

Evolutionary-rooted models for denial of pregnancy, concealment of pregnancy and pseudocyesis

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ABSTRACT

Women in denial of pregnancy remain unaware of their gravid state. Typically women in labor present to emergency units while attributing their pain to unrelated causes. In higher risk cases, women experience unassisted delivery in a non-hospital setting. In concealment of pregnancy, the woman knows about her pregnancy but keeps it secret for diverse reasons. This induces also a lack of prenatal care and increased perinatal risks for mother and child. Such cases are very challenging to clinicians because of increased medical risk and psychological needs. Better understanding of these psychosomatic disorders is necessary to address the public-health issues raised.

In regard to denial and concealment of pregnancy, in which a pregnant woman thinks or says she is not pregnant, pseudocyesis corresponds to the opposite configuration in which a non-pregnant woman believes, claims and presents objective signs to be pregnant. Pseudocyesis takes therefore place in the same psychosomatic issue to be addressed. This paper aims to explain satisfactorily these psychosomatic disorders of gravida status.

We consider human reproduction in regard to evolution with emphasis on the various forms of parenting existing among sexually reproducing species. This evolutionary study highlights that for some pregnant women, the forthcoming maternal status may be internally appraised as psychologically-unacceptable because of diverse personalized causes. The ongoing pregnancy enters then into conflict with the intense fears triggered by the promise of motherhood. From this perspective, denial and concealment of pregnancy are satisfactorily explained as transitory means to cope with such an internal conflict by pursuing pregnancy while containing associated fears. In the absence of conflict resolution, the avoidance means is protracted over time, sometimes until an unexpected delivery.

Reversely, pseudocyesis is explained as an attempt to obtain a psychologically-indispensable maternal status in the absence of actual pregnancy. Specific conflict formulations are elucidated for each type of psychosomatic disorder of gravida status considered. These formulations, related to subjective internal appraisals, comply with the huge diversity of causative events reported in literature and specific to each woman concerned.

These explanations will help clinicians in caring those high-demanding patients and in exploring individualized causative events of such challenging experiences.

Keywords: Denial of Pregnancy, Concealment of Pregnancy, Pseudocyesis, Parenting, Motherhood, Psychic Conflict, Evolution.

1 BACKGROUND

Denial of pregnancy, concealment of pregnancy and pseudocyesis have been acknowledged for a long time even if underlying psycho-physiological mechanisms remain unclear today. In their 1897 collection of anomalies and curiosities of medicine, Gould and Pyle already compile several cases of both unconscious pregnancies and pseudocyesis Gould and Pyle (1897). Concealment of pregnancy seems easier to be understood since the pregnant woman is aware of her condition but keep it secret for diverse reasons such as fears of reject or abandonment. At a first glance, there is no more than malingering behind this syndrome but this would miss the actual strength of the woman's psychological despair Murphy Tighe and Lalor (2016). In denial of pregnancy the woman herself remains unaware of her own pregnancy and the usual signs of pregnancy may be absent, significantly reduced or misinterpreted, sometimes with a surprising degree of naivety Milstein and Milstein (1983); Milden et al. (1985); Brezinka et al. (1994); Spielvogel and Hohener (1995); Lee et al. (2006); Spinelli (2010). Concealment and denial of pregnancy are often undifferentiated under the diverse denominations of unconscious, secret, ignored or cryptic pregnancies Gould and Pyle (1897); Murphy Tighe and Lalor (2016); Tursz and Cook (2010); Del Giudice (2007) or merged into the concept of negated pregnancy Beier et al. (2006). The main difference lays indeed in the woman's awareness and no-one else than the woman herself is able to differentiate those conditions with certainty Milden et al. (1985). For some people, health professionals included, the existence of denial of pregnancy remains uncertain today. This confusion can also be understood because concealment and denial of pregnancy are not clearly distinct conditions but correspond rather to a continuum with a fluid transition from conscious adaptation strategies to unconscious defense mechanisms Brezinka et al. (1994); Beier et al. (2006). Cases of intermittent awareness of pregnancy were reported and tied to the concept of "middle knowledge" Brezinka et al. (1994). Pregnancy may also begin with denial and continue with concealment once the woman becomes aware of her gravid state.

