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Effects of different phases of the lunar month on humans

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The four prominent phases of the lunar month are new moon, first quarter, full moon, and third quarter. According to the position of the moon in its orbit, the gravitational pull of the moon on earth changes and the amplitude of ocean tides also vary. A large number of investigations have shown the association of different lunar phases with the mental health or physical health and diseases, physical activity pattern, and reproduction of humans. The changes occurred may be due to either the disturbance of electromagnetic field of the earth or the changes of lunar gravitational force on earth and changes of "human tidal wave" or "biological tide" during different lunar phases. The altered autonomic neural activity and cardiovascular activity during different lunar phases is probably one of the fundamental causes of the changes of human physiology.

Keywords: gravitational pull; lunar phases; mental health; physical activity; reproduction; human tidal wave; autonomic neural activity; cardiovascular activity

1. Introduction

The earth revolves around the sun and completes a cycle in 365 days 5 h 48 min and 46 s. On the other hand, the moon, which is the only natural satellite of the earth, completes an orbit around the earth in 29 days 12 h 44 min 3 s and this is called the synodic period of the moon or lunar month or lunation. As the moon orbits around the earth once per month, the angle between the earth and the moon changes. Different phases of the lunar month are determined on the basis of the position of the sun, the earth, and the moon during the movements of the earth and the moon in their orbits. The prominent phases of the lunar month are new moon (NM), first quarter (FQ), full moon (FM), and third quarter (TQ) (Figure 1).

Tides are created because the earth and the moon are attracted to each other, just like magnets. The moon tries to pull at anything on the earth to bring it closer. But, the earth is able to hold onto everything except the water. Since the water is always moving, the earth cannot hold onto it, and the moon is able to pull at it. Two high tides and two low tides are created every day. The ocean is constantly moving from high tide to low tide and then back to high tide. There is about 12 h and 25 min between the two high tides.

In different phases of the lunar month, the gravitational pull of the moon on earth varies and the amplitude of ocean tides also changes according to the relative position

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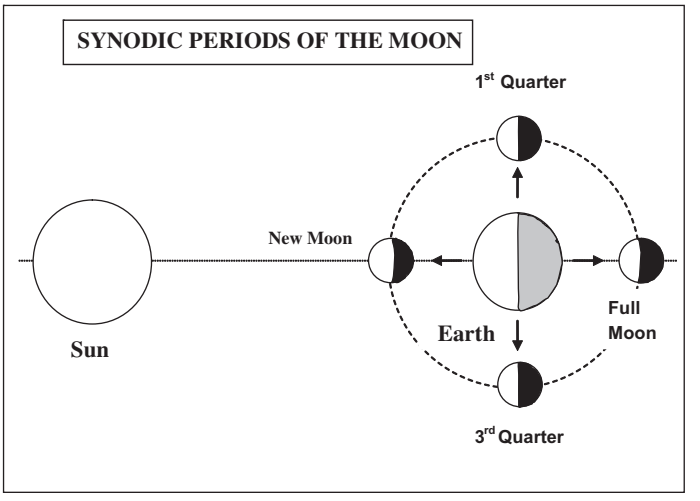

Figure 1. Position of the earth, the moon and the sun during the different phases of synodic periods of the moon. The arrow indicates the action of gravitational force of the moon and sun in opposite direction to the earth's gravitational pull.

of the moon in its orbit (Monkhouse 1971; Lieber & Sherin 1972; Myers 1995; Morgan 2001). When the moon is full or new, the gravitational force of the moon and the sun act in a straight line on the earth, and higher tides in NM and FM are due to the greater gravitational pull of the moon on these days (Monkhouse 1971; Lieber & Sherin 1972; Morgan 2001; Lahner et al. 2009). These high tides are known as spring high tides, and at the same time, the low tides are very low and low tides occur, when the earth, the moon, and the sun are in a line (conjunction or opposition). The gravitational forces of both the moon and the sun contribute to the tides (Morgan 2001) (Figures 2 and 3).

