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RESEARCH ARTICLE

THE EXCITEMENT THEORY AND CARDIOVASCULAR EVENTS.

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Abstract

During the recent years, there has been quite a controversy whether watching exciting matches like World Cup Soccer, Super Bowl matches, etc. could have a cardiovascular risk on spectators (while a positive correlation has been established in cases of exciting events like earthquake, war, etc.). Some studies reported a positive correlation while some studies reported no or negative correlation when cardiovascular risk was assessed on spectators watching exciting matches.

I have tried to resolve this dispute with the help of a general theory on human behaviour using the 'excitement' emotion as a mathematical factor, to explain the different observations and results of various studies of games.

Introduction:-

This is a world where numerous things occurs, and some of them takes us by surprise. But one thing common for all the surprising things that occurs is their low chance of occurrence. Because even the greatest miracles (from the blooming of flowers to the motion of the planets), which we witness everyday are not considered strange, because they commonly occur in nature and we are used to it. The human mind, by the sheer effect of repetition and habit, gradually becomes accustomed to even the strangest and least familiar ideas.[1]

You would marvel if, owing to strange events of some sorts, frogs and lizards suddenly grew on apple and orange trees instead of fruit, or if roses began to smell like a sweating horse.[2] And these strange events, which have low chance of occurrence, cause excitement, '*a sense of interest and wonder'*, for the unknown, in the observer who experiences it.

There is nothing romantic about a definite proposal. The very essence of romance is uncertainty[3]. It is for certain that the most unpredictable events are most interesting, and have high excitement in them. And we have observed people to watch surprising events (be it unexpected outcome, thrilling movie, unexpected news, etc.) and have cardio-vascular events or commit self-harm. People have died as a result of these surprising events. It's plausible to explain, that a sub-group of people are susceptible to surprises of uncertainty and have cardiovascular events, but then we develop a hypothesis that explain these observations in terms of probability of occurrence of event.

Historically, we have seen that there were wars, whose result (outcome) surprised the world. Either it be the defeat of the Spanish Armada by Sir Francis Drake in 1588, or the defeat of the Italians by the Ethiopians in 1896, or the defeat of Russians by the Japanese in 1905.

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What we mathematically observe is that England, Ethiopia and Japan had low chances of winning the war (as predicted), but after the war the prediction turned out to be false, and that surprised the world.

The Excitement Theory[4]:-

We have seen that events that have less chance of occurring, when it occurs, surprises the observer and brings excitement in him. And events that happen as predicted does not bring much excitement to the observer.

(1). **Excitement in the Event**

To explain this "Excitement" mathematically, we take a die. Now suppose, we have the following situations.

1. If we throw it and expect a number less than 7.
2. If we throw it and expect a number less than 6.
3. If we throw it and expect a number less than 5.
4. If we throw it and expect a number less than 4.
5. If we throw it and expect a number less than 3.
6. If we throw it and expect a number less than 2.
7. If we throw it and expect a number less than 1.

What do you think will the Excitement be in each case?

Case 1: We are certain that, when we throw the die, a number less than 7 will definitely come. This is a sure event. So we presume that it is a common natural phenomenon and therefore there will be no excitement.

Case 7: When we throw again the die, and expect a number less than 1, we are sure it will never be. This is an impossible event. So there will be no excitement.

Case 2: When we throw a die and expect a number less than 6. The probability of the number less than 6 is 5 out of 6 i.e. 83.33%. It will raise our interest, but then due to very high probability of the occurrence of the event, it won't be of much interesting.

Case 6: When we throw a die and expect a number less than 2. The probability of the number less than 2 is 1 out of 6 i.e. 16.7%. Now it has very less probability of occurrence, so the observer won't be much interested in the event.

Case 3: When we throw a die and expect a number less than 5. The probability of a number less than 5 is 4 out of 6 i.e. 66.67%. So there is high chance that number may come and low chance that the number may not come. We can correctly predict two-third of the time the outcome. So the excitement will be much higher than the earlier cases.