From a clinical point of view, denied and concealed pregnancies correspond to a public health issue because of diverse associated risks, namely the lack of prenatal care ; the non-anticipation of delivery ; the possibility of unattended delivery in a non-hospital setting and the psychological state of parturient women. Increased maternal and neonatal risk levels were confirmed by different studies Wessel et al. (2003); Haddrill et al. (2014); Schultz and Bushati (2015). Neonaticide is also a rare but dramatic consequence of negation of pregnancy Craig (2004); Putkonen et al. (2007); Huchzermeier and Heinzen (2015); Oberman (2003); Porter and Gavin (2010); Ellonen et al. (2015). Furthermore, the patient - clinician relationship can be impaired if caregivers are insufficiently informed of those syndromes and remain skeptical of the woman's words. A better understanding of those psychosomatic disorders is therefore necessary.

Pseudocyesis, that is commonly named false pregnancy, is defined in the DSM V as : "*a false belief of being pregnant that is associated with objective signs and reported symptoms of pregnancy, which may include abdominal enlargement, reduced menstrual flow, amenorrhea, subjective sensation of fetal movement, nausea, breast engorgement and secretions, and labor pains at the expected date of delivery*". This condition does not raise significant obstetrical issues and main risks concern the woman's mental health Gould and Pyle (1897); El Ouazzani et al. (2008). However, pseudocyesis can be seen as a "reverse syndrome" of denied or concealed pregnancies since the claim for pregnancy in a non-pregnant woman corresponds to the opposite configuration of denied or concealed pregnancies in which a pregnant woman thinks or claims she is not pregnant. False pregnancies cover different conditions with an analog discrimination of the unconscious condition from variants involving a psychiatric condition or some degree of woman's awareness O'Grady and Rosenthal (1989); Tarín et al. (2013); Seeman (2014). The inclusion of pseudocyesis in the exploration of psychosomatic disorders of pregnancy may

therefore help in exploring underlying mechanisms or in evaluating the different hypotheses.

This paper aims to elaborate a common framework suited to explain the diverse psychosomatic disorders of gravida status satisfactorily. For that purpose, we consider parenting in regard to evolution and observe the existence and the various forms of parental investment across sexually reproducing species Clutton-Brock (1991). We observe that parenting appeared recently as a supplementary function that is both high-performing and costly. The parental investment is particularly high in humans of which infants remain dependent on their caregivers for several years after birth Geary and Flinn (2001); Bjorklund et al. (2002). Psychological adjustments triggered by the birth of a descendant seem also paramount in our species. Human reproduction is thus tied to complementary aspects: i) to give birth to a new individual sharing many genes and ii) to become a parent with inherent parenting charges and psychological adjustments. As a result of evolution and natural selection, those complementary aspects function accordingly in most cases. Normal psychological changes experienced by pregnant women can even be seen as autonomous processes aimed to tune those aspects with each other. We claim, however, that in a minority of women, unresolved painful memories may cause psychic conflicts opposing those complementary sides of reproduction. We then explain psychosomatic disorders of gravida status as means to transitory cope with such psychic conflicts. For each type of disorder, this approach allows the elucidation of a satisfactory conflict formulation matching the huge diversity of clinical observations.

2 CURRENT KNOWLEDGE ON PSYCHOSOMATIC DISORDERS OF GRAVIDA STATUS

Only a few authors Milden et al. (1985); Brezinka et al. (1994); Beier et al. (2006); Kenner and Nicolson (2015); Sandoz (2016a) did address denial of pregnancy, concealment of pregnancy and pseudocyesis as possibly-related forms of psychosomatic disorders of gravida status and most papers in literature address those dysfunctions separately. First research were carried out in an attempt to document the most incomprehensible and the most dramatic cases. As a rare but fatal consequence of negation of pregnancy, neonaticide was explored by different groups worldwide, sometimes from the systematic study of judicial files and without specific interview of the incriminated women Ellonen et al. (2015); Friedman and Resnick (2009). The reported results are therefore representative of the most dramatic cases and their extrapolation to other cases of denied or concealed pregnancy must be carried out cautiously. Similarly, denial of pregnancy seems more difficult to understand than concealment of pregnancy and was therefore the subject of a larger number of scientific papers. Pseudocyesis was mainly addressed in regard to its psychological, socio-cultural and neuro-endocrinological aspects O'Grady and Rosenthal (1989); Tarín et al. (2013); Seeman (2014); Miller and Maricle (1988); Ouj (2009).

