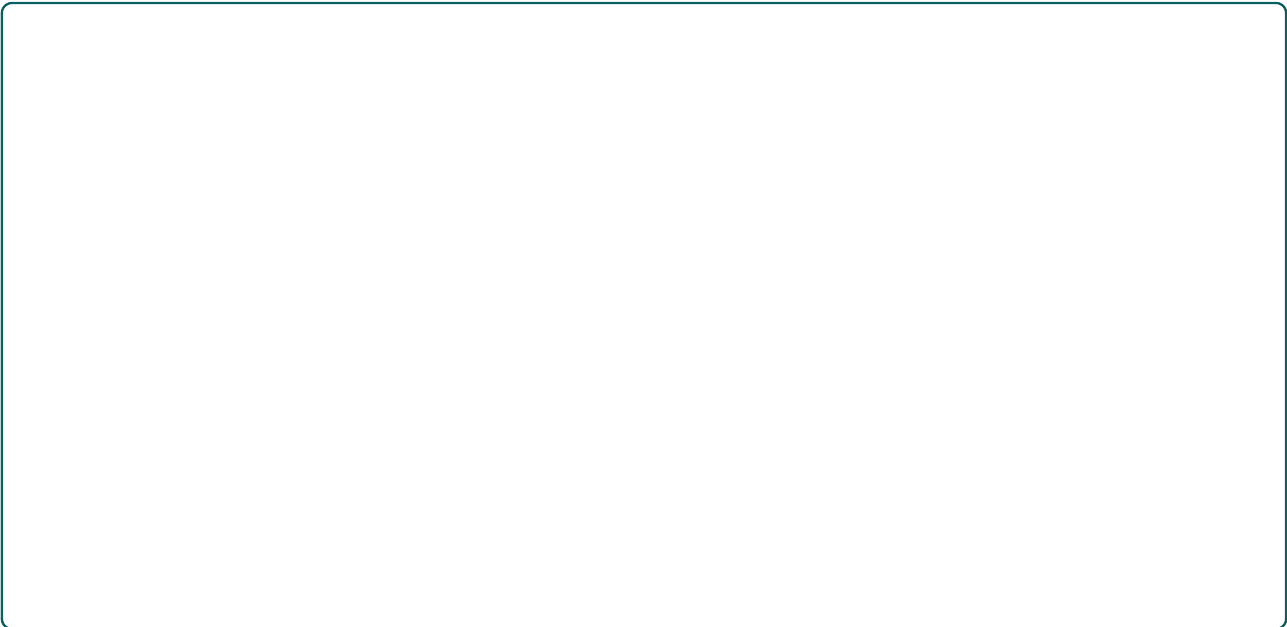


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and older) at 65%, and at 77% for women between 45-54 years of age [7]. These high levels of female overweight and obesity have serious implications for the intergenerational transfer of metabolic disease risk, particularly with regard to altered maternal glucose metabolism during pregnancy and the related consequences for the infant [6,8]. High maternal body mass index (BMI) and gestational diabetes mellitus (GDM) are independent risk factors for perinatal complications, and GDM has been

future. The project started in 2007 with collaborating institutions that included the University of the Witwatersrand (Wits, SA; leading institution), University of Cambridge (UK), University of North Carolina at Chapel Hill (USA), University of Oxford (UK), Umea University (Sweden), University of Southampton (UK), and the University of Cape Town (SA).

The primary hypothesis is that maternal pre-pregnancy body composition, pregnancy weight gain, and altered maternal glucose metabolism, can significantly impact maternal postnatal risk of T2D, pregnancy complications (such as obstructive labour), and offspring growth, body composition and later risk for T2D and metabolic disease.

iterative manner [27,28], and the need for flexibility in the approach is acknowledged by its authors [24].

1.0 1.0 1.0 1.0 1.0 1.0

eating behaviours [27,54-56] (with a stronger association

**Table 1 Behavioural objective – Improve reproductive health**

**PERSONAL DETERMINANTS**

Knowledge	Attitudes	Beliefs	Skills	Resources
<p><b>K</b> <b>a</b></p> <p><b>HIV</b></p>	<p>Understand the importance of knowing your HIV status Understanding of HIV treatment options</p>	<p>Awareness of HIV status</p>	<p>Confidence to take HIV test Confidence to seek appropriate treatment if test is positive</p>	<p>Choice to take HIV test</p>
<p><b>A</b> <b>a</b> <b>a</b> <b>r</b></p>	<p>Understanding of the conditions for which health services should be consulted Understanding of the services (including</p>			

