

## THE DEPENDENCE OF VIGOR ON THE ENVIRONMENT

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*The last one of the authors (J.F.), an older woman, living in the state Tennessee, USA, has observed since long time a considerable decrease of her vigor, the feeling of exhausting, weariness etc. These episodes start usually on the beginning of summer and winter and last about two months. Following the recommendation of specialists she recorded every day in 2009/2010 the level of her vigor using a special index. The series of these whole year data displays as a most striking phenomenon a clear semiannual wave with sharp minima. However, their position does not correspond to solstices or equinoxes. Its annual course displays no similarity with the solar or geomagnetic activity. It seems that the period of decreased vigor starts always in the days with extremes in air temperature, i.e., in hot and cold days. This hypothesis is supported by the fact that deviations of the air temperatures from the normal annual course correspond well with the changes in vigor. Besides the optically most pronounced semiannual wave, a less pronounced wave with the period of about one month and the peak placed around the first quarter of Moon takes place. This wave is in the investigated range not present in solar or geomagnetic activity. In contrary, this cca 29-day-period wave agrees relatively well with the Moon's phases. It cannot be explained only by a possible influence of tides because they display strong semilunar periodicity and this is not quite clearly manifested in vigor. The most probable explanation could be a possible psychic influence of Moon's light. The maximum of vigor falls in the time, when the Moon is shining in evening, in the time of going to bed.*

**Keywords:** vigor, environment, temperature extremes, lunar phase

### INTRODUCTION

Vigor, or vitality, or physical condition, of a human being reflects his over-all physical and psychical status. The decrease of vigor manifests itself (or is accompanied) by the feeling of weariness, exhausting, sleeping, sometimes headache, troubles with stomach, joints and many other parts of one's body. All these difficulties have the physiological or psychical origin and together they contribute to a decrease of one's vigor. So the decrease of the vigor can signalize that something is not in order, earlier than the respective illness will manifest itself (Shirom et al., 2010, Shirom, 2011). Very frequent mental cause of the decrease in vigor is depression, even in the initial stage.

Vigor can be influenced also by some external factors. It is known that e.g. the influence of meteorological factors on the health and morbidity or on the psychical status cannot be neglected (Marktl and Machalek, 1983). Some these factors may deteriorate the respective illness and psychical status. For patients with depression it is a frequent case. As a consequence, some of the above mentioned difficulties increase and lead to the decrease of the vigor. It can be expected that external factors influence directly the vigor of some persons though they do not suffer from an illness. This point is not yet sufficiently investigated and known.

### MATERIALS AND METHODS

The last author (JF) is an older woman (62 yr at the time of the investigation) living in the town Memphis, Tennessee, USA. Since more than 20 years, she has regularly observed a considerable decrease of her vigor, together with feelings of exhaustion, weariness, sleepiness, etc. All these episodes have started regularly with the beginning of summer and winter, have lasted about two months and then all have returned to the normal status. Moreover, she has observed short periods when she felt herself a little better, and other short periods when she felt herself a little worse than in other days in the appropriate season. These fluctuations appeared during periods of her low

vigor as well as of her high vigor.

Some time ago, she contacted researchers in chronobiology and started to participate in the research in order to find the origin of her difficulties. These have been analyzed together with other medicine quantities, as e.g. blood pressure, heart rate etc. (Halberg et al., 2011a). In that time, a special attention has been turned to possible lunar influences (Halberg et al., 2011b).

In order to describe the "value" of vigor numerically she started to record the level of her vigor. For the whole year, from March 2009 to March 2010, she evaluated her vigor every three hours when she was not sleeping, usually from 6 a.m. to 9 p.m. During this period, she was not ill and did not leave her town, so that the obtained material can be considered as homogeneous. In the case of maximal vigor, i.e. full condition without any limitations, the value of vigor was denoted by 100. In the case of any difficulties, the estimated value obtained a proportionally lower value. For example, 60 = short intervals of work required frequent breaks, 30 = many symptoms and only very limited activity, 10 = only possible to move from the bed in bath and nothing more (more details see Halberg et al., 2011b). This evaluation is of course subjective; nevertheless, when the same person makes it for a long time in the same way, one may expect that all numbers will be comparable. From these estimated values, daily averages have been calculated.

