with obesity, type 2 diabetes insulin resistance, glucose intolerance,hypertriglyceridemia,hyperleptinemia and heart attack, which could be greater in patients with attacks.There is no previous evidence that people consuming large breakfast have greater proinflammatory cytokines,as observed in our study. There is potential evidence, however, that ACS may be associated with greater levels of proinflammatory cytokines due to metabolic reactions such as catecholamines, cortisol, serotonin, hyperinsulinemia, hypertriglyceridemia and hyperglycemia that are common in patients with attacks. It is possible that people consuming large, fatty breakfast enhance the release of catecholamines, glucose, insulin, triglycerides which may have an adverse effects on cardiovascular function.

However, A few studies just published (14-18) provides added evidence that feeding at the "wrong time" can lead to weight gain. These recent findings on mice were extended to humans in 1973 (17). A start with nutriceuticals indicates that in a person investigated by varying the administration times of coenzyme Q10 (CoQ10), the circadian stage played an important role (14,18). It is possible that a heavy breakfast as well as a heavy dinner, both may have adverse effects.

Experiments in animals indicate that ventromedial hypothalamic(VMH) lesion in the brain, in rats induces hyperphagia, and excessive weight gain, fasting hyperglycemia, hyperinsulinemia, hypertriglyceridemia and glucose intolerance (19-24). There may be suppressed splenic natural killer cell activity, when the animals are hyperphagic and obese (21-24). There is increased release of interferon-alpha,IL-1,IL-2 and TNF in response to noninflammatory and inflammatory stresses. Longterm infusion of norepinephrine plus serotonin into the VMH part of brain, impaired pancreatic islet cell function in as much as these abnormalities are observed in insulin resistant animals by several researchers (19-23).It is possible, that heart attack is associated with high level of psychological and hormonal stress, which may have caused the release of proinflammatory cytokines which can damage heart and endothelial cells resulting into increased susceptibility to clot formation and ACS and heart failure.

**ADVERSE EFFECTS OF DIET**:

Dietary fat composition can also influence platelet function and platelet aggregation and blood clotting (25,26). Recent evidence indicate that dietary butter or coconut, increase the sensitivity of platelets

to aggregation and clot formation and enhances the release of harmful catecholamines (25).Hypercholesterolemia is known to be associated with an increased sensitivity of platelets to aggregating agents. A large breakfast rich in fat may enhance platelet aggregation and clotting resulting into heart attack, as noted in our study. Reduction in the saturated fat in the diet may decrease, platelet aggregation and catecholamines resulting into decrease in blood pressure and heart rate. A diet rich in n-3 fatty acids may decrease cytokines and hence may be baneficial because it is cardioprotective as well as neuroprotective (19-26)

**ROLE OF FASTING OR LOW ENERGY INDO-MEDITERRANEAN DIET:**

We have found that subjects eating low energy diet had low blood pressure, lower glucose, insulin, cholesterol, triglycerides and cytokines. In 32 subjects, on no breakfast, fruits and vegetables in the lunch and normal dinner, we observed a very low blood pressure no vascular variability and no overweight and obesity, compared to subjects eating normal meals. It is possible that no breakfast or small amount of breakfast, and small frequent meals including dinner containing protective foods such as almonds, walnuts and black raisins, whole grains bread, legumes, fruits, vegetables and salads, 5-6 times in a day, may have a beneficial effect on the harmful body chemistry that occurs during the $2^{nd}$ and $4^{th}$ quarters of the day (25-28). It is suggested that take small breakfast and dinner and normal lunch and supper to avoid the adverse effects of foods during circadian rhythms of our body and prevention of heart attacks. Recent studies also indicate that fasting for few hours is also cardio and neuroprotective.

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**Table 1. Neuropsychiatric and other risk factors of acute coronary syndrome (reference 5).**

| **Precursors** | **Healthy Subjects (n-595)** | **Acute coronary sundrome (n=202)** |
|---|---|---|
| Anxiety | 88(14.8) | 122(60.4)* |
| Depression | 42(7.0) | 45(22.3)* |
| Type A behaviour | 103(17.3) | 95(47.2)* |
| Emotional stress | 147(24.2) | 92(45.5)* |
| Sleep deprivation | 42(7.0) | 56(27.7)* |
| Cold Climate | - | 59(29.2)* |
| Hot climate (>40 degree celcius) | - | 50(24.7)* |
| Large Meals | 147(24.7) | 96(47.5)* |
| Physical Exertion | 173(29.1) | 63(31.2)* |
| Diabetes mellitus | 70(11.7) | 53(26.2)* |

