# The Kids and Teens at School (KiTeS) Framework: An Inclusive Bioecological Systems Approach to Understanding School Absenteeism and School Attendance Problems 

Glenn A. Melvin ${ }^{1,2 *}$, David Heyne ${ }^{3}$, Kylie M. Gray ${ }^{2,4}$, Richard P. Hastings ${ }^{2,4}$, Vaso Totsika ${ }^{2,4,5}$, Bruce J. Tonge ${ }^{2,4}$ and Mina Mirjana Freeman ${ }^{4}$<br>${ }^{1}$ School of Psychology, Faculty of Health, Deakin University, Burwood, VIC, Australia, ${ }^{2}$ Centre for Educational Development, Appraisal and Research, University of Warwick, Coventry, United Kingdom, ${ }^{3}$ Developmental and Educational Psychology Unit, Faculty of Social and Behavioural Sciences, Institute of Psychology, Leiden University, Leiden, Netherlands, ${ }^{4}$ Department of Psychiatry, Centre for Developmental Psychiatry and Psychology, School of Clinical Sciences at Monash Health, Monash University, Clayton, VIC, Australia, ${ }^{5}$ Division of Psychiatry, Faculty of Brain Sciences, University College London, London, United Kingdom

## OPEN ACCESS

## Edited by:

Mats Granlund, Jönköping University, Sweden

## Reviewed by:

Nina Klang, Uppsala University, Sweden Despina Papoudi, University of Birmingham, United Kingdom

## *Correspondence:

Glenn A. Melvin glenn.melvin@deakin.edu.au

## Specialty section:

This article was submitted to Special Educational Needs, a section of the journal Frontiers in Education

Received: 25 March 2019
Accepted: 14 June 2019
Published: 28 June 2019

## Citation:

Melvin GA, Heyne D, Gray KM, Hastings RP, Totsika V, Tonge BJ and Freeman MM (2019) The Kids and Teens at School (KiTeS) Framework: An Inclusive Bioecological Systems Approach to Understanding School Absenteeism and School Attendance

Problems. Front. Educ. 4:61.
doi: 10.3389/feduc.2019.00061


#### Abstract

Absence from school jeopardizes children's and adolescents' education and their social and emotional development. Proximal and distal individual, parental, familial, and environmental factors have been linked to absenteeism and the development and maintenance of school attendance problems. The complex interaction among these factors necessitates a multifactorial approach to understanding school absenteeism and attendance problems. The current paper builds on recent calls to apply bioecological systems frameworks when studying risk factors for school absenteeism and attendance problems. The Kids and Teens at School (KiTeS) Framework presented here is an application of Bronfenbrenner's bioecological systems model, incorporating candidate factors of particular relevance to school absenteeism and attendance problems. The current paper is also a response to the Warnock report which highlighted the need to individualize educational supports for children and adolescents with disabilities, to foster optimal educational outcomes. The KiTeS Framework is an inclusive framework, inclusive of students with and without disabilities. It is envisaged that the KiTeS Framework will provide guidance to researchers aiming to improve understanding of the factors influencing absenteeism among all school-aged students, including those from minority or vulnerable populations.


Keywords: absenteeism, school, school attendance problems, disability, bioecological systems

## INTRODUCTION

School, as construed by any culture, is essential for the cognitive and social-emotional development of all children and adolescents (hereafter referred to as youth). It represents preparation for life beyond school, irrespective of the youth's abilities or disabilities (Warnock Report; Department for Education and Science, 1978). Attending school can be understood as a behavior but also as a developmental outcome because it is a marker of the youth's developmental capacity to separate from their caregiver and be engaged at school.

Poor school attendance predicts lower academic achievement over time (Hancock et al., 2013) and subsequent school drop out (Barrington and Hendricks, 1989; Schoeneberger, 2012). Those who leave school early are at greater risk of long term negative outcomes, such as reduced employment and economic security, poorer mental and physical health, and lower life expectancy, compared to youth who complete schooling (Rumberger, 2011).

Absenteeism appears to be a universal problem. In the UK in 2016-17, almost $11 \%$ of youth in state-funded primary and secondary schools were classified as persistent absentees for having missed $10 \%$ or more of school (United Kingdom Department of Education, 2018). In the US chronic absenteeism has been described as a "hidden crisis," with nationwide data showing that $16 \%$ of youth had absences of 15 or more days during the 2015-16 school year (U.S Department of Education, 2016). An Australian report concluded that $\sim 30 \%$ of youth were at some educational risk due to being absent from school for $10 \%$ or more of the time (Western Australia Auditor General's Report 16, 2015). In rural Karnataka, South India, $8 \%$ of lower caste adolescent girls reported being frequently absent from school (four or more days missed in a month; Prakash et al., 2017). A study of youth in Mozambique found that $36.6 \%$ of those surveyed reported being truant at least 1 day during a 30 day period (Seidu, 2019). Research conducted by the Consortium for Research on Educational Access, Transitions, and Equity identified high rates of absenteeism in India and Ghana (Lewin, 2011). As the aforementioned studies illustrate, different cut offs are used to define when absenteeism becomes problematic. This is an important issue as Skedgell and Kearney (2018) found that associations between problematic levels of absenteeism and contributing factors differ according to the cut-off applied ( 1,10 , $15 \%$ absence).

While acknowledging that a consensus has not yet been reached on an appropriate cut-off to define problematic absenteeism, a body of research shows that a broad range of individual, parental, familial, and environmental factors are implicated in absenteeism and school attendance problems (SAPs) (Kearney, 2016). Given this broad range of factors spanning multiple contexts, some researchers have proposed bioecological models to inform approaches to prevention and intervention (Lyon and Cotler, 2009; Doren et al., 2014; Guralnick, 2015; Gottfried and Gee, 2017). Bioecological models typically position the individual at the center of a nested hierarchy of environments that are understood to influence the individual's development over time (Bronfenbrenner, 1977; Bronfenbrenner and Morris, 2006). These environments extend outward from the most immediate contexts experienced by the individual (e.g., home, school) to broader contexts which impact on the individual and their immediate environments in more or less direct ways (e.g., educational policies, overarching societal, cultural, and historical contexts).