2.1 Current understanding of denial of pregnancy

The most commonly used definition distinguishing denial of pregnancy from concealment of pregnancy considers three different denial categories: pervasive, affective and psychotic denials of pregnancy Miller (2003). In the pervasive case, the woman remains unaware of her pregnancy and associated physiological symptoms and perceptions are mis-interpreted, significantly reduced or even absent Brezinka et al. (1994). In the affective case, the woman is aware of her pregnancy but does not experience the normal emotional adjustments and behaves as if she was not pregnant. She does not attend prenatal care and does not anticipate delivery. Rather than the pregnancy itself, it is its significance and consequences that are actually denied. Psychotic denial of pregnancy concerns women who tend to be chronically mentally ill and remain psychotic before, throughout and after pregnancy Jenkins et al. (2011). This type of denial of pregnancy is usually addressed specifically for that reason and, accordingly, we discard this type.

A one year prospective study in Berlin involving 29462 women determined an incidence for late awareness of pregnancy (> 20 weeks) of 1/475 living births and of 1/2455 for totally unexpected delivery Wessel et al. (2002). From projecting this ratio to a country like Germany, about 300 cases of totally unexpected, and therefore unanticipated and unprepared, births can be expected yearly. The consecutive public health issue has raised the interest of researchers and diverse risk factors for non-psychotic denial of pregnancy were identified, among which: low socio-educational status Dayan and Bernard (2013); Struye et al. (2013); lack of social support Dayan and Bernard (2013); the woman's own maternal deprivation Spielvogel and Hohener (1995); acute or chronic psychosocial stressors Brezinka et al. (1994); a history of emotional, physical or sexual abuse in childhood Dayan and Bernard (2013); conflicting or repressed sexuality Spielvogel and Hohener (1995); Friedman et al. (2007); Bonnet (1993); rejection of the fetus Spielvogel and Hohener (1995); anger toward the baby's father Spielvogel and Hohener (1995); fear of abandonment Friedman et al. (2007); memory or anticipation of custody loss Friedman et al. (2007); Miller (2003). Denial was also observed in otherwise well-adjusted women that respond to none of these conditions Jenkins et al. (2011). It is thus commonly accepted that the heterogeneity of affected women prevents the definition of a clear-cut typology of a pregnancy denier Jenkins et al. (2011); Wessel et al. (2007). However, beyond the diversity of this list of external risk factors, it must be noted that the hypothesis that a psychological conflict may constitute an underlying cause for denial of pregnancy appears recurrently in research papers for 40 years Jenkins et al. (2011); Uddenberg and Nilsson (1975); Sandoz (2016b).

Denial of pregnancy was also addressed from the physiological perspective tied to the actual repression of normal signs of pregnancy observed in a proportion of pervasive cases. It is worth noting two interesting results: On the one hand, the persistence of cyclic menstruation-like bleeding during denied pregnancies could not be associated with a hormonal cause from a study carried out immediately after delivery in 28 women who denied their pregnancy Wessel and Endrikat (2005). On the other hand, the spontaneous and immediate onset of normal pregnancy signs as usually triggered by pregnancy announcement confirms the psychic origin of denial of pregnancy Sandoz (2011).

2.2 Current understanding of concealment of pregnancy

Once a woman who suspected a pregnancy has confirmed her gravid state, she may take a few days to reveal it to her family and friends without any aim to conceal it. Therefore, to consider a temporarily unrevealed pregnancy as a concealed one requires a formal definition. Several authors consider a pregnancy as concealed when the woman presents for prenatal care past 20 weeks of gestation and did not disclose her pregnancy to her social network Wessel et al. (2002); Conlon (2006); Thynne et al. (2012). Few studies did explore the prevalence rate of concealment of pregnancy and reported results present variability. In the German study, the rate of concealment of pregnancy is below 1/1178 living births Wessel et al. (2002). Several studies in Ireland report variable rates, from 1/146 to 1/768 births with differences between rural and urban areas Conlon (2006); Thynne et al. (2012); Lalor and Murphy Tighe (2016). However, Irish studies do not clearly distinguish between denial and concealment of pregnancy and this may partially explain the reported variability in prevalence rates. We note that Conlon considers '*concealment of pregnancy*' as a subtype of a '*concealed pregnancy*' category together with '*unconscious and conscious denial*' subtypes that correspond to the '*pervasive and affective denial*' subtypes of Miller's classification Conlon (2006). Such a subtle distinction in definitions may result in confusion and a clearer nomenclature is recurrently claimed in literature Murphy Tighe and Lalor (2016); Beier et al. (2006); Vellut et al. (2012).