Case 5: When we throw a die and expect a number less than 3. The number that will come (1&2) has 2 out of 6 chance of appearing i.e. 33.33%. The chance of such occurrence is low and that of not occurring is high, and again we can correctly predict the outcome in two-third cases. So the excitement of such an event's occurrence will be similar to that of case 3.

Case 4: When we throw a die and expect a number less than 4. The number that will come (1, 2 and 3) has 50 percent chance of appearing. Now there is equal chance that a number less than 4 or greater or equal to 4 can appear. It is difficult for observer to predict with certainty what will occur, so the excitement is high in such event. The excitement is similar when we consider even-odd throw in the die, because there is equal chance of appearance of even or odd number.

In all the above cases, we are presuming to throw the die and predicting the outcome. Neither the die has been thrown nor has the outcome been recorded. So the 'Excitement', which comes is Pre-Event Excitement (before the event has occurred) or 'Excitement **in** the Event' and we can denote it as $\mathbf{E_i}$ (the subscript '**i**' for in).

To understand the situation better, consider a team X which plays a match against team A, B, C, D, E, F, G, H, I, J and K.

Table 1

Team X	Opposite team	Chance of X winning the match
X	A	0%
X	B	10%
X	C	20%
X	D	30%
X	E	40%
X	F	50%
X	G	60%
X	H	70%
X	I	80%
X	J	90%
X	K	100%

Now, as an observer if we watch the game, we see that X has no chance of winning against team A, and will definitely win against team K.

For these two situations, when we can predict the occurrence of the event with certainty, there will be no excitement for the observer. Excitement comes with uncertainty of the prediction. More the uncertainty, more will be the excitement. In this case, the maximum excitement the observer will get when team X plays against its equal, i.e. team F, when it has 50% chance of winning, making the outcome of the match unpredictable.

Now if we plot a graph, with X-axis showing the probability of occurrence of an event, and Y-axis showing the Excitement generated, we get a curve like this:

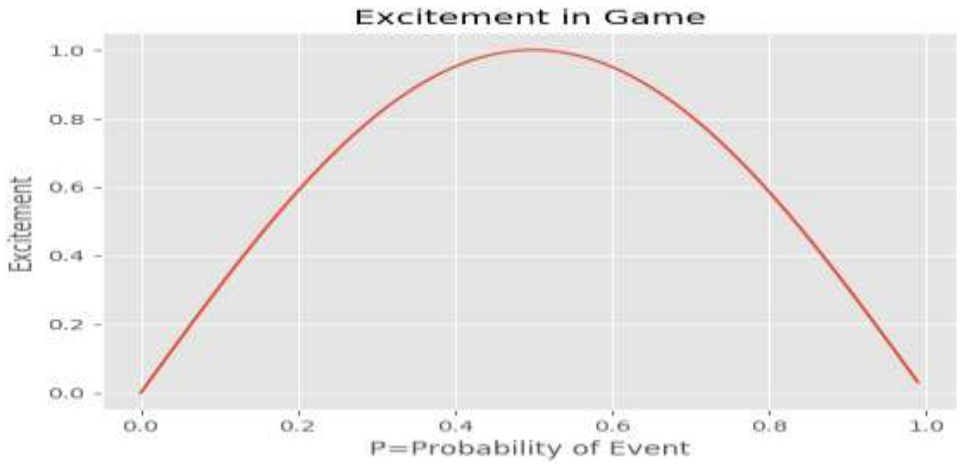

Figure 1

If we compare Excitement with Probability of occurrence of Event, then we can see it peaks to maximum when there is 50% chance of occurrence and becomes zero when the event can be predicted correctly (when probability is 0 and 1). In other words, Excitement is directly proportional to the uncertainty of occurrence of an event.