### RESULTS

#### Semiannual periodicity

Daily values of the estimated vigor during the complete investigated period are graphically represented in Fig. 1 together with their smoothed course calculated after Woolhouse formula. Very rapid decreases at the beginnings of summer and winter, and very rapid increases after two months are clearly seen. At the same time, short periodical fluctuations with the period of about one month are also apparent. Hence, two periodicities in the obtained material are pronounced – the semiannual wave and the circatridecadal one.

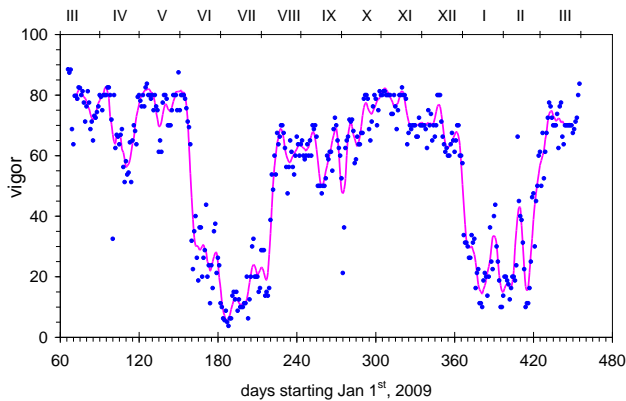


Fig. 1. Daily values of vigor from March 2009 to March 2010 (blue points) and their smoothed course (red line).

The semiannual period has the form of a nonsymmetrical wave with short minima and long flat maxima. The time difference between two minima (2009 and 2010) is seven months, though the half-year distance should be expected. However, one cannot conclude that there is a 14-months periodicity, because of the length of the period of observation. Moreover, periods of low vigor, as JF says, come every year regularly nearly in the same time. Probably there is a similar effect as it appears often in air temperatures: in some years, February is colder than January and therefore the distance between this winter minimum and the preceding one (when January was the coldest month) appears to be 13 months instead of 12. This point will be treated later in details.

Now there is a question, what is the cause of the strong semiannual periodicity. From among many possibilities, meteorological factors can be expected to be the most probable. However, all meteorological quantities, as air temperature, air humidity, cloudiness, precipitation etc., display only annual variation and not a semiannual one, therefore the correlation between the vigor and any meteorological quantity is very poor, nearly zero. The same is valid for the length of the day (i.e., summer – winter).

On the other hand, it would be possible to expect that the decrease of the vigor is connected with extreme conditions, i.e., too high temperature in summer and too low temperature in winter. The climate in Tennessee has a more continental character than that in the Central Europe. Geographical latitude of Tennessee corresponds to that of Cyprus, Crete or Gibraltar, but the climate is somewhat colder than in the mentioned localities because the temperature in Europe is influenced by Gulf Stream. Maximal temperatures in summer usually stay between 30 and 35 degrees centigrade for a long time, daily averages being between 25 and 30 degrees. Minimal temperatures in winter fall often under  $-10$  degrees and daily averages are often deep under zero (Fig. 2). In 2009, maximal temperatures in summer were reached to the end of June, and later in summer higher temperatures than these did not occur. This unusual course agrees well with the observed minimum of vigor. In winter (January and February), the course of temperatures displayed considerable fluctuations and this effect again agrees well with the observed fluctuations in vigor. The unusual course of the summer temperature in 2009 (the air temperature maximum occurs earlier) explains why the distance between both minima of vigor in Fig. 1 is not just six months. Though a longer series of observations is not yet available (because it is difficult to provide such observations for a long time), the above described explanation can be considered as very probable due to the coincidence in details.