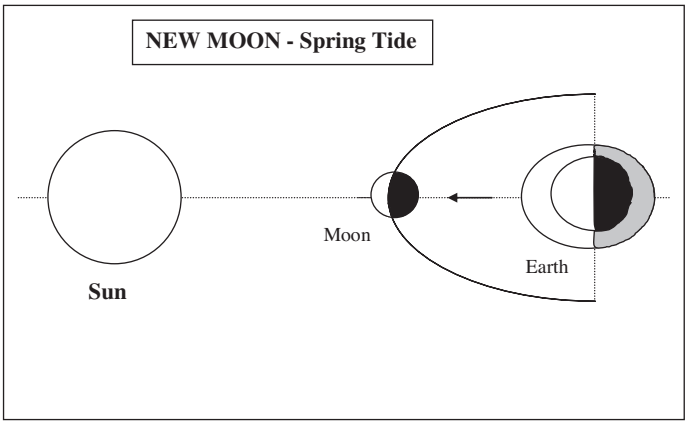

Figure 2. Position of the earth, the moon and the sun during NM days. The arrow indicates the action of gravitational force of the moon and sun acting in a straight line and in opposite direction to the earth's gravitational pull.

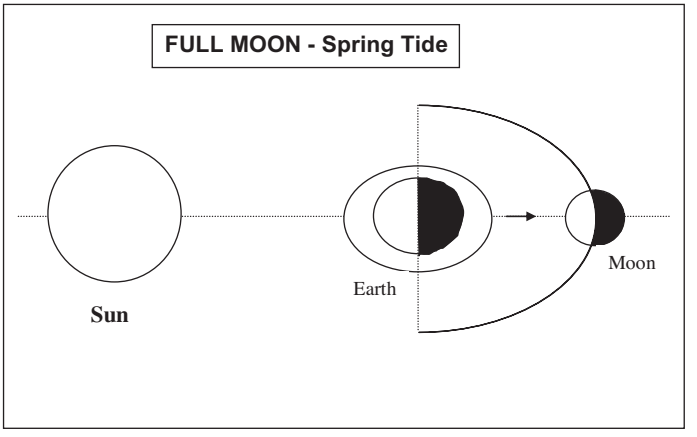

Figure 3. Position of the earth, the moon and the sun during FM days. The arrow indicates the action of gravitational force of the moon and sun in the opposite direction and acting in a straight line to the earth's gravitational pull.

During the moon's quarter phases (FQ and TQ), the gravitational pull of the sun and the moon work at right angles with respect to the earth and a smaller difference between high and low tides occurs known as a neap tide (Morgan 2001) (Figure 4). For a few days near the neap tide, a minimum variation occurs between high and low tides called "dead tide" and at the end, when the moon starts changing to another phase (to waning crescent), the tide is called "head of dead water" (Perkins 1974; Thurman 1997).

The idea that the stars and planets may influence human health and behavior can be traced as far back as Roman times where the moon was considered to be a supernatural power which played a significant role in the phenomena of nature and also on human behavior. Indeed, the word "lunacy" is derived from Luna, the Roman goddess of the

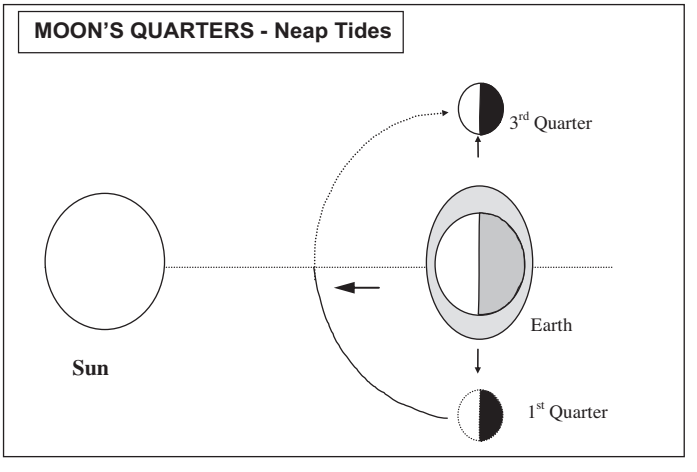

Figure 4. Position of the earth, the moon and the sun during 1st and 3rd quarter days. The arrow indicates the action of gravitational force of the moon and sun in the opposite direction and acting right angle to the earth's gravitational pull.