## Reasons for and Types of Absenteeism

Reasons for school absenteeism vary greatly. For example, students may be absent due to an illness or medical appointment; anxiety about being away from parents or being amongst other youth at school; difficulty with school work or disinterest in
learning; because parents keep a child at home; family transport problems; and the school's exclusion of youth engaged in problematic behavior at school. Often, absences are differentiated according to whether they are excused (e.g., illness) or unexcused (e.g., truancy), and there is some evidence that risk for academic impairment is greater for students with unexcused absences relative to those with excused absences (Gottfried, 2009; Hancock et al., 2018a). In practice and research, it is difficult to reliably establish whether absence is excused or unexcused, and policy and practice differ within and between countries. Moreover, the fact remains that absence for any reason is a risk factor for negative student outcomes (Gottfried, 2009; Hancock et al., 2013).

SAPs are often differentiated by type. Four types described by Heyne et al. (2019) are school refusal, truancy, school withdrawal, and school exclusion. There is some scientific support for differential associations between psychosocial risk factors and types of SAPs (Heyne et al., 2019). However, most research into the multiple determinants of absenteeism does not usually account for likely differential relationships between risk factors and different types of absenteeism. Rigorous research accounting for types of absenteeism may reveal that specific risk factors have weaker or stronger relationships with absenteeism contingent upon the type of absenteeism under investigation.

## Absenteeism in Disadvantaged Populations

It is concerning that youth facing relative disadvantage, such as youth with disabilities and those from minority and indigenous backgrounds, tend to be absent from school more than their non-disadvantaged peers (Kearney, 2008; Hancock et al., 2013). For example, studies have found that youth with intellectual and development disabilities (IDD) have higher rates of absenteeism than their typically developing peers and are less likely to complete school, participate in tertiary education, or be in paid employment after schooling (Australian Institute of Health Welfare, 2008; U.S Department of Education, 2016; Gottfried et al., 2017; United Kingdom Department of Education, 2018). In Australia, only $49 \%$ of indigenous students in school years $1-10$ attended $90 \%$ or more school days, compared to $79 \%$ of non-indigenous students (Australian Curriculum Assessment Reporting Authority, 2017). Further, Australian indigenous youth in Western Australia, who account for $\sim 9 \%$ of all students, represented half of all youth considered to be at severe educational risk due to school absenteeism (Western Australia Auditor General's Report 16, 2015). School absenteeism has thus been acknowledged as a priority social welfare issue for education authorities.

There is a paucity of research addressing absenteeism among youth with IDD, despite the increased risk for absenteeism in this group. However, prior research has demonstrated that youth with IDD have elevated known risk factors for absenteeism such as higher rates of chronic and multiple health conditions and health care utilization relative to youth without IDD (Boulet et al., 2009; Schieve et al., 2012). The complex health needs of IDD youth may partly explain their higher rates of school absenteeism. At
the same time, some youth with IDD may have a decreased risk for particular types of SAPs. For example, youth with moderate to severe intellectual disabilities may be less likely to truant from school because they may find it more challenging to plan out-ofschool activities and to conceal their absence from parents and school staff.

A few studies have addressed the question of whether the reasons for absence differ between disadvantaged and nondisadvantaged populations. For example, Havik et al. (2015) reported a tendency for youth with special educational needs to explain their own absences in terms of truancy rather than school refusal. Maynard et al. (2017) reported divergent risk patterns for different racial/ethnic groups of truanting youth. One finding was that non-Hispanic White youth using illicit drugs were at higher odds of truanting relative to those not using illicit drugs, whereas this difference was not observed among African-American youth and Hispanic youth.

## ORGANIZING RISK FACTORS FOR ABSENTEEISM

Researchers across the fields of education, psychology, mental health, sociology, and juvenile justice have identified a broad range of individual, peer, family, school, and environmental factors associated with school absenteeism and SAPs (Kearney, 2008, 2016). These factors include but are not limited to student physical and mental health (Egger et al., 2003; Allison and Attisha, 2019), family and neighborhood socio-economic status (SES; Zhang, 2003; Gottfried, 2014), family functioning (Carless et al., 2015), parent mental health (Bahali et al., 2011), school climate (Hendron and Kearney, 2016), and social norms and practices (Prakash et al., 2017). As noted above, given the diversity of factors, some researchers have proposed multisystemic approaches to understand and respond to absenteeism, aiming to integrate knowledge gained across various fields (Lyon and Cotler, 2009; Kearney, 2016; Guralnick, 2017; Prakash et al., 2017). It has been argued that models based on bioecological and developmental systems, which attend to the interaction of factors across multiple contexts, offer a useful way to navigate the complexity of absenteeism and SAPs (Benner et al., 2008; Lyon and Cotler, 2009; Doren et al., 2014; Guralnick, 2015).

Indeed, research indicates that a combination of risk factors may better explain the development and maintenance of absenteeism and SAPs, with no single factor determinative (Ingul et al., 2012; Hancock et al., 2018b; Skedgell and Kearney, 2018). For example, Gottfried and Gee (2017) applied Bronfenbrenner's bioecological systems model to examine the determinants of chronic absenteeism in US pre-school students. Factors across various domains, including child attributes and environmental factors, interacted in their influence on chronic absenteeism. The authors found that students who were broadly defined as having a disability (based on school records indicating an individualized education program) and who were in the low SES group had lower odds of being chronically absent than low SES students without disability. This finding was somewhat unexpected given prior research linking low SES to
absenteeism and showing higher rates of absenteeism among students with disabilities (Ingul et al., 2012; Balkis et al., 2016; Gottfried et al., 2017). Gottfried and Gee (2017) speculated that parents of pre-school children with disabilities and from low SES environments may place emphasis on their child being at school to receive specialized services they could not otherwise afford. The study provides a useful example of how individual level factors (e.g., child's age, disability status) can combine with factors at other levels (e.g., SES, access to services) to influence attendance.

According to Bronfenbrenner's bioecological systems model, human development is driven by ongoing interactions between the person and elements of their immediate environment, referred to as proximal processes. For school-aged youth, proximal processes related to absenteeism and SAPs include the interactions they have with parents, siblings, friends, and peers, as well as their engagement in morning and evening routines, learning, and extra-curricular activities. The impact of proximal processes on development is understood to vary as a function of individual characteristics (e.g., social skills, personality) and variables spanning multiple ecological contexts (e.g., family, school) as well as broader social contexts and changes over time (Bronfenbrenner, 1977; Bronfenbrenner and Morris, 2006). Accordingly, the fundamental elements of bioecological models are referred to as process-person-context-time.