Now if we observe Figure 1 carefully and using analogy of occurrence of most natural phenomena, we can see it to be similar to a sine curve. Writing this as an equation that fits the curve,
Excitement (E) $\propto \sin(p\pi)$,
where '**p**' is probability of occurrence of event and π is angle in radian
$E = k \sin(p\pi)$ ---------- (1)
Where k is the bias constant which will depend on the cohort group.
If we assume k=1, for the group we are studying,
Excitement (E) = $\sin(p\pi)$ ---------- (2)
Now, this Pre-Event Excitement attracts the people to watch the event.

When the Excitement **in** the Event (pre-event excitement) will be high, more people will watch the event. $\mathbf{E_i}$ is the crowd pulling factor, and people interest is closely associated with it.

(2). **The concept of Nash equilibrium**[5]

Suppose two twin brothers, A with 10 toffees and B with 10 toy cars have to share their items with each other. A is given two boxes P and Q while B is given two boxes X and Y.

The game is that A can put any number of the 10 toffees in either of the boxes, P and Q. B doesn't know the quantity of toffees in either boxes and has to choose one of the boxes. The order in which A can distribute the toffees in boxes P and Q is {(10,0), (9,1), (8,2), (7,3), (6,4), (5,5), (4,6), (3,7), (2,8), (1,9), (0,10)}. Similarly B can choose to distribute 10 toy cars in boxes X and Y in any order of which A has no knowledge. And A can choose any one of the boxes.

If A puts 10 toffees in box P and none in box Q and B chooses box P, then A is at total loss while B is at total gain. And if B chooses box Q then he is at total loss. Similarly, if B distributes his toy cars in order of (10, 0) in boxes X and Y, then he will be at total loss or total gain depending on whether A chooses X or Y respectively. As we equate the distribution of items, then a point comes (5, 5), no matter whatever boxes A or B chooses, both will be at equal gain, a point of equilibrium.

Just as equal number of toffees and toy cars should be placed in either boxes for the best outcome, no matter what A or B choices are, similarly for maximum Excitement **in** an Event, all the outcomes should have equal probability, no matter what the outcome will be.

Writing an equation for the product of the distribution in the above example, $(10 - x)(x)$, and plotting on a graph also shows a similar curve as in figure 1. And if we use this equation for Excitement in the Event, $E_i = (p - p^2)$, we get similar results as in equation – (2). Where '**p**' is the probability of the occurrence of event, and $p \in [0, 1]$.

(3). Excitement of the Event:-

After a match or an event, people expect an outcome. When the outcome is as expected then the excitement is less, because the prediction is correct and the uncertainty is low.

When the outcome is contrary to what people had expected, the uncertainty has become high, so the Excitement is high. This happens when the event having high chance of occurrence doesn't occur making the outcome unpredictable for the observer. The result will be surprising for the observer.

Now once again in the die case, we study the Excitement after an Event has occurred (Post-Event Excitement).

Case 1: We have thrown the die and the event has occurred. We can have two situation here, one is practical, and the other a hypothetical one.

1. When a number less than 7 has come, it is a sure event with 100 percent chance of occurrence. Excitement of the outcome is 0, because the outcome has occurred as predicted.
2. When a number less than 7 didn't come, it has 0 percent chance of occurrence. And such an outcome will cause a heightened excitement. Excitement of the Event will be infinite (theoretically).

Case 7: Getting a number less than 1 on a die is an impossible event. If it doesn't occur, then the Excitement is 0. And if it occurs, then the Excitement is extremely high (infinite theoretically).

Case 2: We throw the die, and

1. 6 appears. The chance of 6 appearing is 1/6 or 16.67%. So the predicted outcome is less. But as 6 has appeared, there will be heightened excitement.
2. 6 doesn't appear. The chance of numbers 1, 2, 3, 4, and 5 appearing is 5/6 or 83.33%, which is very high. And as the event has occurred as predicted for the highly probable outcome, causing very low Excitement of the event.

Case 6: It is similar to case 2. If number 1 appears, Excitement will be very high, and if 1 does not appear, Excitement will be very low.