moon. The possible influence of the lunar cycle over psychological and physiological disturbances in the human being is a phenomenon that has now come to be known as "the Transylvanian Effect" in academic literature (Mason 1997; Owens & McGowan 2006). There are many reports that the biological system may be influenced by the position of the moon in its orbit. The reproduction and behavior of humans and animals are influenced by the different phases of the lunar month. According to the lunar phases, not only the activity of the human autonomic nervous system (Chakraborty & Ghosh 2013b) and the cardiovascular system but also the physical efficiency (Chakraborty & Ghosh 2013a) may also be changed.

Numerous investigations have been carried out and documented in the literature with regard to the effects of different phases of the lunar month on humans in general human health and diseases, human behavior and activity, and human reproduction in particular, but there is a controversy about the effects of lunar rhythm on human behavior and onset of diseases (Bauer & Hornick 1968; Nalepka et al. 1983; Martin et al. 1992; Mikulecky & Schreter 1993; Yvonneau 1996; Raison et al. 1999; Kollerstrom & Steffert 2003; Kumar et al. 2004; Biermann et al. 2005; Das et al. 2005; Polychronopoulos et al. 2006; McAlees & Anderson 2007; Terra-Bustamante et al. 2009; Bueno et al. 2010; Schuld et al. 2011). The aim of this review is to assess the effects of different phases of the lunar month on human health and diseases, human behavior and activity, and human reproduction.

2. Effects of lunar phases on humans

2.1. Effects on human health and diseases

From the studies it has been observed that the mental or physical health and diseases are associated with different lunar phases. But why has mental health become so uniquely associated with the FM? Perhaps this belief arose because of the disruption to sleep that would have occurred in societies regulated by lunar illuminance, thus sleep disruption and sleep loss would have occurred in association with the FM (Foster & Roenneberg 2008). Röösli et al. (2006) examined the influence of moon phase on sleep duration in a secondary analysis of a feasibility study of mobile telephone base stations and sleep quality. They studied 31 volunteers from a suburban area of Switzerland longitudinally over 6 weeks, including two FMs. The sleep duration varied with the lunar cycle, from 6 h 41 min at FM to 7 h 00 min at NM ($p < 0.001$) with the mean sleep duration of 6 h 49 min. Men slept 17 min longer than women ($p < 0.001$) and sleep duration decreased with age ($p < 0.001$). There was also evidenced that rating of fatigue in the morning was associated with moon phase, with more tiredness ($p = 0.027$) at FM.

The mechanisms by which the effect of lunar phases on biological organisms studied are unclear. However, many putative theories of lunar action have also been suggested. The effect of the moon on seizure occurrence may be secondary through a sleep-deprivation mechanism due to increased nocturnal illumination, especially before the invention of artificial lighting (Raison et al. 1999). For the investigation of a possible relationship between seizure frequency and the lunar cycle, Benbadis et al. (2004) reviewed the occurrence of seizures recorded in their epilepsy monitoring unit over a 3-year period. Analysis of the total number of seizures (epileptic plus non-epileptic) showed no significant association. It has been revealed from the analysis that non-epileptic seizure was increased in FM and epileptic seizure was increased in TQ.