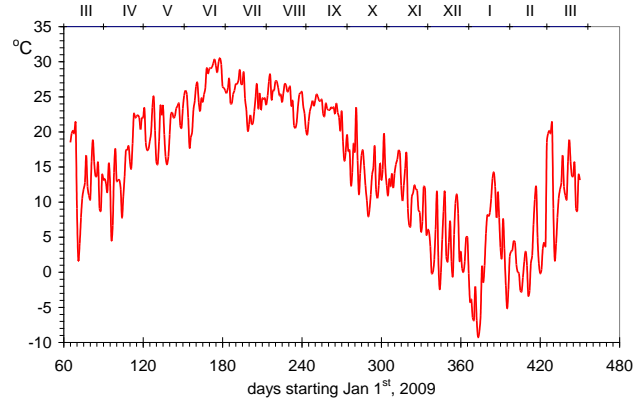


Fig. 2. The course of daily mean temperatures in Memphis, Tennessee, during the period of investigation.

Subdividing the whole data set into the summer and the winter part, taken from the equinox to the next one, correlations between the air temperature and the observed vigor become significant. In summer, the decreased vigor corresponds to higher air temperature, coefficient of correlation being  $-0.53$ . In winter, the decreased vigor corresponds to lower air temperature with coefficient of correlation being  $+0.52$ . In both cases is the correlation high significant (the limit of the 95 % significance is 0.15). Using smoothed data (five-day running averages), the correlation is even higher:  $-0.71$  in the summer and  $+0.64$  in the winter part Fig. 3).

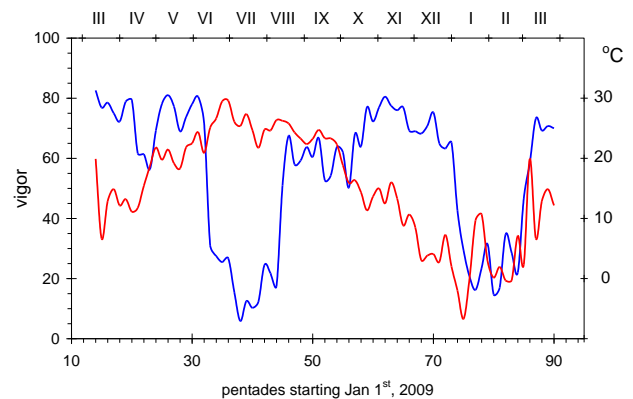


Fig. 3. Smoothed course (five-days running averages) of the vigor (blue, left-hand scale) and mean daily air temperatures in Memphis, Tennessee (red, right-hand scale), during the period of investigation.

The dependence of the vigor decrease on extreme temperatures can be presented also in another form. Mean vigor in days when the daily mean temperature moved between  $-10$  and  $-5$  °C, then between  $-5$  and  $0$  °C etc. has been determined. This is shown in Fig. 4 for each interval together with the mean error. A different error is given by the number of days in the respected interval. Vigor described by the index 50 or more is observed only in days with the mean temperature between  $0$  and  $25$  °C, in warmer and colder days it sinks rapidly down.

Another factor, which may influence the vigor, is the geomagnetic activity. This activity displays also a semiannual periodicity, its maxima occurring around the equinox. However, in 2009, the geomagnetic activity was generally very low and its annual variation differed much from the usual one: a strong maximum in December, other maxima in March and July with a weak minimum in May. Correlation coefficient between the vigor and geomagnetic activity is negative but very poor ( $-0.11$  for the individual days,  $-0.16$  for pentads), under the limit of the 95 % significance, so that the influence of the

geomagnetic activity is negligible.

The semiannual periodicity is observed also in the tidal acceleration. Its maximum appears in the time when the Sun culminates (upper culmination takes place in June, lower one in December). Just after the culmination, the decrease of vigor has been observed. However, for the tidal acceleration, the semiannual periodicity is much weaker than the semilunar one, whereas for the vigor the semiannual periodicity is the most pronounced one. Therefore the correlation between tidal acceleration and vigor is very poor, the coefficient being under the significance level.

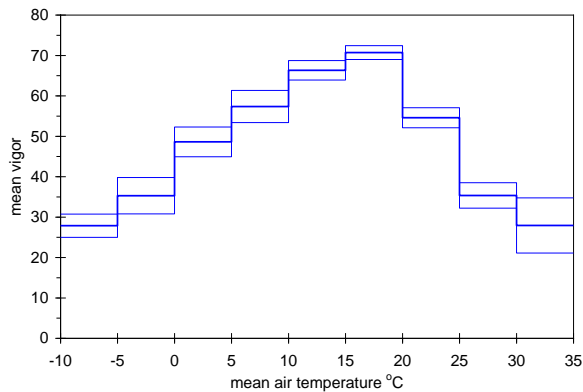


Fig. 4. Mean values of vigor in days when the observed mean air temperature in Memphis, Tennessee, did not overstep the given limits. Thin lines denote the mean error.