We know that the societal belief that concealment of pregnancy would only affect teenagers

is wrong and that women of all reproductive age and socio-educative status can be concerned Friedman et al. (2007). In many cases, the pregnancy is concealed because in her mind, the woman subjectively appraises it as unacceptable to others for diverse reasons such as: guilt for premarital/extramarital sex, fear of abandonment, lack of support to mother the child... Murphy Tighe and Lalor carried out a concept analysis from available bibliography Murphy Tighe and Lalor (2016). In addition to detrimental consequences for woman, infant and society, they identified the following antecedents and attributes of concealment of pregnancy: (antecedents) *aware of pregnancy; fear (of others or for others); compares own situation to societal norms & expectations; context-relationship/finances/culture/religiosity; perceives a lack of support or mechanism to mother the child* (attributes) *secrecy; hiding; daytime story; staying away; avoidance*. The complex psychological distress experienced by women concealing their pregnancy may include fear, stigma and isolation Murphy Tighe and Lalor (2016).

Sometimes the woman conceals her pregnancy because of pressure by (a) significant other(s). Such cases cover different configurations since pressure can be exerted either explicitly, for instance through verbal injunctions, or implicitly through indirect communication features repeated over time, or through a subtle mix of both forms. Such a woman's subordination is not restricted to procreation issues and all aspects of the woman's life may be controlled to some extent by others. Therefore, these cases go beyond the woman's own psychology to involve patterns of system-based psychology at a familial and/or sociocultural level. However, they can be related to antecedents defined by Murphy Tighe and Lalor, notably: *fear of others, compares own situation to societal norms & expectations* and *context-culture/religiosity* Murphy Tighe and Lalor (2016). For adolescents and women with low economic status, the antecedent *context-finances* may also apply.

2.3 Current understanding of pseudocyesis

With respect to denied and concealed pregnancies, pseudocyesis corresponds to the reverse dysfunction with an analogous continuum from the unconscious condition to conscious coping strategies. Pseudocyesis vera fits with the definition by DSM V in which the woman firmly believes to be pregnant and experiences the signs of pregnancy in the absence of actual pregnancy. Small emphasizes on the heterogeneous character of pseudocyesis and lists diverse alternative denominations: spurious pregnancy, feigned pregnancy, imaginary pregnancy, hysterical pregnancy, brain pregnancy, wind in the bowels, and grossesse nerveuse Small (1986). In these variants, the woman's belief is based on minor symptoms and/or involves some degree of misinterpretation, delusion or malingering. Supplementary formulations such as false, phantom, delusional, deceptive, or erroneous pseudocyesis can be found in literature O'Grady and Rosenthal (1989); Tarín et al. (2013); Seeman (2014); Drife (1985). The frequency is thought to have decreased during the last decades thanks to the improvement of pregnancy tests and ultrasound imaging. However, pseudocyesis still exists today, especially in developing countries in which there is a strong sociocultural pressure on women to be fertile El Ouazzani et al. (2008); Tarín et al. (2013); Ouj (2009). Differences in inclusion criteria may also contribute to the wide range of incidence reported, from 1/22000 births in the United-States of America, to 1/200 births in South Africa Tarín et al. (2013).

Pseudocyesis was mainly addressed in regard to the underlying psychological profiles, the associated sociocultural patterns and the neuro-endocrinological mechanisms responsible for the onset of pregnancy symptoms in a non-pregnant women. The neuro-endocrinology of pseudocyesis remains unclear today despite some contributive traits also involved in polycystic ovarian syndrome and in mild to major depression were identified Tarín et al. (2013). The psychological stress is commonly associated with internal conflicts and/or paradoxical needs such as in women who wish for children but fear for becoming pregnant Tarín et al. (2013); Small

(1986). In accordance with literature accounts, Paulman classifies the underlying causes into three categories of etiological hypotheses Paulman and Sadat (1990). *i*) Conflict theory: Signs and symptoms of pregnancy result from endocrine changes triggered by the internal conflict caused by desire or fear of pregnancy; *ii*) Wish-fulfillment theory: minor changes initiate the false belief in pregnancy in susceptible individuals; *iii*) Depression theory: The neuroendocrine changes associated with a depressive disorder may initiate pseudocyesis symptoms and beliefs. However, the elucidation of a model consistent with the diversity of clinical cases reported is still lacking.