Polychronopoulos et al. (2006) also analyzed the effect of lunar phases on seizure occurrence in an emergency unit and found a striking increase in overall seizure occurrences for both genders during the FM days (n = 294, 34.2%), while the rates of seizure occurrence were significantly lower ($p < 0.0001$) at all other phases of the lunar month, ranging between 21.4% for the NM days (n = 184) and 22.5% for the FQ (n = 193) and 21.9% for the TQ (n = 188). According to them, this may be due to the direct effect of the moon or an indirect effect via the influence of patients' behavior. But irrespective of scientific explanation, their results support a significant clustering of seizure occurrences around the FM days. According to Baxendale and Fisher (2008), there was a significant negative correlation between the mean number of seizures and the fraction of the moon illuminated by the sun ($\rho = -0.09$, $p < 0.05$). Terra-Bustamante et al. (2009) analyzed the incidence of Sudden Unexpected Death in Epilepsy (SUDEP) in their epilepsy unit over an 8-year period and found that the number of SUDEPs was highest in FM (70%), followed by waxing moon (20%) and NM (10%). No SUDEPs occurred during the waning cycle. So this result suggested that the FM has a correlation with SUDEP.

The most interesting example of human response during the synodic lunar cycle is the daily occurrence of gout attacks. There is a distinct cycling of gout attacks with highest peaks under the NM and FM. Thus, the maximal occurrence of attacks coincides with the peaking lunisolar tidal effect. Similar relation of attacks to synodic moon was seen in bronchial asthma of children, and a reciprocal one in paroxysmal tachyarrhythmia (Mikulecky & Rovensky 2000). The attack of atrial fibrillation in male subjects during a 14 year study is lowest in the FM and a marked increase to peak shortly after the extreme southern position of the moon in the tropic cycle (Mikulecky & Valechova 1996). A very recent study investigated that visual acuity was highest at the FM and lowest at the NM (Burke et al. 2012).

Takagi and Umemoto (2004) analyzed 130 abdominal aortic aneurysm (including iliac artery aneurysm) ruptures with consecutive urgent surgery in two hospitals and found that the ruptures occurred in 29 patients (22.3%) during NM period, in 47 patients (36.2%) during the waxing moon period, in 23 patients (17.7%) during FM period, and in 31 patients (23.8%) during the waning moon period. The frequency of abdominal aortic aneurysm ruptures was significantly higher during the waxing moon period than the other periods ($p = 0.03$, χ^2 test). Another study was carried out by Ali et al. (2008) about the impact of the lunar cycle and season on the incidence of aneurysmal subarachnoid hemorrhage (SAH). A total of 111 patients were admitted over a 5-year period to their department. They found that the numbers of aneurysm ruptures was significantly increased during NM (n = 28, $p < 0.001$). On the other hand, no seasonal variation in the incidence of SAH was observed. So the lunar cycle seems to affect the incidence of intracranial aneurysm rupture, with an increased risk during NM.

Román et al. (2004) compared the number of admissions in FM and non-FM days of 447 consecutive patients with gastrointestinal hemorrhage during a period of 2 years. They observed that there was an increase in the number of admissions related to gastrointestinal hemorrhage during FM (26 admissions in 25 days) compared with non-FM days (421 admissions in 713 days). Oomman et al. (2003) studied the incidence of acute coronary events and admission patterns in the departments of emergency medicine and cardiology from 1999 to 2001. Authors compared the admissions with unstable angina, non-ST elevation myocardial infarction (MI) and ST elevation MI on FM days with those on NM days and noticed that the admissions in NM was significantly higher than admissions in FM (p = 0.005). The subgroup analysis of mortality, post infarction

angina, effect on diabetics and hypertensive also showed the same trend. Thus, it is concluded that there is an increased incidence of acute coronary events associated with NM. Zetting et al. (2003) found that the lunar cycle was significantly associated with the number of requests for both follow-up appointments ($p = 0.007$) and new appointments ($p = 0.001$) at thyroid outpatient clinic. Requests for follow-up appointments had their highest peaks three days after the FM, whereas requests for new appointments were most frequent five days afterwards.