Bioecological models typically depict the child embedded in a hierarchy of systems. Immediately surrounding the child is the microsystem, the environments in which proximal processes occur (e.g., family, school, community). Surrounding the microsystem is the mesosystem which is composed of associations between elements of the child's microsystem, such as connections between parents and teachers. At the next level is the exosystem encompassing those settings that influence elements of the microsystem but are not experienced directly by the child (e.g., a parent's work setting; parent and sibling social networks; local health and social services, and infrastructures). Additional levels include the macrosystem and the chronosystem. The macrosystem encompasses broader cultural and institutional norms and beliefs and SES (e.g., family SES; community attitudes to people with disabilities). The chronosystem encompasses the influence of time on development (e.g., timing of significant events; changes in systems over time) which can manifest across a number of domains including cultural and societal values, community attitudes, government policies, and economic stability.

The interplay of proximal and distal factors on school attendance can be illustrated by the proximal processes involved in preparing for school in the morning. The morning routine typically involves some level of cooperation between the child and family members and may be influenced by many individual child characteristics such as age, functional abilities, and mental and physical health. Such child factors may interact with the mental health and wellbeing of parents as well as the family's functioning (Egger et al., 2003; Bahali et al., 2011; Carless et al., 2015). A depressed parent who lets their anxious child stay at home to give them "a day off" may base their decision, in part, on their own need for support or the desire to avoid the stress
associated with getting their child to school in the morning. In turn, a child with separation anxiety who is allowed to remain home is relieved of their anxiety when they observe their parent and feel assured that the parent is safe. Exosystem factors such as a parent's employment (Ingul et al., 2012), school start times (Bowers and Moyer, 2017; McKeever and Clark, 2017), and transport options (Gottfried, 2017) might also exert an influence on proximal processes. Such distal factors may differentially influence attendance outcomes for special populations such as indigenous students or those with a disability. It is well established that youth with IDD, for example, are more likely than typically developing peers to live in low income, single parent, or unemployed households and poorer neighborhoods (Emerson et al., 2010b). Moreover, socio-economic risk factors are linked to poorer mental and physical health in children with IDD and their parents (Emerson et al., 2006, 2010a; Emerson and Hatton, 2007). In turn, poor mental and physical health in parents and children are known risk factors for absenteeism and SAPs (Allison and Attisha, 2019). Bioecological models that focus on the interaction of factors across domains are, therefore, in line with trends in disability research to shift the focus from individual factors to an understanding of how broader cultural and structural factors, including educational settings, impede the development of students with disabilities (Mittler, 2015).

There have been calls for more research on factors influencing absenteeism and SAPs among disadvantaged populations, such as students from diverse ethnic backgrounds along with those with disabilities, to better understand potentially unique risk profiles (Zubrick et al., 2006; Lyon and Cotler, 2007; Gee, 2018). Moreover, there is no conceptual framework which is explicitly inclusive of factors relevant to disadvantaged populations. Efforts to improve school attendance, educational outcomes, and lifelong outcomes for these disadvantaged populations requires a better understanding of the determinants of absenteeism.

Research on absenteeism and SAPs in typically developing populations provides a useful starting point for examining the same phenomena in other student sub-groups, including those experiencing disadvantage. However, absenteeism and SAP types and their key risk and protective factors may differ across disadvantaged and non-disadvantaged groups. A comprehensive research framework is needed to ascertain whether there are meaningful differences in the pathways to absenteeism and SAPs between and among the various populations of students. Research informed by a broad framework relevant to all student populations may have important implications for prevention and intervention for absenteeism and SAPs, including family support, school policy, community services, and culturally sensitive school adaptations.

The Kids and Teens at School (KiTeS) Framework—applies Bronfenbrenner's bioecological systems model to facilitate research that builds knowledge about attendance and absence among all school students, including those from disadvantaged populations (see Figure 1). The framework seeks to inform research on the development, maintenance, and alleviation of school absenteeism and SAPs.

## THE KITES FRAMEWORK

The KiTeS Framework uses the conceptual structure of Bronfenbrenner's bioecological model including micro-, meso-, macro-, exo-, and chrono-systems to organize factors known to influence human development (Bronfenbrenner and Morris, 2006). We also describe the extant literature in its relationship with the factors included in the framework.

We place youth characteristics operating at the micro- and meso-system level at the center of the KiTeS Framework because of their key influence on the interactions between the individual and their environment (i.e., proximal processes). Bronfenbrenner and Morris (2006) conceptualized person characteristics as demand, resource, and force characteristics. Demand characteristics are features of the person that are directly apparent to others and invite or discourage interactions and reactions. Examples include age, gender, and appearance. Resource characteristics refer to a person's skills, abilities, experiences, and disabilities which can influence the capacity of the person to engage in proximal processes. Force characteristics are considered the shapers of development as they refer to behavioral dispositions that either support or disrupt proximal processes and therefore development. Examples include responsiveness, distractibility, and emotional regulation.

Demand characteristics such as age and gender have been associated with absenteeism and SAPs. Absence rates tend to increase as students get older and move through school, peaking in high school (Hancock et al., 2013; U.S Department of Education, 2016; Skedgell and Kearney, 2018). Links between gender and absenteeism are somewhat mixed and may differ by type of SAP (Havik et al., 2015; Maynard et al., 2017; Skedgell and Kearney, 2018). Race and ethnicity are also associated with chronic absenteeism, with US national data showing American Indian, Pacific Islander, and Black students more likely to be absent for three or more weeks compared with their White peers (U.S Department of Education, 2016). Indigenous Australian youth are also at greater risk of absenteeism and they are more adversely affected by absence than are non-disadvantaged peers (Hancock et al., 2013).

A range of resource characteristics are linked to absenteeism and SAPs, including biological and psychological factors such as functional limitations, acute and chronic illness, mental health conditions and sleep (McShane et al., 2001; Egger et al., 2003; Houtrow et al., 2012; Hysing et al., 2015; Allison and Attisha, 2019). Specific learning disabilities, IDD, and neurodevelopmental conditions are also associated with absenteeism (Redmond and Hosp, 2008; Gottfried et al., 2017; Black and Zablotsky, 2018).