3 PSYCHOLOGICAL ISSUES IN A WOMAN WHO BECOMES A MOTHER

Even wanted and uncomplicated pregnancies raise significant psychological challenges to the women's psyche. Almost 60 years ago, Bribing postulated that "*pregnancy, like puberty or menopause, is a period of crisis involving profound psychological as well as somatic changes*" Bribing (1959). 15 years later, Uddenberg described the para-natal period (pregnancy and puerperium) as: "*a period of maturational crisis during which the woman must integrate past and present experiences in order to adapt to her new tasks as a mother*" Uddenberg and Nilsson (1975). These early views were confirmed by different authors and the woman's transition to motherhood is known to involve several psychology phases Slade et al. (2009). The latter are often grouped in three main steps that roughly correspond to the three trimesters of pregnancy and appear to be triggered by various psychological, biological and cultural influences Philipp and Carr (2001). The fundamental task of the first step consists in accepting the pregnancy. Especially at this early stage ambivalence is common in the expectant mother and the development of uncomfortable physical symptoms can be viewed as a contributing cause.

The main task of the second psychological step consists for the woman in initiating an emotional affiliation, or attachment, to the fetus and to recognize him/her as a separate individual contained within her Philipp and Carr (2001). This step was historically considered to be triggered by the perception of fetal movements but, nowadays, an earlier progression into this step may result from fetal ultrasounds that make the existence of the fetus more real. While the woman begins to recognize the fetus as a separate entity, issues of separation and individuation from her own mother may reemerge. "*The typical resolution of this period is a reworking of previous attitudes that helped the young woman separate from her mother. Ideally, the pregnant woman develops a new-found appreciation for her mother and the mothering role in general*" Philipp and Carr (2001).

The third psychological step of pregnancy is tied to the anticipation of physical separation when the infant is thought as viable. "Nesting behavior" with the preparation of baby's arrival is expected at this stage that can be related to the concept of primary maternal preoccupation introduced by Winnicott Winnicott (1956).

In their study of the transition to first-time motherhood, Darvill *et al.* identified *changes in the woman's self concept* as the major psychological issue associated to the maternal transition with three main themes: control, support and forming a family Haddrill et al. (2014). The feeling of loss of control is related to different aspects; mostly frequent unpleasant physiological disorders in early pregnancy, rapid changes in body shape, reduced occupational freedom due to restricted mobility and additional mothering tasks and dependency on others. An important need for support, either practical or emotional, exists through pregnancy, birth and the postnatal period. Three major supporting figures emerged - mothers, partners and peers; this can be related to their ability to help in rationalizing the diverse sensations and fears experienced and in satisfying daily needs. The feeling of forming a family includes a sense of responsibility for the new life from very early in the pregnancy. This adjustment in self-perception from individuals or a couple

into members of a new family is acknowledged as a fundamental transformation Haddrill et al. (2014).

Slade *et al.* explain that pregnancy is a time of crucial internal reorganization concerning object relations, attachment and representations and corresponds thus to an opportunity for intense reworking and growth Slade et al. (2009). In this subconscious process, the woman's own life experience is of prime importance. A way of projecting herself as a mother is by identifying with her own mother and, similarly, she may imagine her future child's life course analogous to her own life course as she appraised and integrated it. Philipp and Carr note also that preparation for motherhood may be seen as beginning in childhood when girls try the mother role in play with baby-like dolls, siblings or friends Philipp and Carr (2001). Representations elaborated in this way are naturally based on their current experience of life. We understand then that this normal psychological process of pregnancy becomes conflicting - or even impossible - when it awakens negative object or self-representations or painful memories Slade et al. (2009). Campbell-Jackson *et al.* documented this latter case in parents having a child following a recent stillbirth Campbell-Jackson et al. (2014).

Beyond those issues of pregnancy, to become a mother also implies for the woman significant identity adjustments in regard to her sociocultural environment. In their study of the transition to parenthood, Ammanati *et al.* uses the term "*self-with-other*" to refer to the dynamic, intersubjective sense of personality in mothers and fathers Ammaniti et al. (2014). Haddrill *et al.* emphasize on the social dimension of pregnancy by introducing the term of "*social pregnancy*" in their exploration of delayed access to antenatal care. They particularly state : "*Women need a certain amount of approval and social support before their pregnancy can be acknowledged and accepted, both by the woman herself and her social network*" Haddrill et al. (2014).

As summarized in this analysis, the woman's psyche is challenged in diverse ways by the transition to motherhood. This complexity has to be considered in regard to the particularly sophisticated social character of the human species in which infant's very survival depends on parental investment Bjorklund et al. (2002). To explore psychosomatic disorders of gravida status from an evolutionary perspective seems therefore appropriate.