After analysis of a data set of 1,374,235 consultations from 60 general practices, they found that the best model was one in which the maximal effect was observed 6 days after the FM ($R^2 = 0.83$). There was a statistically significant, but small, effect associated with the lunar cycle of 1.8% of the mean value (Neal & Colledge 2000). The relation between spontaneous pneumothorax events and the synodic lunar cycle was studied by Sok et al. (2001) in a retrospective analysis of patients. The study was included a total of 244 patients (203 males and 41 females). Periodogram analysis revealed a 14 day rhythm, significant for the male and pooled sample. Cosinor analysis found the whole synodic lunar cycle and its 2nd, 4th, and 5th harmonics as significant. Maximal accumulation of cases happened 1 week before and 1 week after the NM, that is, around TQ and FQ. Ahmed et al. (2008) also determined a relationship between lunar phases and medically unexplained stroke symptoms. Authors analyzed a total of 7219 admissions during 167 complete lunar cycles. Stroke admissions were evenly spread throughout lunar phases ($p = 0.72$), but admission with medically unexplained stroke symptoms was significantly increased during FM phases ($p = 0.023$). The overall mortality and cardiovascular mortality data from Romania within 1989–1995 were processed by Střeštík et al. (2001). They found that the variation of mortality has a form of the semilunar wave with maximum two days before FQ and TQ. They also found the same semilunar variation in the sudden cardiovascular mortality data in Brno, Czech Republic (400,000 inhabitants), within 1975–1983. All these periodicities in both data sets (from Romania and from Brno) are only connected with the lunar month.

Payne et al. (1989) analyzed retrospectively a total of 815 male patients presenting urgently with urinary outflow obstruction and requiring immediate bladder decompression between August 1985 and July 1988 in Portsmouth, and January–June 1988 in Newcastle. They found that there were no significant circadian, monthly or seasonal variations of urinary retentions. Only with no apparent reason, annual variation in the numbers of retention was significantly lower in 1987 ($p > 0.005$). But one-third of the total patients in Portsmouth presented during the NM achieved significantly greater ($\chi^2 = 23.558$, df = 3, $p < 0.001$) in comparison with other lunar phases and a small secondary nonsignificant peak also observed in FM. Similar pattern of presentations with urinary retention was also seen in Newcastle.

Few reports found that there is no relationship between lunar phases and human health and diseases. Peters-Engl et al. (2001) found that the timing of surgery during any particular lunar phases of lunar cycle did not influence the survival of patients with breast cancer. Schwendimann et al. (2005) examined the association of in-hospital patient fall rates with lunar phases and found no significant result. There was no effect of FM on emergency department patient volume, ambulance runs, admissions, or admissions to a monitored unit during a 4-year study period in a suburban community hospital (Thompson & Adams 1996). There are no effects of different phases of lunar cycle on SAH (Lahner et al. 2009), acute MI (Wende et al. 2013) and hip arthroplasty (Ficklscherer et al. 2012).

2.2. Effects on human behavior and activity

Moonlight, especially around the three days of FM, would have permitted many activities, including work, hunting, travel and even social gatherings. Thus, real changes in many aspects of human behavior and activity pattern would have become associated with the lunar phase and various studies support this phenomenon (Foster & Roenneberg 2008). For identifying peoples' opinion about lunar effects in New Orleans, Italy, a questionnaire was sent to 325 people, out of which 140 individuals (43%) held the opinion that lunar phenomena alter personal behavior. Specifically, it came out that mental health professionals (social workers, clinical psychologists, nurses' aides) held this belief more strongly than other occupational groups (Vance 1995; Zanchin 2001).