Self-regulation, a force characteristic according to Bronfenbrenner and Morris' conceptualization, has been found to negatively associate with absenteeism (Balkis et al., 2016). Similarly, attitudes toward school and perceptions of academic ability have been linked to absenteeism and these might best be viewed as force characteristics given their influence on a student's active orientation toward school (Green et al., 2012; Balkis et al., 2016). Mental health conditions, including anxiety, mood disorders, and externalizing behavior problems


FIGURE 1 | The KiTeS bioecological systems framework for school attendance and absence.
such as inattention, impulsiveness, and hyperactivity are developmentally disruptive and are linked to absenteeism and SAPs (McShane et al., 2001; Egger et al., 2003; Ingul et al., 2012; Kearney, 2016). While these disorders are considered resource characteristics (Bronfenbrenner and Morris 2006), their symptoms, such as anxiety, low affect, and cognitive impairment impact on force characteristics such as social avoidance, selfregulation, inattention, and motivation and are likely to invite or discourage responses from others and impact the likelihood of proximal processes being initiated or sustained.

There is evidence that youth with IDD experience increased rates of resource and force characteristics linked to absenteeism. These include, for example, chronic physical health conditions, mental health and behavior problems, functional limitations, and sleep problems (Einfeld et al., 2006; Cotton and Richdale, 2010; Emerson et al., 2010a; Oeseburg et al., 2011; Houtrow et al., 2012; Green et al., 2015; Black and Zablotsky, 2018). Accordingly, youth with IDD may be at greater risk for absenteeism and SAPs. Evidence that the academic functioning of disadvantaged students is more adversely affected by absences (Hancock et al., 2013) points to IDD populations potentially facing greater educational risks on account of absenteeism.

The KiTeS Framework identifies a range of parent, family, and school factors at the micro- and meso- levels that
may influence proximal processes and factors implicated in absenteeism and SAPs. Important parent factors include parental stress, mental and physical health, and parenting styles (Dura and Beck, 1988; Corville-Smith et al., 1998; Martin et al., 1999; Hastings, 2002; Herring et al., 2006; Lipstein et al., 2009; Bahali et al., 2011; Woodman et al., 2015). Parental attitudes to school and parental involvement in their child's schooling are also relevant because these factors are linked to youth's academic achievement and school engagement which are factors associated with school attendance (Newman, 2005; Jeynes, 2007; Doren et al., 2012).

At the family level, family composition (Bernstein and Borchardt, 1996), family functioning (Corville-Smith et al., 1998; Carless et al., 2015), and family dynamics (Kearney and Silverman, 1995) have been linked to absenteeism and SAPs. School factors at the micro- and meso- system levels include aspects of school climate, a multi-dimensional construct encompassing teacher, student, and peer relationships; feelings of safety and inclusion at school; levels of academic and social support; the quality of the school's physical environment; and connections within the broader school community including parents (Cohen et al., 2009). Positive school climate is associated with a number of positive school outcomes such as academic achievement, fewer student behavior problems, and better
attendance rates (Faircloth and Hamm, 2005; Freeman et al., 2015; Hendron and Kearney, 2016; Roorda et al., 2017; Van Eck et al., 2017).

Factors at the exo- and macro-system level are identified in the KiTeS Framework due to their links to absenteeism and SAPs. These factors include housing instability (Fantuzzo et al., 2013; Deck, 2017), socio-economic status (Zhang, 2003; Balkis et al., 2016), and neighborhood characteristics such as poverty and the household size and age of neighbors (Gottfried, 2014). With respect to neighborhood characteristics, Gottfried (2014) found that absenteeism increased as neighbor household size increased and, conversely, decreased as average neighbor age increased. Structural barriers such as a lack of transport infrastructure and living in remote locations are also associated with absenteeism (Hancock et al., 2013; Gottfried, 2014).

Exo-system factors related to the school domain such as classroom setting, school type, and school organizational factors also show some links to absenteeism and SAPs (Gottfried et al., 2017; Lenhoff and Pogodzinski, 2018). For example, Lenhoff and Pogodzinski (2018) found that school organizational effectiveness moderated the influence of demographic and individual level factors (sex, race/ethnicity, special educational status, English language learner status, and economic disadvantage) on absenteeism in US state schools but not in charter schools (publicly funded independent schools). A study by Gottfried et al. (2017) found that the risk of chronic absenteeism was lower for mainstream school students with disabilities (broadly defined by special educational needs and including students with emotional problems) who received instruction in classrooms among a higher percentage of typically developing students (inclusive classrooms) compared to students with disabilities receiving instruction in separate classrooms among fewer typically developing students (exclusive classroom). Further, students who received part-time instruction with a special education teacher in inclusive classrooms were less likely to be chronically absent compared to students who had the same disabilities but were in contact with special education teachers full-time in the inclusive classrooms.

Factors at the exo- and macro- system levels may be particularly salient to disadvantaged populations. Youth with IDD are more likely to be exposed to risks of socio-economic disadvantage such as living in low income or unemployed households, poorer neighborhoods, and single parent households compared to their typically developing peers (Emerson and Hatton, 2007). These distal factors are considered within the KiTeS Framework given they may exert a particular influence on absenteeism and SAPs in disadvantaged populations.

Within the macro-system, attitudes toward education vary between cultural groups and may impact attendance rates. There is evidence of variability across cultural groups in parent's beliefs and behaviors regarding their children's education which may influence how parents socialize their child to school (Stevenson and Lee, 1990; Taylor et al., 2004). For example, in a cross-cultural study, Stevenson and Lee found that Chinese and Japanese mothers held higher standards for their child's academic achievement than did American mothers and they also endorsed the importance of academic effort to
a greater degree than American mothers. Cultural attitudes toward persons with disabilities also vary. In the Australian multi-cultural context, there is some evidence that cultural groups differ in their acceptance of persons with disabilities (Westbrook et al., 1993). A report from Victoria, Australia, noted that students with disabilities from culturally and linguistically diverse backgrounds may be missing more school because of cultural views about the benefits and cultural relevance of mainstream education (Victorian Equal Opportunity Human Rights Commission, 2012). The KiTeS Framework prompts researchers to consider such factors when investigating risks for absenteeism in disadvantaged populations.

With respect to the chronosystem, absenteeism that occurs early in schooling places students at increased risk for absenteeism in later years (Hancock et al., 2013). Different constellations of risk factors for absenteeism are also likely to be influential at different ages. For example, Skedgell and Kearney (2018) found that rates of absenteeism differed across school grades. Similarly, separation anxiety may be a more influential risk factor for the SAP school refusal at younger ages (Last and Strauss, 1990). Consideration of chronosystem factors is thus required to achieve a comprehensive understanding of absenteeism and SAPs.