Case 3: The probability of number less than 5 is 4/6 or 66.67%. Now the two cases are:

1. The event has occurred: It was expected, so the Excitement is low, but higher than in case 2(2).

2. The event didn't occur: the Excitement will be high in this case because it had a chance of occurrence of only 33.33%.

Case 5: It is similar to Case 3.

Case 4: The probability of a number less than 4 is 3/6, i.e. is 50%. This is an event of maximum uncertainty. There is equal chance that the event can occur or not. The Excitement will be maximum for the occurrence of the predicted most probable outcome. The product of the Excitement for both occurrence and non- occurrence of the expected outcome is maximum. An equilibrium has been reached.

If we plot a graph, with Y – axis representing the Excitement after an event has occurred, and X – axis showing the probability of the occurrence of the event, we get a curve like this:

Figure 2:-The Excitement is Post- Event Excitement, or Excitement **of** the Event (after the event has occurred), denoted as $\mathbf{E_o}$ (the subscript '**o**' denotes of).

Writing the Excitement in mathematical equation,
Excitement of the Event (E_o) is directly proportional to the Excitement in the Event (E_i) and inversely proportional to the square of the probability of occurrence of the event.
$E_o = K \sin(p\pi)/ p^2 = K E_i / p^2$ ---------- (3)
Where K is the bias constant.
Assuming K = 1, for a specific sub-group of population,
$E_o = E_i / p^2$ ---------- (4)
Excitement of Event (E_o), denotes people reaction towards the occurrence of event. An event having low E_0 will be considered plausible by the onlookers and will be overlooked. While the event with high E_0 will be surprising to the onlookers and will make headlines and news.

(4). Excitement during the Event:-
Lastly, we study the Excitement during the Event. We have observed that for a book or movie to be interesting, the climax is usually kept at the end. It is similar in case of an event. The Excitement is maximum at the climax (the time period after which the outcome can be predicted with certainty). If the climax occurs at the end of the event, the Excitement during the Event (E_d, where subscript '**d**' denotes during) is maximum.

If 'T' be the total time of the event and 'T_0' be the time at which climax occurs, it follows a relation from practical observation that,

Excitement **during** the Event (E_d) = $K (T_0/ T)^2 E_o$ ---------- (5)

Where K is a bias constant, and E_o is the Excitement of the Event. Assuming $K = 1$ for a specific group of people, we get,

$E_d = (T_0/ T)^2 E_o$ ---------- (6)

It is this E_d (total duration of Excitement) that is responsible for most of the cardio-vascular events and deliberate self-harm in the observers. These 6 equations usually govern the dynamics of human behaviour to a large extent.

Individuals who are biased to get a particular outcome of an event or match are more prone to have cardiovascular accidents or deliberate self-harm. These adverse effect is proportional to the bias and the Excitement during the Event/Game.

Bias arises mainly because of identifying oneself as a part of a team or participant[6-8]. Nationalism, the involvement with a particular team for a long time, betting, etc. all may lead to bias.

(5).The susceptible pool hypothesis:-

It's like some observers are more biased and prone to develop cardiovascular events than others. The individual who try to identify themselves more with the group, are more biased towards the group they support. And there are individual with underlying cardiovascular disease who are at risk. And if these individuals are old (they have invested more time in the event/game) and are betting towards a particular outcome, they are the most susceptible to the adverse effect of Excitement. During a World Cup tournament (when the duration of Excitement is long), these susceptible individuals are more likely to succumb to the effect of Excitement. After some number of events due to cumulative effect of emotional triggers[9-11] (Excitement), the susceptible pool of individuals is likely to get exhausted and it will require time to regenerate the susceptible pool once again. The similitude is that of a neuron on repeated high frequency stimulation fails to fire after some time because the pool of neurotransmitter in the synapse gets exhausted.