The homicides in Dade County peaked at FM and showed a trough leading up to NM, followed by a secondary peak just after NM. The number of cases occurring within the 24 h before and after FM was significantly greater ($p < 0.03$). Twenty-four h after NM, the homicides committed in the next 24 h period showed a significant increase ($p = 0.003$). In Cuyahoga County starting 24 h after NM, the cases in the next 24 h period approached significance ($p = 0.07$); and starting 48 h after FM, the cases in the next 24 h period also approached significance ($p = 0.07$). Thus, findings of this study supported the relationship between the lunar synodic cycle and crimes of violence (homicides) (Lieber & Sherin 1972). Lieber (1978) also found that the homicides, suicides, fatal traffic accidents, aggravated assaults and psychiatric emergency room visits occurring in Dade County, Florida all showed lunar periodicities. Homicides and aggravated assaults were higher around FM. Psychiatric emergency room visits was higher around FQ and showed a significantly decreased frequency around NM and FM. The suicide curve showed correlations with both aggravated assaults and fatal traffic accidents, suggesting a self-destructive component for each of these behaviors. But Temte (1989) found that the psychiatric inpatient was significantly higher at TQ. Recently, Kazemi-Bajestani et al. (2011) discovered that frequency of inpatient admissions, severity of illness, aggressive behaviors and agitation were highest in the first and last parts of the three part model (lunar month is divided in three 10 day parts) and in the first and last parts of six part model (lunar month is divided in six 5 day parts) followed by second and fifth parts, that is, just after NM and FM. Another interesting study was carried out by Thakur and Sharma (1984) about the relationship between FM and crime committed in the area of three police stations (Gaya Sadar, Kirtya Nand Nagar and Sonari) of Bihar State from January 1978 to December 1982. Authors found that crimes committed in FM days were highly significant ($p < 0.001$) compared with NM and non-FM days. Thakur et al. (1980) also reported that the cases of self-poisoning were increased significantly on FM days compared with non-FM days ($p < 0.005$). On the other hand, Ossenkopp and Ossenkopp (1973) pointed out a different result that the self-inflicted injuries by poisoning was higher in FQ and smaller in TQ of the lunar cycle in the Winnipeg, Canada. Beside these, there is a positive correlation between the FM and incidence of psychological crisis (Snoyman & Holdstock 1980). Diagnosis of schizophrenia showed a significant change at the time of FM (Barr 2000). So from these studies, the existence of a biological rhythm of human aggression and quality of life which resonates with the lunar synodic cycle is postulated.

Biological rhythm occuring in the human body in conjugation with the lunar cycle interferes with food and alcohol consumption behavior (De Castro & Pearcey 1995). There was a significant ($p < 0.05$) lunar rhythm of nutrient intake with an 8% increase in meal size and a 26% decrease in alcohol intake at the time of the FM relative to the NM.

Kollerstrom and Steffert in 2003 reported the relationship between the lunar month and sex differentiated crisis-call frequency. They found that a significant increase in calls was recorded from females and a decrease in calls by males in NM, suggesting a sex difference in response, and there were proportionally more calls by males a fortnight later. Vandebosch et al. (2006) found a weak but significant positive relation between "the amount of television viewing" and "the percentage of the moon illuminated" in Denmark in 2002 (over a 12-month period). Owens and McGowan (2006) investigated the association between human biology or behavior (Transylvanian effect) and lunar phases. The number of misbehaviors on the day of FM was significantly higher than the number on any other day of the lunar period (Hicks-Caskey & Potter 1991).

There are some literatures reporting that there is no influence of lunar phases on human behavior and activity. Such as, there is no significant relationship between total violence and aggression or level of violence and aggression and any phase of the lunar month (Owen et al. 1998). There was no significant association detected between full, absent, and the moon's interphases and serious crimes of battery (Biermann et al. 2009). According to Laverty and Kelly (1998), occurrence of traffic accidents involving damage to property and involving nonfatal injury has no relationship with the total or half synodic and anomalistic lunar cycles or between the waxing and waning synodic cycle. Other studies discovered that crime (Karan et al. 2010), mood fluctuations of men and women (McFarlane et al. 2006), incidence of major trauma (Coates et al. 1989), frequency of contact with community-based psychiatric services (Amaddeo et al. 1997) did not differ significantly during different lunar phases.