4 PARENTING ACROSS SEXUALLY REPRODUCING SPECIES

As a very recent product of evolution, the human species counts numerous ancestor species sharing many of our functional processes, either physiologically or behaviorally. However, in regard to procreation, diverse modes of reproduction can be observed across sexually reproducing species with very different degrees of progenitor investment. In primitive species, sea turtles for instance, progenitor contribution ends by laying fertilized eggs in a favorable environment. Embryo development occurs then unassisted and offspring are autonomous at birth. From an evolutionary perspective, parenting includes any post-fertilization progenitor investment susceptible to improve the offspring fitness Royle et al. (2012). Parenting does not exist in solitary animal species in which reproductive adults do not provide post-fertilization assistance. Parenting exists only in species that appeared more recently, predominantly in mammals and birds Clutton-Brock (1991); Bardwick (1974). In birds, parenting involves behavioral processes, as necessary for incubation and nourishing the fledgling, whereas in mammals, parenting involves also physiology through gestation and lactation.

This discussion highlights that the production of fertilized eggs constitutes a common ground shared by all sexually reproducing species, whereas incubation in birds and gestation in mammals correspond to supplementary progenitor contributions only present in species in which parenting exists. Therefore, from an evolutionary perspective, gestation in mammals as well as incubation in birds, can be seen as parental contributions favorable to embryo development. To consider

incubation or gestation as parental features is supported by the observation that, in particular cases, incubation or gestation is carried out by non-genetic parents. This is notably observed in the cuckoo species that practices brood parasitism. Female cuckoos lay eggs in the nest of birds of other species that, in the most favorable case, will incubate the egg and nourish the fledgling Wyllie (1981). The cuckoo's case is striking and remarkably paradoxical. The species did fully integrate parenting in its reproduction cycle whereas individuals do not present the corresponding behavior. In humans, pregnancy is carried out by non-genetic mothers in case of medically assisted procreation involving egg donation or surrogacy Benagiano et al. (2009).

This evolutionary discussion invites us to consider human reproduction as a two step process. The first step is directly inherited from our most primitive ancestors and ends with the production of a fertilized egg. The second step corresponds to a parental function covering pregnancy, lactation as well as postpartum assistance to the child. These two step were harmoniously coordinated by natural selection across evolution to form an apparently unique and consistent process. However, the evolutionary combination of two complementary steps allows a new perspective to address psychosomatic disorders of gravida status.

5 MODELS FOR DENIAL OF PREGNANCY, CONCEALMENT OF PREGNANCY AND PSEUDOCYESIS

Alike in the cuckoo's species, the psychosomatic disorders of gravida status explored in this paper are highly paradoxical. In denial and concealment of pregnancy, the reproductive process goes on at the physiological level whereas its psycho-sociological significance; i.e. the upcoming parental status, is either denied or concealed. Pseudocyesis presents the opposite configuration with a claim for an upcoming parental status despite the absence of actual pregnancy.

The composite character of human reproduction elucidated above, in which parenting stands for a recent additional layer of sexual reproduction, suggests a new etiological perspective. In the latter, psychosomatic disorders of gravida status are explained as the result of a psychologically-caused disruption of the normal, evolutionary-inherited, combination of parenting with sexual reproduction. This view allows a satisfactory elucidation of the psychic conflicts associated with the different syndromes as detailed in the following hypotheses.

5.1 Evolutionary-rooted model for denial of pregnancy

We claim that in denial of pregnancy, the parenting side of reproduction is denied because, at an unconscious level, the pregnant woman does not allow herself to become a mother. The psychological cause of such a subjective internal appraisal is specific to each woman concerned and have to be explored on a case-by-case basis. These causes may be related to the various implications of motherhood and a non-exhaustive list of possible categories of causes can be established:

- **Problem with sexuality:** Implicitly, to become a mother means active sexuality at the conception stage. If sexuality is problematic to the woman, her inability to acknowledge active sexuality may be the cause of denial of pregnancy. This category covers a diversity of causative events such as a history of sexual abuse during childhood, repressed sexuality for religious reasons, guilt for illegitimate sex . . .
- **Fear for the future parent-child relationship:** To give birth is the starting stage of a many year-long parent-child relationship with inherent attachment bonds and mothering role. If, when she was a child, the woman herself suffered in her relationship with her parents, the projection of a similar scenario for her coming child may trigger unacceptable fears. This category of possible causes gathers many sub-categories of factual events including history of parental violence, abandonment or dramatic loss . . .

- Permission to start a family: Depending on the woman's familial dynamics and specific situations and needs, she may have had to care for others or assist them lastingly during childhood. If the woman has integrated this assisting role as a personal mission, to start her own family may be internally appraised as an unacceptable betrayal towards her relatives and cause denial of pregnancy.