**Table 4 Behavioural objective – Eat a healthy, balanced diet**

EXTERNAL DETERMINANTS			
Behavioural Objective	Barrier	Enabler	Intervention
R a - b a , , )	Peers and family are perceived to be consuming less sugar Association between sugar and positive experiences is not reinforced	Peers and family support reduction in consumption of sugar	Accessibility of healthy alternatives to high sugar foods and beverages Availability of adolescent-friendly health education material, delivered by an appropriate health care worker
R ( . . a1 a , a , L I b a , 15 , a a)	Peers and family are perceived to be reducing portion sizes Association between large portion sizes and positive experiences is not reinforced	Peers and family support reduction in portion sizes	Availability of adolescent-friendly health education material, delivered by an appropriate health care worker
R 1 1 1 1	Peers and family are perceived to be consuming less convenience foods Association between convenience foods and positive experiences is not reinforced	Peers and family support reduction in consumption of convenience foods	Accessibility of healthy alternatives to convenient foods Availability of adolescent-friendly health education material, delivered by an appropriate health care worker
L a 1 ab	Peers and family are perceived to be consuming more fruits and vegetables	Peers and family support an increase in consumption of fruits and vegetables	Accessibility of affordable fruit and vegetables Availability of adolescent-friendly health education material, delivered by an appropriate health care worker

**Table 5 Behavioural objective – Increase physical activity**

PERSONAL DETERMINANTS				
Behavioural Objective	Barrier	Enabler	Enabler	Intervention
L a 1 a	Understanding of the importance of exercise intensity in order to achieve health benefits	Awareness of walking intensity	Confidence to increase walking intensity	Choice to increase walking intensity
L a a 1 a 1 1 -ba a 1 1 1 a , . . a 1 ,	Understanding of the benefits of physical activity	Awareness of available community-based activities that promote movement	Confidence to participate in community-based activities	Choice to participate in community-based activities that promote movement

**Table 6 Behavioural objective – Increase physical activity**

EXTERNAL DETERMINANTS			
Behavioural Objective	Barrier	Enabler	Intervention
L a 1 a	Walking for transport is not stigmatised Peers and family are perceived to be increasing their walking intensity	Peers and family are perceived to have a positive perception of walking Peers and family support increased walking intensity	Availability of adolescent-friendly health education material, delivered by an appropriate health care worker
L a a 1 a 1 1 -ba a 1 1 1 a , . . a 1 ,	Peers are perceived to be participating in community-based activities that promote movement	Peers and family support increased participation in community-based activities that promote movement	Accessibility of appropriate activities that promote movement for adolescent girls Availability of adolescent-friendly health education material, delivered by an appropriate health care worker

nor are they intended to provide details of the interventions. These matrices of change help to provide a 'map' for the development of specific intervention components.

In step 3, theory-based methods and practical strategies are identified that will be appropriate for bringing about behaviour change in an intervention target group, which in this case is adolescent girls. Appropri-



antenatal care has been identified as a barrier to early initiation of antenatal care [83,85].

In terms of interventions that address behaviours associated with over- and under-nutrition, school-based, multi-component interventions with adolescent girls, targeting lifestyle behaviours associated with obesity, have been shown to increase PA [86] and decrease sedentary behaviour [87], as well as improve selected body composition measures and some dietary behaviours [88]. However, systematic reviews on obesity interventions in adolescents have shown that the effectiveness of school-based interventions can be limited (only 41% of studies reviewed showed a positive effect) [89], and that there is a need for more quality trials

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intervention [104,105]. The HCS approach will be used by adolescent CHWs in their interactions with individual adolescents, adolescents' family members and peer groups. It aligns well with the theoretical framework and behaviour change techniques listed earlier and presented in Figure 1.

Based on the evidence presented, as well as the IM process, an intervention plan was developed by a small working group (CD, LM and SN), and presented to the co-authors, along with the results of the IM process and a rationale for a rural adolescent health promotion intervention in May 2013. These presentations were then refined and presented to a stakeholder group in Agincourt for their comment and input in July 2013. The stakeholder group included the University of the Witwatersrand staff involved in research and community engagement in Agincourt, a local religious leader, as well as representatives of the local educational services, health services and youth organisations. Feedback from stakeholders was positive, particularly around the inclusion of adolescent CHWs. Stakeholders perceived adolescents to be reluctant

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