### Lunar periodicity

After the long-term variations have been subtracted from the original data, a new series has been obtained, in which many short-term fluctuations are seen more clearly than in the original data (Fig. 5). Waves with the periods about one month are conspicuous at the first sight, especially when the smoothed curve is used instead of the unsmoothed data. These variations are not stable, their period and amplitude fluctuates sometimes considerably with time. Vertical scale in the Figure tells that these waves have much smaller amplitudes than the semiannual wave.

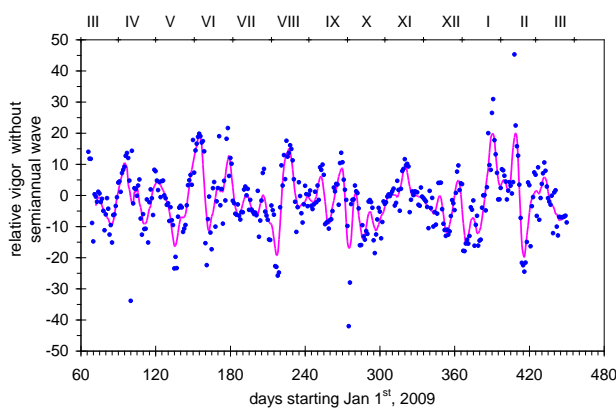


Fig. 5. Daily values of vigor from March 2009 to March 2010 after removing its semiannual variation (blue points) and their smoothed course (red line).

There is a question what could be the origin of the quasitridennial period appearing at the vigor index. The fact that the investigated person is a woman suggests that this periodicity could be done by the woman menstruation cycle, the length of which moves usually near 28 days. However, this person is an older one (62 years) and it makes this explanation doubtful. One can perhaps suppose that the appropriate

biorhythm continues further though it does not manifest itself, but in the case of the investigated person, no direct evidence is available, e.g. in the form of a measurement of any suitable quantity. It would be necessary not only to prove, that this cycle exists and continues, but also that its course (maxima and minima) agrees with the observed fluctuations of vigor.

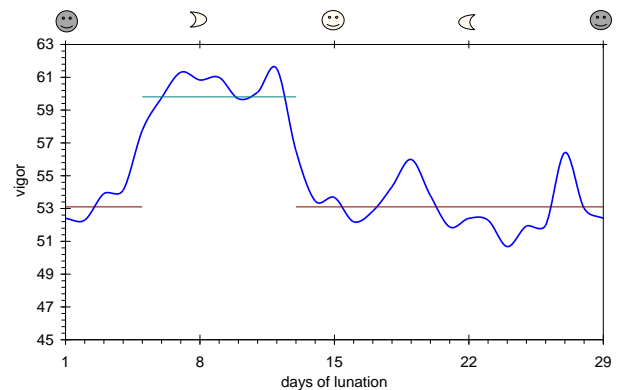


Fig. 6. Lunar variation of the vigor from March 2009 to March 2010. Horizontal lines mark the mean vigor in the individual parts of the lunar cycle.

Solar and geomagnetic activity displays also a variation with the period near 27-28 days. Its origin is the solar rotation, therefore observed disturbances repeat after 27-28 days. However, due to the very low general activity in 2009 this periodicity is not pronounced in solar nor in geomagnetic activity. Therefore, the observed periodicity in vigor in the same range cannot be caused by an expected similar periodicity in solar or geomagnetic activity. Tidal effects display a strong semilunar wave supplemented by a smaller lunar wave. Because in vigor a lunar wave prevails, tidal effects cannot be considered as a possible source as well.