We note that this diversity of possible causes is consistent with the list of contradictory causes reported in literature and summarized p. 6 in '*Current understanding of denial of pregnancy*'. Nevertheless, the key-point remains the woman's individually subjective appraisal of her own life experience, thus explaining that no overall necessary nor sufficient risk factor can be identified Jenkins et al. (2011); Wessel et al. (2007).

This etiological hypothesis allows also a satisfactory explanation of the particularities of the pervasive and affective subtypes of denial of pregnancy. In the pervasive case, the misinterpretation, reduction or absence of pregnancy signs respond to the requirement to keep the woman unaware of her own pregnancy to comply with her psychological inability to become a mother. This hypothesis suggests that the repression of pregnancy signs results from a psychological control of physiology. This view is consistent with the spontaneous onset of normal signs of pregnancy when the woman becomes aware of her gravid state as observed clinically. Indeed, once the inability to become a mother has been infringed by the pregnancy announcement, there is no more reason to keep the pregnancy secret. Therefore, the psychological repression of normal signs and symptoms of pregnancy can be stopped, thus triggering notably the striking transformation of the woman's silhouette Sandoz (2011).

In the affective subtype of denial of pregnancy, we suggest that the woman does not allow herself to become a mother because she rejects the inherent mothering role that is subjectively appraised as unacceptable to her. In such a configuration, there is no need to hide the pregnancy to anyone. The absence of emotional adjustment and of anticipation of delivery, that are characteristic of this type of denial of pregnancy, is consistent with her refusal to take on the mothering charge.

To summarize, denial of pregnancy involves indeed some disruption of the evolutionary-inherited coordination of sexual reproduction and parenting. The woman does not allow herself to become a mother because parenting is conflicting to her psyche for some individualized reason. Denial of pregnancy provides then a transitory means to cope with the psychological conflict experienced by postponing its resolution. In the absence of conflict resolution, denial of pregnancy is protracted over time and may then last for weeks, months or even until unexpected labor and delivery.

5.2 Evolutionary-rooted model for concealment of pregnancy

Concealment of pregnancy involves a similar mismatching of parenting with sexual reproduction but the latter responds, however, to a slightly different psychological conflict. In concealment of pregnancy, we suggest that the pregnant woman's subjective belief is that others do not allow her to become a mother. Alike in denial of pregnancy, the woman is psychologically unable to become a mother but, in concealment of pregnancy, the cause of this inability is projected onto others. When the woman conceals her pregnancy because of pressure by (a) significant other(s), her belief that others do not allow her to become a mother is no longer subjective but rooted in reality.

Since the cause is related to others, it is to others that the pregnancy must be hidden and, as long as others remain unaware of her gravid state, the woman may acknowledge her pregnancy. The psychological conflict involved does not require the suppression of the signs of pregnancy until the latter can be concealed to others or attributed to other causes. Because of her belief, the

pregnant woman anticipates a negative reaction from others, thus explaining why to announce her pregnancy can be experienced as tremendously difficult and fearful.

We note that this elucidation of the psychological conflict associated to concealment of pregnancy is fully consistent with the antecedents and attributes identified by Murphy Tighe and Labor as listed p. 4 in '*Current understanding of concealment of pregnancy*'. Alike in denial of pregnancy, the diverse risk factors are neither necessary nor sufficient since the woman's subjective appraisal remains the key determinant. Finally, this elucidation of the underlying conflict highlights that concealment of pregnancy goes far beyond malingering to involve actual psychological difficulties.

5.3 Evolutionary-rooted model for pseudocyesis

As the reverse syndrome of denial and concealment of pregnancy, Pseudocyesis corresponds to the opposite configuration of mismatch between sexual reproduction and parenting. In her subjective belief, the non-pregnant woman needs to become a mother imperatively. Then pseudocyesis provides a delusional means to fulfill this internal requirement. The woman may firmly believe to be pregnant (pseudocyesis vera), be aware of her non-gravid state (deceptive or feigned pregnancy) or present a psychiatric condition (delusional pregnancy) O'Grady and Rosenthal (1989); Tarín et al. (2013). These different forms correspond to a continuum of transitory means to cope with the psychological conflict experienced by the non-pregnant woman. In pseudocyesis vera, similarly to pervasive denial of pregnancy, the presence of objective signs of pregnancy in a non-pregnant woman would result from a psychological control of physiology (in a depressive context and associated endocrine imbalance). Alike pervasive denial of pregnancy also, pseudocyesis has to be considered as a transitory means to cope with the psychological conflict. Its protraction over time results from the absence of further conflict resolution. Then, once the absence of pregnancy is confirmed by an ultrasound examination or because the delivery date is past, the woman's subjective belief is adjusted and her physiology returns spontaneously to normal.