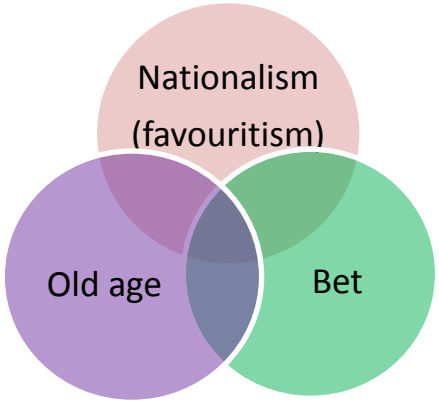

Figure 3:- (the highly susceptible pool – shaded dark)

(6). The behaviour of betting:-

Now there are two sort of individuals:

(a). One who supports a team (is biased due to nationalism, favouritism, etc.) but bets on other team to win. These are intelligent people. Suppose a patriotic individual A, is biased towards his national team win, but bets that his national team will lose. If A's team wins, there is positive Excitement because of the nationalism bias and a negative Excitement to counter-balance it because of bias in betting. And if A's team loses, there is negative Excitement due to nationalism bias but a positive Excitement due to bias in betting. Therefore the overall Excitement for these individuals, in the event/game is low and they have minimal risk of having adverse effect of the Excitement of the event/game.

And the best example to illustrate this hypothesis is the behaviour of Stephen Hawking's betting: "*I had a bet with Kip Thorne of the California Institute of Technology that in fact Cygnus X-1 does not contain a black hole! This was a form of insurance policy for me. I have done a lot of work on black holes, and it would all be wasted if it turned out that black holes do not exist. But in that case, I would have the consolation of winning my bet..*."[12]

(b). The other individuals are emotional sages. They will bet in favour of their team they are biased towards. In either case, if their team wins or loses, there is going to be very high Excitement. And these individuals have greater chance of dying due to heart failure or committing suicide. Stephen Hawking, again in his later years made this sort of bet[36].

Review of Literature:-

1. Word Cup Soccer, Germany 2006:-

The FIFA World Cup, held in Germany from June 9 to July 9, provided Lampen[13] *et al* an opportunity to examine the relation between emotional stress and the incidence of cardio-vascular events (CVE). They concluded that viewing a stressful soccer match more than doubles the risk of acute cardiovascular event (particularly in men). The significant increase in CVE was supposed to be due to high bias and the high Excitement during the Event. Discussing Lampen's study in table 2 and figure 4:

Costa Rica was a weak team and Germany won by a good margin (4, 2). Both the E_i and E_o was low. And less number of CVE was expected. In the second match, the two teams were strong teams (Poland vs Germany), the Excitement **in** the Match was high. And the Excitement **during** the Match was also high (0, 1). So the CVE count increased. The third match Germany played against Ecuador, which was a weak team. The E_i was low. And the E_d was also low. So very less number of people had CVE.

Table 2

Date (2006)	Game	Score
June 9th	Germany vs. Costa Rica	4:2
June 14th	Germany vs. Poland	1:0
June 20th	Germany vs. Ecuador	3:0
June 24th	Germany vs. Sweden	2:0
June 30th (quarter final)	Germany vs. Argentina	(Penalty shootout) 4:2
July 4th (semi-final)	Germany vs. Italy	(extra time) 0:2
July 8th (for 3rd place)	Germany vs. Portugal	3:1
July 9th (final)	Italy vs. France	(Penalty shootout) 5:3

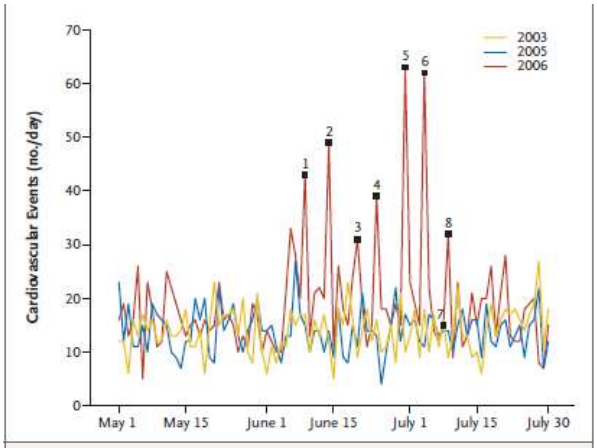

Figure 1. Daily Cardiovascular Events in the Study Population from May 1 to July 31 in 2003, 2005, and 2006.