## ADVANCING RESEARCH WITH THE KITES FRAMEWORK

The KiTeS Framework, based on Bronfenbrenner's bioecological systems model, offers an inclusive structure to inform research. It highlights the complex array of factors within the micro-, meso-, macro-, and chrono-systems, that may contribute to school absenteeism and SAPs amongst diverse student populations. A strength of the KiTeS Framework is that it demands the consideration of multiple levels of influence on school absenteeism and SAPs by placing the child within a nested framework of interacting systems. The Framework is relevant to many disciplines, including but not limited to education, psychology, psychiatry, pediatrics, disability, youth justice, social work, sociology, and criminal justice and is well placed to inform the development of a multi-disciplinary research agenda for absenteeism and SAPs which the field is currently lacking.

As noted earlier, several student populations experience elevated levels of, and vulnerability to, absenteeism and SAPs, including indigenous youth and those with disabilities. The KiTeS Framework is applicable to all student populations and fosters examination of the interacting factors that may underlie increased risk for different groups of students. The KiTeS Framework is equally applicable to research into protective factors that promote attendance, counteracting risk factors for the development of absenteeism and SAPs. To-date, the literature in the field has had a greater focus on understanding risk factors for absenteeism and non-attendance. However, the development of interventions to prevent and reduce SAPs will need to target both a reduction in risk factors and an increase in protective factors. The Framework offers a comprehensive context for
exploring risk and protective factors to help explain absenteeism and SAPs and develop appropriate interventions.

## IMPLICATIONS

It is envisaged that the knowledge gained through research guided by the KiTeS Framework will inform the development of interventions to prevent absenteeism and reduce SAPs. Lyon and Cotler (2009) have argued that traditional psychological interventions for SAPs, which largely focus on individual child factors, should be complemented by knowledge of the influence of factors at other levels, such as broader school, family, and policy levels. Research informed by the KiTeS framework might also influence policies and laws on school attendance and absenteeism by yielding policy-relevant research data. Although policies and laws around absenteeism evidently change over time, the empirical basis for these changes appears to be lacking (e.g., Brouwer-Borghuis et al., 2019).

There are scientific and practice advantages associated with the explicitly inclusive objective of the KiTeS Framework, whereby the needs and experiences of disadvantaged populations are acknowledged, including those with special education needs. The complexities of these youths' lives are challenging for researchers and practitioners who wish to understand school absenteeism and SAPs among these youth. An inclusive framework can help reduce inequalities in the longer term by ensuring that organizations and systems are enabled to develop

## REFERENCES

Allison, M. A., and Attisha, E. (2019). The link between school attendance and good health. Pediatrics 143:e20183648. doi: 10.1542/peds.2018-3648
Australian Curriculum Assessment and Reporting Authority, ACARA (2017). National Report on Schooling in Australia 2017. Retrieved May 2019, from: https://www.acara.edu.au/reporting/national-report-on-schooling-in-australia-2017
Australian Institute of Health and Welfare (2008). Data Visualizations of Chronic Absenteeism in Our Nation's Schools. Retrieved April 2018, from: https://www. aihw.gov.au/reports/disability/disability-in-australia-intellectual-disability/ formats
Bahali, K., Tahiroglu, A. Y., Avci, A., and Seydaoglu, G. (2011). Parental psychological symptoms and familial risk factors of children and adolescents who exhibit school refusal. East Asian Arch. Psychiatry 21, 164-169.
Balkis, M., Arslan, G., and Duru, E. (2016). The school absenteeism among high school students: contributing factors. Educ. Sci. Theory Pract. 16, 1819-1831. doi: 10.12738/estp.2016.6.0125
Barrington, B. L., and Hendricks, B. (1989). Differentiating characteristics of high school graduates, dropouts, and nongraduates. J. Educ. Res. 82, 309-319. doi: 10.1080/00220671.1989.10885913
Benner, A. D., Graham, S., and Mistry, R. S. (2008). Discerning direct and mediated effects of ecological structures and processes on adolescents' educational outcomes. Dev. Psychol. 44, 840-854. doi: 10.1037/0012-1649.44.3.840
Bernstein, G. A., and Borchardt, C. M. (1996). School refusal: Family constellation and family functioning. J. Anxiety Disord. 10, 1-19. doi: 10.1016/0887-6185(95)00031-3
Black, L. I., and Zablotsky, B. (2018). Chronic school absenteeism among children with selected developmental disabilities: National Health Interview Survey, 20142016. National Health Statistics Reports. Number 118. National Center for Health Statistics. Retrieved May 2019, from: https://files.eric.ed.gov/fulltext/ ED590450.pdf
and provide interventions and supports that consider the needs of all children-those with and without disadvantage.

## CONCLUSION

School attendance is important for youths' optimal development. A comprehensive understanding of the complex interplay of protective and risk factors for school attendance and absence is critical. The KiTeS Framework applies Bronfenbrenner's bioecological systems framework to guide research toward an inclusive and multifactorial examination of absenteeism and SAPs. It is hoped that research informed by the framework will yield data directly relevant for enhancing prevention programs, tailoring interventions to the needs of those displaying SAPs, and informing evidence-based policies and laws. In turn, these will help improve school attendance, educational outcomes, and the social and emotional well-being of all youth.

## AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

## FUNDING

Preparation of this manuscript was supported by an Australian Research Council Discovery Project Grant DP160101142.

Boulet, S. L., Boyle, C. A., and Schieve, L. A. (2009). Health care use and health and functional impact of developmental disabilities among US children, 1997-2005. Arch. Pediatr. Adolescent Med. 163, 19-26. doi: 10.1001/archpediatrics.2008.506
Bowers, J. M., and Moyer, A. (2017). Effects of school start time on students' sleep duration, daytime sleepiness, and attendance: a meta-analysis. Sleep Health 3, 423-431. doi: 10.1016/j.sleh.2017.08.004
Bronfenbrenner, U. (1977). Toward an experimental ecology of human development. Am. Psychol. 32, 513-531. doi: 10.1037/0003-066X. 32.7.513

