



Review article

Internet Addiction in adolescence: Neurobiological, psychosocial and clinical issues

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ABSTRACT

Despite it has not been formally included in DSM-5 as a disorder, 'Internet addiction (IA)' has become a worldwide issue. It can be broadly defined as a non-chemical, behavioral addiction, which involves human-machine interaction. We pinpoint it as an "instrumental" form of social interaction (i.e. mediated by machines), a notion that appears useful for the sake of possible preclinical modeling. The features of Internet use reveals as addictive when this comes at the expense of genuine real-life sociability, with an overlap towards the hikikomori phenomenon (i.e., extreme retreat to one's own room). Due to the specific neuro-developmental plasticity in adolescence, IA poses risks to youths' mental health, and may likely produce negative consequences in everyday life. The thwarted development of adolescents' identity, self-image and adaptive social relationships is discussed: the IA adolescents often suffer loss of control, feelings of anger, symptoms of distress, social withdrawal, and familial conflicts. Further, more severe clinical conditions are also associated to IA, such as dysthymic, bipolar, affective, social-anxiety disorders, as well as major depression. This paper overviews the literature on IA, from neuro-biological, psychosocial and clinical standpoints, taking into account recent debates on diagnostic criteria, nosographic label and assessment tools. Neuroimaging data and neurochemical regulations are illustrated with links to pathogenetic hypotheses, which are amenable to validation through innovative preclinical modeling.

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1. Introduction

New technologies and the Internet have undoubtedly changed our lives in the last twenty years. They modified our way of communicating, socializing, entertaining ourselves, working, studying, and even thinking. For those of us who were born in these times, the Internet constitutes an everyday life companion, something that is perfectly integrated in daily experience. Conversely, who among us is a *web immigrant* (Ferri, 2011), recognizes how different our lives have become, and wonder about how to cope with the many great advantages the web has brought about and the dangers possibly coming from its misuse. This review will focus on one of the many specific aspects connected with the topic, which is Internet Addiction (IA) among adolescents.

While in UK, USA and Asia over 80% of the adolescent population can access to the Internet, lower rates have been found in South America (45–55%). Although with still lower rates, Africa and Middle East young Internet users have grown by ~3000% in the last ten years (Internet World Stats, 2013). According to international research more than 30% of children under the age of two have used a tablet or smartphone and ~80% of adolescents owns a similar device (Fox and Duggan, 2013). These impressive numbers have raised understandable concerns among those, in the developmental psychopathology framework, study adolescents and their emotional-behavioral functioning, also because the American Academy of Pediatrics (Christakis, 2014) has suggested that creativity, imagination and the possibility of achieving optimal motor and sensory development might be reduced by the use of such tools (Dalbudak and Evren, 2014).

2. Profiles of altered sociability in IA

2.1. Youth social withdrawal. selectively social while staying at home in adolescence

Social withdrawal is described as typical of asocial individuals, who prefer to stay at home in their bed. Some adolescents spend much time in their rooms at home, making a minimal effort in engaging towards interpersonal relationships (Chong and Chan, 2012; Ovejero et al., 2013). They watch television, play computer or video games and read books; they may have day–night reversal, staying awake all night and sleeping all day (Masataka, 2002). Anyway, some of these socially withdrawn youths can still handle some forms of communication, with people not directly connected to their real life (Suwa and Suzuki, 2013). Typically, they do this by maintaining minimal social contacts through digital means: the Internet at home provides – indeed – a very convenient channel for inter-personal communication. More specifically, an innate preference for online rather than real communication may even play a key role for development of social withdrawal, at least in certain individuals (Suwa and Suzuki, 2013). They can chat online with strangers and hence develop a virtual kind of intimacy with many partners, found over the social networks (Wong et al., 2014). These young adolescents, although staying at home for long time, do not completely lose the ability to socialize, and are even willing to express and share their own experience of social withdrawal (Kaneko, 2006). Through these virtual relations, carried out on social networks, these people can receive support and recogni-

tion from peers (Chan and Lo, 2013) and even redefine their social identity.

Many symptoms are non-specific and can be found across various mental conditions, all of which include social isolation and deterioration, dysphoric mood and sleep disorders (Gariup et al., 2008). Most commonly, these mental conditions are overt schizophrenia or other psychotic disorders; less commonly, these – also – include mood or anxiety disorders, autism spectrum disorder, personality (such as schizoid or avoidant) disorders, to end up with the amotivational syndrome, or even genuine forms of Internet addiction (Koyama et al., 2010).

2.2. One particularly severe case: hikikomori

A new phenomenon is emerging and becoming a source of concern: young people who live by themselves in their rooms, make an exaggerated use of Internet and have minimal social contacts apart from online network-mediated ones (Kato et al., 2011). The Japanese expression, indicating people who voluntarily live confined at home for very long periods, is ‘hikikomori’ (Heinze and Thomas, 2014); notably, the essential feature of a hikikomori is self-isolation due to social withdrawal. Such a condition is part of a spectrum of social dissociative problems, ranging from a simple disengagement from social roles (makeinu) up to refusal of school, work, and other duties (futoko).

Although first described in Japan, many cases have been described from all around the world (e.g. in Spain, USA, and Italy; Aguglia et al., 2010; Malagón-Amor et al., 2015; Teo, 2012). This extreme form of deviance may emerge as a symptom of underlying psychiatric disorders like e.g. schizophrenia, social anxiety disorder, or avoidant personality disorder. This disorder affects mainly adolescents or young adults, who live cloistered within their parents’ homes; on the one side, they refuse to communicate even with their parents or members of their family, while on the other hand spending more than 12 h a day in front of the computer, exploiting the gaming as well as social networks over the Internet. Therefore, such individuals are at-risk of Internet addiction, and one-tenth of them would fit the corresponding diagnostic criteria (Lee et al., 2013). One could argue how to distinguish, within such a hikikomori population, those individuals who simply make use of the Internet, given that this tool may become the only ‘window’ for interaction with the rest of the world, but are not addicted to it.

2.3. Overlap and divergence between hikikomori and internet addicted individuals

Like hikikomori, addiction to Internet is an emerging psychiatric issue, although the definitions are still a matter of debate. DSM-5 has introduced a new term, “Internet gaming disorder”, which comprises among its characteristics the notion that Internet is used to escape negative mood, and/or to solve any own social/interpersonal/vocational problems (APA, 2013). Activity through the new social media (Instagram, Facebook, YouTube etc.) has now become common and widespread, since infancy, leaving room to the emerging of a problematic use of Internet. Prevalence of Internet addiction may well be (already, or become in the next future) higher than that of hikikomori – which is estimated around 1–2% of the population (in Asia). Problematic Internet use

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