This elucidation of pseudocyesis provides a psychological conflict substrate that is consistent with existing hypotheses summarized p. 5 in '*Current understanding of pseudocyesis*'. It supports also the hypothesis that a sociocultural pressure to be fertile may contribute to a higher incidence of pseudocyesis. However, following our analysis, a fear for pregnancy is not a necessary condition despite it may contribute to pregnancy avoidance and thus constitute a risk factor. For instance, Seeman notes that in the Roma community in rural Hungary, a strong pressure to become pregnant as soon as possible after marriage is associated with a high rate of maternal death during labor and delivery Seeman (2014). Such a community pressure corresponds to a typical cause for women's subordination to sociocultural patterns as discussed p. 8 in '*Current understanding of concealment of pregnancy*'. The resulting contradictory forces may cause women's ambivalence about pregnancy and thus contribute to a higher rate of pseudocyesis. However, pseudocyesis may affect women who do not fear pregnancy, for instance in the case of husband's infertility in a community where, socioculturally, infertility is systematically attributed to the woman Ouj (2009).

6 CONCLUSION

The consideration of parenting across sexually-reproducing species sheds a new light on the complexity of human reproduction. In most ancient species, sexual reproduction is based on the autonomous development of fertilized eggs in a favorable environment and does not require any post-fertilization progenitor contribution. In regard to sexual reproduction, parenting stands for an optional complementary layer that is found only in more recent species, notably birds and mammals.

Let us note that in mammals, parenting involves physiology since gestation occurs inside the mother's body. This view that considers gestation as a parental function makes sense in regard to evolution, especially with respect to the most primitive mode of sexual reproduction that works without incubation assistance. However, it contrasts with the usual view that distinguishes between physiology and behavior and restricts then parenting to postnatal assistance. In our evolutionary perspective, parenting takes therefore an unusual meaning that could also be termed post-fertilization investment to cover both physiological and behavioral processes. At a first glance, this semantic distinction may appear useless. However, in regard to psychosomatic disorders of grávida status, this distinction is proving very fruitful since all forms can be clearly related to some degree of parenting dysfunction.

In denied and concealed pregnancies, parenting - in its evolutionary sense - is inhibited to diverse extents; either physiologically, emotionally and/or behaviorally. This results in paradoxical configurations in which the ongoing gestation is associated with abnormal manifestations as categorized by the various forms of denial and concealment of pregnancy. In our analysis, these mismatches between gestation and the various parenting aspects are attributed to psychic conflicts and a specific formulation of the conflict related to each form is satisfactorily elucidated. Pseudocyesis corresponds to the opposite configuration in which, despite the absence of actual gestation, various parenting features are triggered in response to an imperative need to become a mother. For all forms, actual causative events have to be sought in the women's life courses on a case-by-case basis.

The explanations elaborated in this paper are merely theoretical. Nevertheless they provide a common and consistent understanding of the diverse forms of psychosomatic disorders of grávida status that constitutes, to our knowledge, the most satisfactory model available today. Interestingly, the conflict formulations proposed here are based on subjective internal appraisals rather than on factual risk factors. This allows a huge diversity of causative events specific to each woman concerned and explains that risk factors for denial of pregnancy identified in literature are neither necessary nor sufficient conditions (see p. 6 in '*Current understanding of denial of pregnancy*'). This also supports that there is no clear-cut typology of a pregnancy denier Jenkins et al. (2011); Wessel et al. (2007).

Beyond its theoretical interest, this new and affordable understanding of the various psychosomatic disorders of grávida status may improve clinical practice in diverse ways. Adequately informed health professionals will be lesser subject to surprise or suspicion when taking care of a woman in labor who did not attend prenatal care or who claims that she was unaware to be pregnant. By paying attention to the underlying psychological issues associated, clinicians will be able to adjust their relation to the patients and to suggest the most appropriate follow-up when necessary. Furthermore, their ability to explain the underlying mechanisms to the women concerned will help them to understand and accept such highly-challenging experiences, to seek for actual causes in their own history and thus provide opportunities for reworking and growth. Finally, mother-child bonding processes may also benefit from improved understanding when such clinical curiosities end up with '*normally-challenging*' familial configurations.

Competing interests

The authors declare that they have no competing interests.

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Author's contributions

PS developed the evolutionary models. Both authors wrote the paper.

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