



## The ketogenic diet and remission of psychotic symptoms in schizophrenia: Two case studies

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The etiology of schizophrenia is unknown. Recent research suggests that abnormalities in glucose tolerance and insulin resistance may play a role (Perry et al., 2016; Harris et al., 2013). Some research has found insulin resistance in both first-episode psychosis and also unaffected siblings, suggesting that insulin resistance may be a pre-existing risk factor for the development of psychosis (Chouinard et al., 2018). Mitochondrial dysfunction, disturbances in energy metabolism, and redox dysregulation have also been associated with schizophrenia (Clay et al., 2011; Kim et al., 2017). All of these findings suggest bioenergetic abnormalities in schizophrenia.

The ketogenic diet is a high-fat, low-carbohydrate diet used in treatment-resistant epilepsy for 100 years, with some studies suggesting that over 50% of patients experience significant reductions in seizure frequency (Martin et al., 2016). It is well established that many treatments for epilepsy are also effective for psychiatric disorders. The ketogenic diet has many known effects on bioenergetics and the brain, including providing ketones, as opposed to glucose, as an alternate fuel source, improving insulin resistance, affecting a number of neurotransmitters and ion channels, enhancing mitochondrial function and biogenesis, and decreasing inflammation (Rho, 2017). Two studies of a mouse model of schizophrenia demonstrate that the ketogenic diet may be an effective treatment (Kraeuter et al., 2015; Kraeuter et al., 2018). Additionally, two case studies of the ketogenic diet in the treatment of schizoaffective disorder suggested a reduction in PANSS scores (Palmer, 2017). The following additional two cases represent unique patients from those reported in 2017 treated with the ketogenic diet

for 5 and 12 years with complete remission of psychotic symptoms off of antipsychotic medications.

Patient A is an 82 year-old female diagnosed with schizophrenia since the age of seventeen. Her symptoms included chronic paranoia, disorganized speech, and both visual and auditory hallucinations - seeing skeletons and hearing voices on a daily basis. She had numerous hospitalizations throughout her life for psychosis and suicide attempts. Prior to 2008, she had trials of the following antipsychotic and mood stabilizing medications: lithium, olanzapine, ziprasidone, aripiprazole, lamotrigine, quetiapine, haloperidol, perphenazine, and risperidone. In 2008, just prior to starting the ketogenic diet, she was on haldol-decanoate, risperidone, atenolol, furosemide, trazodone, and sertraline. She was 70 years old, receiving social security, had a visiting PACT team and a court-appointed guardian. She started a ketogenic diet in order to lose weight (weighing 330 lb). Within two weeks, she noted a marked reduction in her psychotic symptoms. Over the next several months, she took it upon herself to stop all of her medications. Her mood improved dramatically, and she no longer had suicidal thoughts. Her hallucinations and paranoia remitted completely. She remains on the ketogenic diet today and has lost a total of 150 lb. She takes no medications and remains free of psychotic symptoms, and has also regained her independence, no longer requiring the care of a PACT team and no longer having a guardian. She lives independently, and reports that she is happy to be alive.

Patient B is a 39 year old female with a history of depression, anxiety, anorexia nervosa, and hallucinations and paranoia beginning in 1993. She initially did not disclose the psychotic symptoms to treaters, but was hospitalized and treated for depression, suicide attempts, and anorexia several times. In 2003, after finally disclosing the hallucinations and paranoia, she was diagnosed with schizophrenia. She tried the following medications over the course of treatment: haloperidol, clozapine, ziprasidone, risperidone, quetiapine, aripiprazole, olanzapine, sertraline, paroxetine, citalopram, fluoxetine, duloxetine, and venlafaxine. Her psychotic and mood symptoms persisted despite these medication trials. In 2013, she was started on a ketogenic diet by a functional medicine practitioner for symptoms of chronic GI distress. Shortly after starting the diet, she abruptly stopped the 14 medications she was taking, and became severely psychotic, was hospitalized, but continued the ketogenic diet while in the hospital. She was started on haldol-decanoate and continued the ketogenic diet. Within one month, she

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reported complete resolution of her psychotic symptoms for the first time since 1993, despite having tried haldol-decanoate in the past without a treatment response. She was tapered off haldol-decanoate over the following year, and has remained free of psychotic symptoms for the past 5 years off of antipsychotic medications. She lost 70 lb after starting the diet, exacerbating her anorexia, but regained 30 of those pounds for a normal body weight currently. She continues the ketogenic diet, and since her symptoms remitted, she has finished graduate school and now works full time.

These cases suggest that the ketogenic diet may be an effective treatment for schizophrenia, capable of inducing remission of longstanding psychotic symptoms off antipsychotic medications, and restoring function in life. Both patients also lost weight. Randomized controlled trials are warranted to establish the safety and efficacy of the ketogenic diet for psychotic disorders.

#### Conflict of interest

Dr. Westman receives book royalties and has ownership interest in 2 companies (Adapt Your Life, HEAL Clinics) based on ketogenic diet principles.

Drs. Christopher Palmer and Javier Gilbert-Jaramillo declare no conflicts of interest.

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#### Contributors

EW treated one patient for over 12 years, observed the effects of treatment, and assessed weight and PANSS scores before and after treatment. CP obtained medical and psychiatric records of the second patient, assessed weight and PANSS scores before and after treatment, and wrote the manuscript. *All authors contributed to and have approved the final manuscript.*

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