The last possibility is the direct influence of the Moon, the factor that is usually considered as doubtful because there is no known mechanism how it could work. Lunar and semilunar periodicity connected with lunar phases can be discovered by the method of superposition of epochs. When the mean vigor in the individual days of the lunation has been calculated, a very strong dependence on the lunar phases appears (Fig. 6). The course consists of two very different parts – a very short expressive maximum around the first quarter, between the 5<sup>th</sup> and 13<sup>th</sup> day after the new moon, and a long minimum between the 14<sup>th</sup> day after the new moon and the 4<sup>th</sup> day after the next new moon. The fluctuation inside these two parts is relatively small, whereas the difference between the mean vigor in the first and the second part is strong: it reaches 59.8 in the first part and only 53.1 in the second one. The significance test shows that this difference is high significant, Student parameter  $t = 8.1$ . This is given especially by the small fluctuations inside both parts. The semilunar wave is not pronounced in Fig. 6 at all. The asymmetrical form of the lunar variation (short maximum and long minimum) means that this course cannot be given by any periodical process in the environment.

Nevertheless, the explanation of the observed lunar variation is very simple – no astrology, no somnambulism, and in no case any undiscovered Moon's radiation or forces (see also review of undiscovered lunar forces in Kelly et al., 1985-6). The higher and lower vigor in specific parts of the lunar cycle are done by the psychic influence of the Moon's light. Windows of the sleeping room of the investigated person are situated to the South-West, and no high trees make shadow and no lamps in the street illuminate the room. So in the evening hours, when usually people are going to sleep, the room is a little illuminated by the Moon's light, but only in the days with a certain lunar phase. Short after the new moon, the Moon is very thin and sets

under the horizon too early. Short before the full moon the Moon starts to shine too late and not in the windows. Therefore the most suitable time for the illumination of the room is just the same as that with high vigor as shown in Fig. 6. In other days when the Moon does not illuminate the room, is this room totally dark. The darkness affects sensitive persons; they feel themselves bad, some of them are afraid of the darkness. Probably they think of stories, which they heard in their childhood, when evil people and ghosts appeared in the dark night. For these sensitive persons it is difficult to start sleeping under these conditions, in the next days they feel not well, and it all demonstrates itself in the decreased vigor. Of course, in days with clouded sky this mechanism does not work, all evenings are dark independently on the Moon's phase, but such days are not so numerous and the number of days with Moon's light is sufficient to produce the above described effect.

## CONCLUSION

We investigated repeating strong decreases of the vigor of an extremely sensitive older lady and found two periodical variations caused by two different factors. There is a question how this decrease can be restricted, in other words, how the effect of unfavorable factors can be suppressed.

The first factor is the high sensitivity on extreme air temperatures – hot summer and cold winter. Though the period of investigation is too short, this explanation can be accepted because the decrease of vigor agrees well with smaller variations and irregularities in the course of the air temperature. Temperature extremes affect the organism as a burden. It is not able to defend itself adequately. This all leads to symptoms described above. When the temperature approaches to the normal, difficulties decrease. The most effective solution is the most radical one: simply to move in other region (in other state in the USA) with less continental climate, where hot summers and very cold winters do not take place. If not possible, it is enough to move in other region only for shorter time, for weeks with the unfavorable weather.

The second factor is of psychical origin. The vigor is higher only when sleeping room is illuminated by the Moon's light during the evening time when people are going to sleep. Thick darkness certainly promotes the depression and only in short times without thick darkness is the depression weaker. The solution of this problem is simple. To exclude the fear of the darkness it is quite sufficient to illuminate the sleeping room by a weak light which supplies the Moon shining on the street.

Most people, of course, do not suffer from such kind of decreased vigor and problems described here do not concern

them. Nevertheless, similar problems may appear at some people in a smaller extent. They may try to solve them in a way described here. In any case, because the depression cannot be excluded, patients with similar problem should consult their problems with a psychiatrist. The treatment of the depression could reduce the sensitivity to all above mentioned disturbing factors. The depression, of course, is not necessarily the only or the main cause of the decreased vigor. In such a case no strong regular periodicities would be observed. Therefore the above recommendations are valid in all cases. Moreover, the knowledge itself of the cause of the problem may be sufficient and may help to remove the effect of unfavorable circumstances which contribute to the decreased vigor and living standard.

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