The FIFA World Cup 2006 in Germany started on June 9, 2006, and ended on July 9, 2006. The 2006 World Cup matches with German participation are indicated by numbers 1 through 7: match 1, Germany versus Costa Rica; match 2, Germany versus Poland; match 3, Germany versus Ecuador; match 4, Germany versus Sweden; match 5, Germany versus Argentina; match 6, Germany versus Italy; and match 7, Germany versus Portugal (for third-place standing). Match 8 was the final match, Italy versus France.

Figure 4:- (From Wilbert-Lampen *et al*. Copyright 2008 Massachusetts Medical Society. Reprinted with permission from Massachusetts Medical Society)

Germany had already qualified, so the bias was less, leading to overall low Excitement in the Match. The E_o was also low.

The fourth match was against two strong teams (Germany vs. Sweden), and both Excitement in the Match and Excitement of the Match was high. But the E_d was less (2, 0). So CVE cases increased a little.

The fifth match of Germany was against Argentina, a very strong team. The Excitement in the Match was very high. The Excitement of the match was also very high, and the climax (outcome) was reached at the end of the game, so the E_d was also very high. So naturally, the CVE cases increased very much.

The sixth match of Germany was against Italy, a strong team. The Excitement in the Match was high, so there was huge crowd. The E_d was also very high, because Germany lost after extra time was given. The Excitement of the Match was also high. So over all CVE cases were much more.

With susceptible pool sufficiently exhausted, and those who had to die already dead (those who had to suffer CVE had already suffered), the seventh match had the lowest CVE cases. The Excitement in the Match was high, but the Excitement during the Match was low as Germany easily beat the Portugal. And the bias effect was reduced because both team were out of final.

The eighth match was between Italy and France. Both strong teams had equal chance of winning. The climax also reached at the end of the game. But the game ended with a comical controversy, Zidane head-butting Materazzi[35]. The French lost, and the CVE cases for the French ought to be high, unless the head-butting incident affected the emotional result. There is however increased CVE cases as compared to baseline in the figure. The possible explanation is that the Germans must have supported the French, as they had lost to Italy or many would have bet in favour of a particular outcome and therefore had become biased.

Lampen's study noticed the CVE cases were more in men than in women, probably because men tended to identify themselves more with group and were therefore more biased[8(c)]. The other likely explanation is that more men watched the matches than women. And the third explanation is that men were more prone to develop CVE, because they had underlying disease, which were exacerbated by the Excitement.

Three years later, the result published by Wilbert-Lampen[14] *et al* showed that though there was significant increase in CVE cases in the German population in World Cup Soccer 2006 matches but the cardiac morbidity could not be translated into a noticeable increase in mortality. The conclusion that naturally follows are:

1. That Lampen's study had several limitations which affected the result.
2. Those who had CVE were promptly treated and there life saved, as compared to others whose underlying cause lead to a greater mortality.
3. Before and after the World Cup, there were other stress factors, which led to the Excitement and death.

A study done by Steptoe[15] *et al* showed the relation between stress and cardiovascular disease. Emotional stress increased the relative risk of cardiovascular events by a factor of 1.88.

But it also shows the risk is minimal as compared to other stress factors, namely anger (with relative risk of 4.0, 2.06, and 9.0 conducted by studies of Mittleman 1995, Strike 2006, and Lipovetzky 2007, respectively) and depression (relative risk of 2.50, study conducted by Steptoe 2006). So if in Lampen's case, there was high CVE morbidity, but not mortality, then other factors also played a role in subsequent control period to get equivalent mortality.