Bronfenbrenner, U., and Morris, P. A. (2006). The bioecological model of human development," In Handbook of Child Psychology, Theoretical Models of Human Development, Vol. 1, eds W. Damon, and R. M. Lerner (Hoboken, NJ: John Wiley and Sons.), 793-828.
Brouwer-Borghuis, M., Heyne, D., Sauter, F., and Scholte, R. (2019). The link: an alternative educational program in the netherlands to re-engage school-refusing adolescents in mainstream schooling. Cogn. Behav. Pract. 26, 75-91. doi: 10.1016/j.cbpra.2018.08.001
Carless, B., Melvin, G. A., Tonge, B. J., and Newman, L. K. (2015). The role of parental self-efficacy in adolescent school-refusal. J. Family Psychol. 29, 162-170. doi: $10.1037 /$ fam 0000050
Cohen, J., McCabe, L., Michelli, N. M., and Pickeral, T. (2009). School climate: research, policy, practice, and teacher education. Teachers College Record 111, 180-213.
Corville-Smith, J., Ryan, B. A., Adams, G. R., and Dalicandro, T. (1998). Distinguishing absentee students from regular attenders: the combined influence of personal, family, and school factors. J. Youth Adolescence 27, 629-640. doi: 10.1023/A:1022887124634
Cotton, S. M., and Richdale, A. L. (2010). Sleep patterns and behaviour in typically developing children and children with autism, Down syndrome, Prader-Willi syndrome and intellectual disability. Res. Autism Spectrum Disord. 4, 490-500. doi: 10.1016/j.rasd.2009.11.006

Deck, S. M. (2017). School outcomes for homeless children: Differences among sheltered, doubled-up, and poor, housed children. J. Children Poverty 23, 57-77. doi: 10.1080/10796126.2016.1247347
Department for Education and Science (1978). Enquiry Into the Education of Handicapped Children and Young People (The Warnock Report). London: HMSO.
Doren, B., Gau, J. M., and Lindstrom, L. E. (2012). The relationship between parent expectations and postschool outcomes of adolescents with disabilities. Except. Children 79, 7-23. doi: 10.1177/001440291207900101
Doren, B., Murray, C., and Gau, J. M. (2014). Salient predictors of school dropout among secondary students with learning disabilities. Learn. Disabil. Res. Pract. 29, 150-159. doi: 10.1111/ldrp. 12044
Dura, J. R., and Beck, S. J. (1988). A comparison of family functioning when mothers have chronic pain. Pain 35, 79-89. doi: 10.1016/0304-3959(88)90279-5
Egger, H. L., Costello, E. J., and Angold, A. (2003). School refusal and psychiatric disorders: a community study. J. Am. Acad. Child Adolesc. Psychiatry 42, 797-807. doi: 10.1097/01.CHI.0000046865.56865.79
Einfeld, S. L., Piccinin, A. M., Mackinnon, A., Hofer, S. M., Taffe, J., Gray, K. M., et al. (2006). Psychopathology in young people with intellectual disability. JAMA 296, 1981-1989. doi: 10.1001/jama.296.16.1981
Emerson, E., Einfeld, S., and Stancliffe, R. J. (2010a). The mental health of young children with intellectual disabilities or borderline intellectual functioning. Soc. Psychiatry Psychiatr. Epidemiol. 45, 579-587. doi: 10.1007/s00127-009-0100-y
Emerson, E., and Hatton, C. (2007). Poverty, socio-economic position, social capital and the health of children and adolescents with intellectual disabilities in Britain: a replication. J. Intellect. Disabil. Res. 51, 866-874. doi: 10.1111/j.1365-2788.2007.00951.x
Emerson, E., Hatton, C., Llewellyn, G., Blacker, J., and Graham, H. (2006). Socio-economic position, household composition, health status and indicators of the well-being of mothers of children with and without intellectual disabilities. J. Intellect. Disabil. Res. 50, 862-873. doi: 10.1111/j.1365-2788.2006. 00900.x

Emerson, E., Shahtahmasebi, S., Lancaster, G., and Berridge, D. (2010b). Poverty transitions among families supporting a child with intellectual disability. J. Intellect. Dev. Disabil. 35, 224-234. doi: 10.3109/13668250.2010. 518562
Faircloth, B. S., and Hamm, J. V. (2005). Sense of belonging among high school students representing 4 ethnic groups. J. Youth Adolesc. 34, 293-309. doi: 10.1007/s10964-005-5752-7
Fantuzzo, J., Leboeuf, W., Brumley, B., and Perlman, S. (2013). A populationbased inquiry of homeless episode characteristics and early educational wellbeing. Child. Youth Serv. Rev. 35, 966-972. doi: 10.1016/j.childyouth. 2013. 02.016

Freeman, J., Simonsen, B., McCoach, D. B., Sugai, G., Lombardi, A., and Horner, R. (2015). An analysis of the relationship between implementation of school-wide positive behavior interventions and supports and high school dropout rates. High School J. 98, 290-315. doi: 10.1353/hsj.2015.0009
Gee, K. A. (2018). Minding the gaps in absenteeism: Disparities in absenteeism by race/ethnicity, poverty and disability. J. Educ. Students Placed Risk 23, 204-208. doi: 10.1080/10824669.2018.1428610
Gottfried, M., Stiefel, L., Schwartz, A. E., and Hopkins, B. (2017). Showing Up: Disparities in Chronic Absenteeism Between Students With and Without Disabilities. IESP Working Paper. Retrieved February 2018, from: https:// steinhardt.nyu.edu/scmsAdmin/media/users/lwb232/IESP__WP03-17__ Chronic_1.pdf, 3-17.
Gottfried, M. A. (2009). Excused versus unexcused: how student absences in elementary school affect academic achievement. Educ. Eval. Pol. Anal. 31, 392-415. doi: 10.3102/0162373709342467
Gottfried, M. A. (2014). Can neighbor attributes predict school absences? Urban Educ. 49, 216-250. doi: 10.1177/0042085913475634
Gottfried, M. A. (2017). Linking getting to school with going to school. Educ. Eval. Pol. Anal. 39, 571-592. doi: 10.3102/0162373717699472
Gottfried, M. A., and Gee, K. A. (2017). Identifying the determinants of chronic absenteeism: a bioecological systems approach. Teachers College Rec. 119, 1-34.
Green, J., Liem, G. A., Martin, A. J., Colmar, S., Marsh, H. W., and McInerney, D. (2012). Academic motivation, self-concept, engagement, and performance in high school: Key processes from a longitudinal perspective. J. Adolescence 35, 1111-1122. doi: 10.1016/j.adolescence.2012.02.016