2.3. *Effects on human reproduction*

The possibility of a lunar effect on the menstrual cycle was investigated in 312 university students by Zimecki in 2006. Out of them only forty-seven women menstruated in the light half of the month; therefore, ovulation tended to occur in the dark phase of the lunar period, that is, half cycle of the month from the TQ through the NM. Even women with irregular menses tended to ovulate during the dark phase of the lunar period. The author speculated that the lunar cycle is associated with the natural rhythm of electromagnetic radiation, which has an effect on the human menstrual cycle (Cutler 1980; Zimecki 2006). Cutler et al. (1987) also evaluated the lunar influences on the reproductive cycle in women, and it was demonstrated by them between the onset of menstruation, among women who have 29.5 ± 1 day menstrual cycles, and the onset of FM. It was established that those women tend to menstruate in the FM with a diminishing likelihood of menses onset as distance from FM increases. Another study was carried out by Law (1986) in a group of 826 female volunteers with a normal menstrual cycle. Out of them a large proportion (28.3%) menstruated around the NM, while at other days of the lunar month the proportions of menstruation were lower (8.8–12.6%) ($p < 0.01$). Also, the difference in 6-hydroxymelatonin level between menstruation and ovulation was significant ($p < 0.01$), indicating a correlation between melatonin level and the menstrual cycle.

Criss and Marcum (1981) investigated the lunar effect on fertility, which was peaked in TQ in New York City in 1968 ($n = 140{,}000$ live births). So, they suggested that the period of decreasing illumination immediately after FM may precipitate ovulation. A study was conducted by Weigert et al. (2002) and they investigated the effect of the lunar cycle on *in vitro* fertilization. The study covered a period of 7 years and concluded a borderline increase in pregnancy rates during the perigee cycle of the moon.

According to Stern et al. (1988), there was an influence of NM and FM on onset of labor and spontaneous rupture of membranes. Admissions during the year 1984 to the labor and delivery unit of a large urban hospital in Cleveland, Ohio, in spontaneous labor or with rupture of the membranes were analyzed. They found that there was a positive significant correlation (χ^2 = 5.018, df = 1, p = 0.025) of the onset of labor to the FM.

The possibility of the lunar effect on daily birth numbers was studied by Mikulecky and Lisboa (2002) in Passo Fundo, RS, Brazil, from 6 October 1997 to 30 April 1999. Periodogram analysis revealed a significant periodicity of 6.98 days and a significant peaking occurred in the tropic lunar cycle and its 4th harmonic. An analysis of 5,927,978 births found that more births occurred between TQ and NM, and fewer in FQ (Guillon et al. 1986). There was another study which suggested a connection between the distribution of spontaneous full-term deliveries and the lunar month. It showed that the mean day of delivery corresponds to the first or second day after the FM (Ghiandoni et al. 1997, 1998). Recently, Agay-Shay et al. (2012) also found a significant relation between lunar cycle and total birth numbers.

Valandro et al. (2004) examined the relationship between human spontaneous abortion (HSA) and lunar periodicity. For this purpose, they collected data of 1392 HSA from two university gynecological clinics and one public hospital division, at Padova, Northern Italy, between January 2000 and April 2003. They obtained acceptable significance values with a U-test ($n1$ = 3; $n2$ = 5; p = 0.05) and more efficient parametric t-test (df = 7; p = 0.0112 one tailed). They found a highly significant statistical differences of HSA in χ^2 test also (χ^2 = 145; df = 8; $p < 0.0001$) between the different phases of the lunar month.