A study conducted by Francesco Barone-Adesi[16] *et al* showed Lampen's study to be an outlier case, (in which he compared the studies of Carroll-AMI, Kirkup, Brunekreef, Carroll-stroke, Toubiana, Bauman-AMI, Witte, Bauman-stroke, Berthier, Katz and Wilbert-Lampen)[14, 17-25]. The relative risk in Lampen's study was between 2 to 3, while for other studies it was around 0.7 to 1.5. The probable reason is that (excepting the limitations), Germany having won the World Cup Soccer three times (till 2006), made the population extremely biased to the game[6 (a)], and they must also have been involved in betting/ gambling, which Lampen's study didn't consider. And gambling has been implicated as a trigger of apical ballooning syndrome[26] and ventricular arrhythmias[27].

Medenwald[28] *et al* studied the mortality on match days of the German national soccer team from 1995 to 2009. They also concluded that there was no relevant increase or decrease in mortality on match days of the German national soccer team. But their results showed that there were more deaths than expected when the team lost. Out of 207 matches, the team won 127 matches, lost 36 matches and drew 44 matches. It shows German team to be a strong team. So a win was associated with low Excitement and hence less mortality and a loss was associated with high Excitement and hence high mortality. A study like Medenwald's can, however give fallacious results, because simply associating a Match with mortality, can give varied results. It's for sure, that an increase in mortality, was definitely due increased CVE cases, but it need not be the other way round.

The results are in concordance with the study of Toubiana[18(c)] *et al* for French cardiovascular mortality during 1996 European football championship and Berthier and Boulay's[19 (d)] study for lower myocardial infarction mortality in French in the 1998 World Cup Soccer final. Berthier reported that there were decreased CVE mortality on the final match day, comparing the stress and myocardial infarction.

2.Solution to the French paradox[29, 18 (c)] of 1998 World Cup Soccer Final:-

France was the winner of World Cup Soccer 1998 final. It can be seen that early in the game Zidane scored two goals before half time. Brazil didn't score any goal. The climax never really occurred. France won with 3-0. As we observe from the equation --- (5), the $(T_0/T)^2$ was very low for the match. Even though the Excitement in the Match was high, but E_d was overall low, which accounted for low mortality. The other stress factors (excitement factor) were also removed; being holiday as the author argued, so mortality was low. But then we considered mortality only. The total number of cardiovascular events were not reported.

As the tournament moves forward towards the end, the E_i increases to maximum, but the E_o reaches an equilibrium as both team has equal chance of winning, for it is best two strong teams that reaches the finals. So all that remains to decide CVE cases is the dynamic probability or the climax of the game. If it occurs towards the end, CVE induced mortality will be high, and if it occurs early, mortality will be low. And the susceptible pool of individuals who were prone to develop CVE are either in hospital or cold in their graves; so to cause a further rise in CVE, the Excitement during the Match should be really high And those who have already survived high Excitement of the Match would easily survive the one which have low E_d.

The solution to this problem is that instead of seeking an increase in the mortality due to cardiovascular events, we should see how many people developed cardiovascular events directly as the result of match. Low cardiovascular mortality doesn't signify that watching the national team win the match was protective.

Instead of working out the mortality for groups, individual cases who were affected by the outcome of a match should be studied[30-33]. It shows those prone to have cardiovascular accidents due to Excitement will definitely have (though the numbers are less) and those who had developed cardiovascular events were eliminated from scene earlier.

3.The 1996 European Football Championship, France Vs. Netherlands:-

The quarter final of the 1996 European Football Championship between France and Netherlands was an exciting match, with high Excitement during the Event. The climax occurred at the end of the match. So the death rate or CVE cases must have increased. Two sides studied the Excitement related CVE mortality rate and came up with different results. Daniel R Witte *et al* studying the Netherlands side showed a rise in mortality[17 (b)] while L Toubiana *et al* studying the French side showed no increase in mortality[18 (c)]. The possible explanation to both side is as follows:

Netherlands had just a bad defeat with England (4, 1). So the current Excitement in the Event was low. But the two teams playing equally good and going in for penalty, the prospect for win was almost equal. The Excitement during the Event was high as the climax was at the end of the game. And the outcome, not in favor, caused increased CVE cases and deaths.