Green, S. A., Berkovits, L. D., and Baker, B. L. (2015). Symptoms and development of anxiety in children with or without intellectual disability. J. Clin. Child Adolescent Psychol. 44, 137-144. doi: 10.1080/15374416.2013.873979
Guralnick, M. J. (2015). Merging policy initiatives and developmental perspectives in early intervention. Escritos Psicol. 8, 6-13. doi: 10.5231/psy.writ.2015.1004
Guralnick, M. J. (2017). Early intervention for children with intellectual disabilities: an update. J. Appl. Res. Intellect. Disabil. 30, 211-229. doi: 10.1111/jar. 12233
Hancock, K. J., Gottfried, M. A., and Zubrick, S. R. (2018a). Does the reason matter? How student-reported reasons for school absence contribute to differences in achievement outcomes among 14-15 year olds. Br. Educ. Res. J. 44, 141-174. doi: 10.1002/berj. 3322
Hancock, K. J., Mitrou, F., Taylor, C. L., and Zubrick, S. R. (2018b). The diverse risk profiles of persistently absent primary students: implications for attendance policies in Australia. J. Educ. Students Placed Risk 23, 53-69. doi: $10.1080 / 10824669.2018 .1433536$
Hancock, K. J., Shepherd, C. C., Lawrence, D., and Zubrick, S. R. (2013). Student Attendance and Educational Outcomes: Every Day Counts. Report for the Department of Education, Employment and Workplace Relations, Canberra.
Hastings, R. P. (2002). Parental stress and behaviour problems of children with developmental disability. J. Intellect. Dev. Disabil. 27, 149-160. doi: 10.1080/1366825021000008657
Havik, T., Bru, E., and Ertesvåg, S. K. (2015). Assessing reasons for school non-attendance. Scand. J. Educ. Res. 59, 316-336. doi: 10.1080/00313831.2014.904424
Hendron, M., and Kearney, C. A. (2016). School climate and student absenteeism and internalizing and externalizing behavioral problems. Children Schools 38, 109-116. doi: $10.1093 / \mathrm{cs} / \mathrm{cdw} 009$
Herring, S., Gray, K., Taffe, J., Tonge, B., Sweeney, D., and Einfeld, S. (2006). Behaviour and emotional problems in toddlers with pervasive developmental disorders and developmental delay: associations with parental mental health and family functioning. J. Intellect. Disabil. Res. 50, 874-882. doi: 10.1111/j.1365-2788.2006.00904.x
Heyne, D., Gren Landell, M., Melvin, G., and Gentle-Genitty, C. (2019). Differentiation between school attendance problems: why and how? Cogn. Behav. Pract. 26, 8-34. doi: 10.1016/j.cbpra.2018.03.006
Houtrow, A., Jones, J., Ghandour, R., Strickland, B., and Newacheck, P. (2012). Participation of children with special health care needs in school and the community. Acad. Pediatr. 12, 326-334. doi: 10.1016/j.acap.2012.03.004
Hysing, M., Haugland, S., Stormark, K. M., Bøe, T., and Sivertsen, B. (2015). Sleep and school attendance in adolescence: results from a large population-based study. Scand. J. Public Health 43, 2-9. doi: 10.1177/1403494814556647
Ingul, J. M., Klöckner, C. A., Silverman, W. K., and Nordahl, H. M. (2012). Adolescent school absenteeism: modelling social and individual risk factors. Child Adolescent Mental Health 17, 93-100. doi: 10.1111/j.1475-3588.2011.00615.x
Jeynes, W. H. (2007). The relationship between parental involvement and urban secondary school student academic achievement: a meta-analysis. Urban Educ. 42, 82-110. doi: 10.1177/0042085906293818
Kearney, C. A. (2008). School absenteeism and school refusal behavior in youth: A contemporary review. Clin. Psychol. Rev. 28, 451-471. doi: 10.1016/j.cpr.2007.07.012
Kearney, C. A. (2016). Managing School Absenteeism at Multiple Tiers: An EvidenceBased and Practical Guide for Professionals. New York, NY: Oxford University Press. doi: 10.1093/med:psych/9780199985296.001.0001
Kearney, C. A., and Silverman, W. K. (1995). Family environment of youngsters with school refusal behavior: a synopsis with implications for assessment and treatment. Am. J. Family Ther. 23, 59-72. doi: 10.1080/01926189508 251336
Last, C. G., and Strauss, C. C. (1990). School refusal in anxiety-disordered children and adolescents. J. Am. Acad. Child Adolescent Psychiatry 29, 31-35. doi: 10.1097/00004583-199001000-00006
Lenhoff, S. W., and Pogodzinski, B. (2018). School organizational effectiveness and chronic absenteeism: implications for accountability. J. Educ. Students Placed Risk 23, 153-169. doi: 10.1080/10824669.2018.1434656
Lewin, K. (2011). Making Rights Realities: Researching Educational Access, Transitions and Equity. Falmer: University of Sussex, Consortium for Research on Educational Access, Transitions and Equity (CREATE).