It has been reported in some publications that there is no effect of lunar phases on human reproduction. Such as Das et al. (2005) found that there was no significant effect of any lunar phase on the incidence of biochemical pregnancy. In 1983, Nalepka et al. also observed no influence by FM or NM on the incidence of birth during their 3-year study period in a community hospital. There are no significant differences found in the frequency of births (Joshi et al. 1998; Staboulidou et al. 2008; Bharati et al. 2012), birth and birth complications (Arliss et al. 2005) during different phases of lunar cycle.

3. Discussion

The mechanism by which this periodicity is controlled is poorly understood. For some organisms, the changing amount of moonlight with the 29.531 day lunar cycle may be the controlling factor, but this concept does not stem from any concrete evidence, since the intensity of full moonlight is hardly more than 10^{-6} of noon sunlight (Clarke 1965). However, a second concept is that the lunar periodicities of different organisms may be affected by the amplitude of the tide which is highest at the times of NM and FM and lowest at the times of FQ and TQ of the moon (Morgan 2001). This concept emanates from the fact that most of the organisms showing lunar periodicities are marine in habitat (Marshal & Williams 1972; Neumann 1987; DeCoursey 1989; Naylor 2001; Yamamoto et al. 2008; Erisman et al. 2010). The tidal amplitudes are controlled by changes of the gravitational effects of the moon during the lunar cycle (Morgan 2001). In other words, the lunar gravitational fluctuations, according to this second concept, are responsible for the lunar periodicities exhibited by different organisms.

Myers (1995) defined two theories to address the influence of the moon on humans. In both of them, the gravitational effect has been directly or indirectly linked to the

changes of biological activity during lunar cycle. As the water mass of the planet is affected by the gravity, so the water mass of the body may also be affected. The second theory emphasizes that it is the disturbance in the electromagnetic field of the earth caused by lunar gravitational changes during the lunar cycle that brings about the behavioral changes.

Lieber and Sherin (1972) conclude from various medical and non-medical scientific disciplines that the moon via the effects of its gravitational forces on humans causes cyclic changes in water flow among the fluid compartments of the body (intracellular, extracellular, intravascular and intraluminal), as well as changes in total body water, termed as "biological tide", and which was stated as "human tidal wave" by Thakur et al. (1980). However, we still have no evidence that the sense organs of any organism can at all respond to the fluctuations of the moon's gravitational effects. Neither of the two concepts seem to be absolutely correct; lunar periodicities may occur in regions where tides are lacking or insignificant (Clarke 1965). It is thus likely that the organisms may have some intrinsic mechanism to time their activities according to the lunar cycle (Banerjee & Sarkar 1995). It has been reported that the autonomic tone was changed in different phases of the lunar month in Valsalva maneuver. The higher sympathetic and vagal activities were noted during Valsalva maneuver in NM and FM compared to that of other lunar phases (Chakraborty & Ghosh 2013b). Our other study indicates that the cardiovascular dynamics are influenced by the lunar cycle, and the factors regulating the cardiovascular system are influenced by the altered gravitational force of the moon in different phases of the lunar cycle. The exercise-induced cardiovascular changes (heart rate and blood pressure) are more prominent than in the resting condition. Moreover, the physical efficiency of humans is increased in NM and FM due to these altered cardiovascular regulations, which may be regulated by the higher autonomic tone on those days (Chakraborty & Ghosh 2013a). So, these altered autonomic and cardiovascular activities are probably two of the underlying causes to the changes of human physiology, and so human health conditions may be changed according to the different phases of the lunar month.

4. Conclusion

As the gravitational pull of the moon on earth varies in different phases of the lunar month, the ocean tides change according to the relative position of the moon. There are different types of effects of lunar phases in the human body reflected in different physiological, psychological or behavioral and reproductive changes. These changes occurred may be due to the disturbance of the electromagnetic field of the earth or may be due to the changes of lunar gravitational force on earth as well as changes of "human tidal wave" or "biological tide" during different phases of the lunar month. The altered autonomic activity during different lunar phases is probably one of the fundamental causes of the changes of human physiology.

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