For the French, their team had played better earlier, and their chance of win was probable. The current Excitement in the Event was low. For which only 8% of the French population watched television as compared to 60% of the population in Netherlands. This shows that the French were less biased to the game as compared to the Dutch.

But the Excitement during the Event was high. The outcome was however, as predictable. So though there seemed to be lower mortality, but the CVE cases must have occurred at the individual biased level. And Toubiana *et al* measured the mortality, which like Lampen's study did not show a noticeable increase. Further the question, "Furthermore, how many of the 41 people reported dead from myocardial infarction or stroke actually watched the match?"[18(c)] applies to Toubiana also. Number of CVE cases, need not all die, and fallacy of result may come. So it is best to study the effect of Excitement at individual level.

4.The Super Bowl Match of 1980 and 1984 [34-35]:-

The Super Bowl XIV between Los Angeles Ram (NFC) and Pittsburgh Steelers (AFC) was a close game during the first three quarters. The Rams led 13-10 at half time. But Pittsburgh controlled the fourth quarter. Los Angeles Ram, which had 19-17 lead at the beginning of the fourth quarter, lost the game. It was considered one of the most competitive games in Super Bowl History with a record number of spectators (hence the bias), and overall, the lead changed six times between both the teams[36]. The Excitement during the Game was high, as climax occurred at the end of the game. The expected and the reported CVE cases were in concordance (high).

The Super Bowl XVIII between Washington Red Skins (NFC) and Los Angeles Raiders (AFC) was almost similar to the World Cup Soccer match between France and Brazil in 1998. Los Angeles Raiders led the match from the beginning and won with a huge margin; thus the Excitement during the Game was very low, and so was the mortality rate.

A point to note is that during 2000-2004, Los Angeles did not have a professional football team. There was a small but statistically significant decrease in all death rates related to the Super Bowl compared with control days for 2000 to 2004[34 (a)].

5.Other Exciting Events:-

Most of the studies relate a positive correlation between Excitement (emotional stress) and CVE[37-39]. Increased CVE cases and mortality have been reported for exciting events like war[40-41], earthquakes[42-45], hurricanes[46], lottery[47], cancer[48] (depression), stock variation[49-50], terrorist attack[51-53], fire fighters and other emergency handlers[54-55]. All these events have low probability of occurrence in a person's life, so they are exciting to those who experience it. Events like war and earthquakes which cannot have a bias, have been shown to affect both men and women almost equally, with similar number of CVE cases (or more in women) [42 (a)]. Several plausible explanation on the mechanism of the accumulation of the emotional triggers have been proposed to cause CVE.

However, some studies do relate a lack of association[56]. Like the Los Angeles study for 2008 Stock Market crash[57], or Corine Aboa-Eboule[58] *et al* study on stroke in population of Dijon, France, etc. The probable explanation all depends on a number of factors like probability, bias, the susceptible pool, etc. An increase in CVE cases may reduce the susceptible pool for stroke and vice versa. However things may be different at the molecular, cellular and physiological level[59-60].

Limitations of this Study:-

A concrete theoretical proof for the Excitement during the Event and other emotions are yet to be developed. There are other equations which can fit in the model to explain human behaviour. And explaining human behaviour in terms of equations might not be satisfying to biologists. The hypothesis cannot exactly predict who is going to die at the individual level.

Conclusion:-

Whatever we observe in this Universe has some chance factor for their occurrence. And this chance factor has been put in the form of mathematical equations to explain complex human behaviour and the occurrence of symptomatic cardiovascular disease as a result thereof. The *wonder* for events which have low frequency of occurrence, have been coined a term "Excitement". And this Excitement has affected the behaviour, in a predictable way, of people like Stephen Hawking to unknown football fans, earthquake and war victims. And therefore this theory, based on human behaviour and response to *excitement* justifies the studies that have reported a positive correlation between exciting matches or events and cardio-vascular events.

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