Retrieved May 2019, from: https://assets.publishing.service.gov.uk/ media/57a08aede5274a31e0000866/Making-Rights-Realities-Keith-Lewin-September-2011.pdf
Lipstein, E. A., Perrin, J. M., and Kuhlthau, K. A. (2009). School absenteeism, health status, and health care utilization among children with asthma: associations with parental chronic disease. Pediatrics 123, e60-e66. doi: 10.1542/peds.2008-1890
Lyon, A. R., and Cotler, S. (2007). Toward reduced bias and increased utility in the assessment of school refusal behavior: the case for diverse samples and evaluations of context. Psychol. Schools 44, 551-565. doi: 10.1002/pits. 20247
Lyon, A. R., and Cotler, S. (2009). Multi-systemic intervention for school refusal behavior: integrating approaches across disciplines. Adv. School Mental Health Promot. 2, 20-34. doi: 10.1080/1754730X.2009.9715695
Martin, C., Cabrol, S., Bouvard, M. P., Lepine, J. P., and Mouren-Siméoni, M. C. (1999). Anxiety and depressive disorders in fathers and mothers of anxious school-refusing children. J. Am. Acad. Child Adolescent Psychiatry 38, 916-922. doi: 10.1097/00004583-199907000-00023
Maynard, B. R., Vaughn, M. G., Nelson, E. J., Salas-Wright, C. P., Heyne, D. A., and Kremer, K. P. (2017). Truancy in the United States: examining temporal trends and correlates by race, age, and gender. Child. Youth Serv. Rev. 81, 188-196. doi: 10.1016/j.childyouth.2017.08.008
McKeever, P. M., and Clark, L. (2017). Delayed high school start times later than 8: 30 AM and impact on graduation rates and attendance rates. Sleep Health 3, 119-125. doi: 10.1016/j.sleh.2017.01.002
McShane, G., Walter, G., and Rey, J. M. (2001). Characteristics of adolescents with school refusal. Austr. N. Zeal. J. Psychiatry 35, 822-826. doi: 10.1046/j.1440-1614.2001.00955.x
Mittler, P. (2015). The UN convention on the rights of persons with disabilities: implementing a paradigm shift. J. Pol. Pract. Intellect. Disabil. 12, 79-89. doi: 10.1111/jppi. 12118
Newman, L. (2005). Family Involvement in the Educational Development of Youth with Disabilities: A Special Topic Report of Findings from the National Longitudinal Transition Study-2 (NLTS2). Menlo Park, CA: Office of Special Education Programs U.S. Department of Education by SRI International.
Oeseburg, B., Dijkstra, G. J., Groothoff, J. W., Reijneveld, S. A., and Jansen, D. E. (2011). Prevalence of chronic health conditions in children with intellectual disability: A systematic literature review. Intellect. Dev. Disabil. 49, 59-85. doi: 10.1352/1934-9556-49.2.59
Prakash, R., Beattie, T., Javalkar, P., Bhattacharjee, P., Ramanaik, S., Thalinja, R., et al. (2017). Correlates of school dropout and absenteeism among adolescent girls from marginalized community in North Karnataka, South India. J. Adolesc. 61, 64-76. doi: 10.1016/j.adolescence.2017.09.007
Redmond, S. M., and Hosp, J. L. (2008). Absenteeism rates in students receiving services for CDs, LDs, and EDs: a macroscopic view of the consequences of disability. Language Speech Hear. Serv. Schools 39, 97-103. doi: 10.1044/0161-1461(2008/010)
Roorda, D. L., Jak, S., Zee, M., Oort, F. J., and Koomen, H. M. (2017). Affective teacher-student relationships and students' engagement and achievement: a meta-analytic update and test of the mediating role of engagement. School Psychol. Rev. 46, 239-261. doi: 10.17105/SPR-2017-003 5.V46-3

Rumberger, R. W. (2011). Dropping Out: Why Students Drop Out of High School and What Can be Done About It. Cambridge, MA; Harvard University Press. doi: 10.4159/harvard. 9780674063167
Schieve, L. A., Gonzalez, V., Boulet, S. L., Visser, S. N., Rice, C. E., Van Naarden Braun, K., et al. (2012). Concurrent medical conditions and health care use and needs among children with learning and behavioral developmental disabilities, National Health Interview Survey, 2006-2010. Res. Dev. Disabil. 33, 467-476. doi: 10.1016/j.ridd.2011.10.008

Schoeneberger, J. A. (2012). Longitudinal attendance patterns: developing high school dropouts. Clear. House J. Educ. Strategies Issues Ideas 85, 7-14. doi: 10.1080/00098655.2011.603766
Seidu, A. (2019). Prevalence and correlates of truancy among school-going adolescents in Mozambique: evidence from the 2015 Global School-Based Health Survey. Sci. World J. 2019:9863890. doi: 10.1155/2019/9863890
Skedgell, K., and Kearney, C. A. (2018). Predictors of school absenteeism severity at multiple levels: a classification and regression tree analysis. Child. Youth Serv. Rev. 86, 236-245. doi: 10.1016/j.childyouth.2018.01.043
Stevenson, H. W., Lee, S. Y. (1990). Contexts of achievement: a study of American, Chinese, and Japanese children. Monogr. Soc. Res. Child Dev. 55, 1-119. doi: 10.2307/ 1166090
Taylor, L. C., Clayton, J. D., and Rowley, S. J. (2004). Academic socialization: Understanding parental influences on children's schoolrelated development in the early years. Rev. General Psychol. 8, 163-178. doi: 10.1037/1089-2680.8.3.163
U.S Department of Education (2016). Chronic Absenteeism in the Nation's Schools. Available online at: https://www2.ed.gov/datastory/chronicabsenteeism.html
United Kingdom Department of Education (2018). Pupil Absence in Schools in England: Autumn 2017 and Spring 2018. Retrieved February 2019, from: https://www.gov.uk/government/statistics/pupil-absence-in-schools-in-england-autumn-term-2017-and-spring-term-2018
Van Eck, K., Johnson, S. R., Bettencourt, A., and Johnson, S. L. (2017). How school climate relates to chronic absence: a multi-level latent profile analysis. J. School Psychol. 61, 89-102. doi: 10.1016/j.jsp.2016.10.001
Victorian Equal Opportunity and Human Rights Commission (2012). Held Back: The Experiences of Students With Disabilities in Victorian Schools. Melbourne, VIC: State Government of Victoria.
Westbrook, M. T., Legge, V., and Pennay, M. (1993). Attitudes towards disabilities in a multicultural society. Soc. Sci. Med. 36, 615-623. doi: 10.1016/0277-9536(93)90058-C
Western Australia Auditor General's Report 16 (2015). Follow-on: Managing Student Attendance in Western Australian Public Schools. Retrieved February 2019, from: https://audit.wa.gov.au/reports-and-publications/reports/follow-managing-student-attendance-western-australian-public-schools/auditor-generals-overview/
Woodman, A. C., Mawdsley, H. P., and Hauser-Cram, P. (2015). Parenting stress and child behavior problems within families of children with developmental disabilities: transactional relations across 15 years. Res. Dev. Disabil. 36, 264-276. doi: 10.1016/j.ridd.2014.10.011
Zhang, M. (2003). Links between school absenteeism and child poverty. Pastoral Care Educ. 21, 10-17. doi: 10.1111/1468-0122.00249
Zubrick, S. R., Silburn, S. R., De Maio, J. A., Shepherd, C., Griffin, J. A., Dalby, R. B., et al. (2006). The Western Australian Aboriginal Child Health Survey: Improving the Educational Experiences of Aboriginal Children and Young People. Perth, WA: Curtin University of Technology and Telethon Institute for Child Health Research.

Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Copyright © 2019 Melvin, Heyne, Gray, Hastings, Totsika, Tonge and Freeman. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