**Table 2: Risk factors and other characteristics of patients and control subjects (Reference 4):**

| | Acute myocardial infarction (n=54) | Controls (n=85) |
|---|---|---|
| Sex- males | 45 (83.3) | 76(89.4) |
| Mean age (years) | 49.5± 4.2 | 52.1± 5.2 |
| Body mass index (kg/m2) | 23.7± 3.2 | 22.4±3.4 |
| Hypertension (>140/90 mmHg) | 25(46.3)* | 25(29.4) |
| Glucose intolerance | 12(22.2)* | 10(11.8) |
| Diabetes mellitus | 14(25.9) | -- |
| Smoking | 24(44.4)* | 28(32.9) |
| Higher trans fatty acids (>5g/day) | 27(50.0)** | -- |
| Large meals(>1000 Kcal) | 27(50.0)** | 25(29.4) |
| Large breakfast(>1000 Kcal) | 22(40.7)** | 10(11.8) |

Values are mean(standard deviation) and number(percentages).*=P <0.05,

** P<0.01; P values were obtained by Student,s t test for continuous variables and by chi square test for ordinal variables.

**Table 3: Food intakes among patients and control subjects (reference 4)**

| Foods intake (g/day) | Before acute coronary syndrome (n=54) | Controls (n=85) |
|---|---|---|
| Antiatherogenic foods(g/day) | | |
| Wheat,rice and millets | 345 ± 43.3* | 486 ± 69.6 |
| Roots and tubers | 49.5± 4.2 | 52.1± 5.2 |
| Fruits and vegetables | 161 ± 13.2* | 221± 25.4 |
| Legumes and pulses | 35 ± 6.7* | 53± 9.1 |
| Almonds and walnuts | 0.5± 0.2* | 1.5± 1.2 |
| Fish | 10± 5.9* | 16.7 ± 6.6 |
| Mustered oil | 10± 4.4* | 18± 6.9 |
| Proatherogenic foods(g/day) | | |
| Butter, Indian ghee, hydrogenated oils. | 38.0 ± 10.0** | 16.7 ±5.9 |
| Oils rich in omega-6 fatty acids | 22.5 ± 4.7* | 11.8 ± 3.5 |
| Total visible fat | 70.5 ± 14.6* | 46.5 ± 11.7 |

| | | |
|---|---|---|
| Sugar, bread, biscuits | 208± 57.8** | 115± 29.6 |
| Meats(chicken, beef, gote, eggs) | 27± 10.7** | 40± 12.8 |
| Milk and it products | 152 ± 34.6* | 112 ± 22.5 |

Values are mean(standard deviation). *=P <0.05, ** P<0.01; P values were obtained by Student,s t test for continuous variables.

**Table 4.Association of size of meals with biochemical risk factors of coronary syndromes.**

| | Large breakfast, n=22 | | Small breakfast (n=32) | |
|---|---|---|---|---|
| Biochemical data | Baseline | After4 weeks | Baseline | After 4 weeks |
| Triglycerides (mmol/L) | 1.88±0.61 | 1.70±0.38* | 1.81+0.60 | 1.64+0.32* |
| Blood glucose (mmol/l) | 7.7±1.6 | 6.0±1.2* | 6.6+1.4* | 5.5+0.30* |
| Plasma insulin(mg/dl) | 47.5+11.3 | 36.3+5.6** | 43.2+8.8* | 27.6+3.5* |
| TBARS(pmol/l) | 1.87+0.46 | 1.32+0.33* | 1.77+0.42 | 1.30+0.31* |
| Malondialdehyde(pmol/l) | 2.68+0.34 | 2.02+0.21* | 2.66+0.33 | 2.01+0.21* |
| Diene conjugate(OD) | 27.5+4.2 | 24.6+4.0* | 26.2+4.1 | 24.2+3.5* |
| Coenzyme Q10(ug/ml) | 0.21+0.02 | 0.32+0.23* | 0.23+0.03 | 0.45+0.24* |
| Interleukin-6(pg/ml) | 32.6+6.2 | 22.5+4.3* | 27.5+5.2* | 20.6+0.22* |
| TNF-alpha(ug/dl) | 42.5+12.8 | 23.6+4.1* | 38.2+10.6* | 19.6+0.18* |
| Lipoprotein(a) Ug/ml | 23.1±5.4 | 20.1±4.2* | 22.5+4.6 | 19.7+4.1* |

Values are mean standard deviation.*= P<0.05,**=P< 0.01.P values were obtained by analysis of variance by comparison of large breakfast verses small breakfast groups.